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"A STUDY ON SATISFACTION OF THE EMPLOYEES TOWARDS THE TRAINING AND DEVELOPMENT PROGRAM CONDUCTED AT MUBEA AUTOMOTIVE PVT LTD."

Abstract

Training improves changes and molds the employee's knowledge, skill behavior and aptitude and attitude towards the requirements of the job and the organization. Training refers to the teaching and learning activities carried on for the primary purpose of helping members of an organization to acquire and apply the knowledge, skills, abilities, and attitudes needed by a particular job and organization.

This research paper explores the satisfaction of the employees towards the training program conducted at Mubea automotive Pvt.Ltd. Training work toward value addition to the company through HRD.

Key Words- Training Aptitude, Satisfaction

INTRODUCTION:-

Corporate success depends upon having and retaining talented people. This is true today as it has always been. The shortage of such people is widely accepted and training, at long last, is beginning to be recognized as part of the solution and hence the total investment in training is on the rise. This is true for all organizations. There really is no alternative than to make sure that human skill so vital to corporate success are recognized, harnessed, developed and suitably maintained.

Training is not, however, one 'one-off' investment. It is a continuing investment. Not only is it needed to create the skilled workforce, but also maintain the high levels of skills demanded by the ever-changing, highly dynamic workplace.

Training is the most important function that contributes directly to the development of human resources. If human resources have to be developed, the organization should create conditions in which people acquire new knowledge and skills and develop healthy patterns of behavior and styles. One of the main mechanisms of achieving this environment is training.

Training is essential because technology is developing continuously and at a fast rate. Systems and practices get outdated soon due to new discoveries in technology, including technical, managerial and behavioral aspects. Organizations, which do not develop mechanisms to catch up with and use the growing technology, soon become outdated.

LITERATURE REVIEW:-

Gordon (1992); has defined training as the planned and systematic modification of behavior through learning events, activities, and programs which results in the participants achieving the levels of knowledge, skills, competencies and abilities to carry out their work effectively.

Krietner (1995); in his book, The Good Manager's Guide stated "no matter how carefully job applicants are screened, typically a gap remains between what the employee does know and what they should know. An organization which desires to gain the competitive edge in its respective industry, needs among other things, extensive and effective training of its human resources."

Baldwin and Johnson (1995); through his study mentioned that, training refers to an activity which deliberately attempts to improve a person's skill at a task. He commented that companies conduct training for three purposes which are to carry the company strategy, bringing innovation and advancement in technology. That is done to improve the quality of the product and for the provision of quality services.

Obisi (1996); stated that the concepts, of training and development, are used interchangeably. Moreover, it can be differentiated from the other. Training is for specific job purpose while development covers not only those activities which improve job performance but also those which bring about the growth of personality.

Steinmetz, Lawrence (1996); in their study that training is a short-term process, utilizing a systematic and organized procedure by which non-managerial personnel learns technical knowledge and skill for a definite purpose. Development, on the other hand, is a long-term educational process utilizing a systematic and organized procedure by which managerial personnel learns conceptual and theoretical knowledge for general purpose.

Aswathappa K. (2000); noted in his study "the term 'training' indicates the process involved in improving the aptitudes, skills, and abilities of the employees to perform specific jobs. Training helps in updating old talents and developing new ones. Successful candidates placed on the jobs need the training to perform their duties effectively.

OBJECTIVES OF THE STUDY:-

- To study the Training and development at Mubea Automotive India Pvt Ltd.
- To study the benefits to the employees from the training and development program conducted at Mubea Automotive Pvt Ltd.
- To study the satisfaction of the employees towards the training and development program conducted at Mubea Automotive Pvt Ltd.

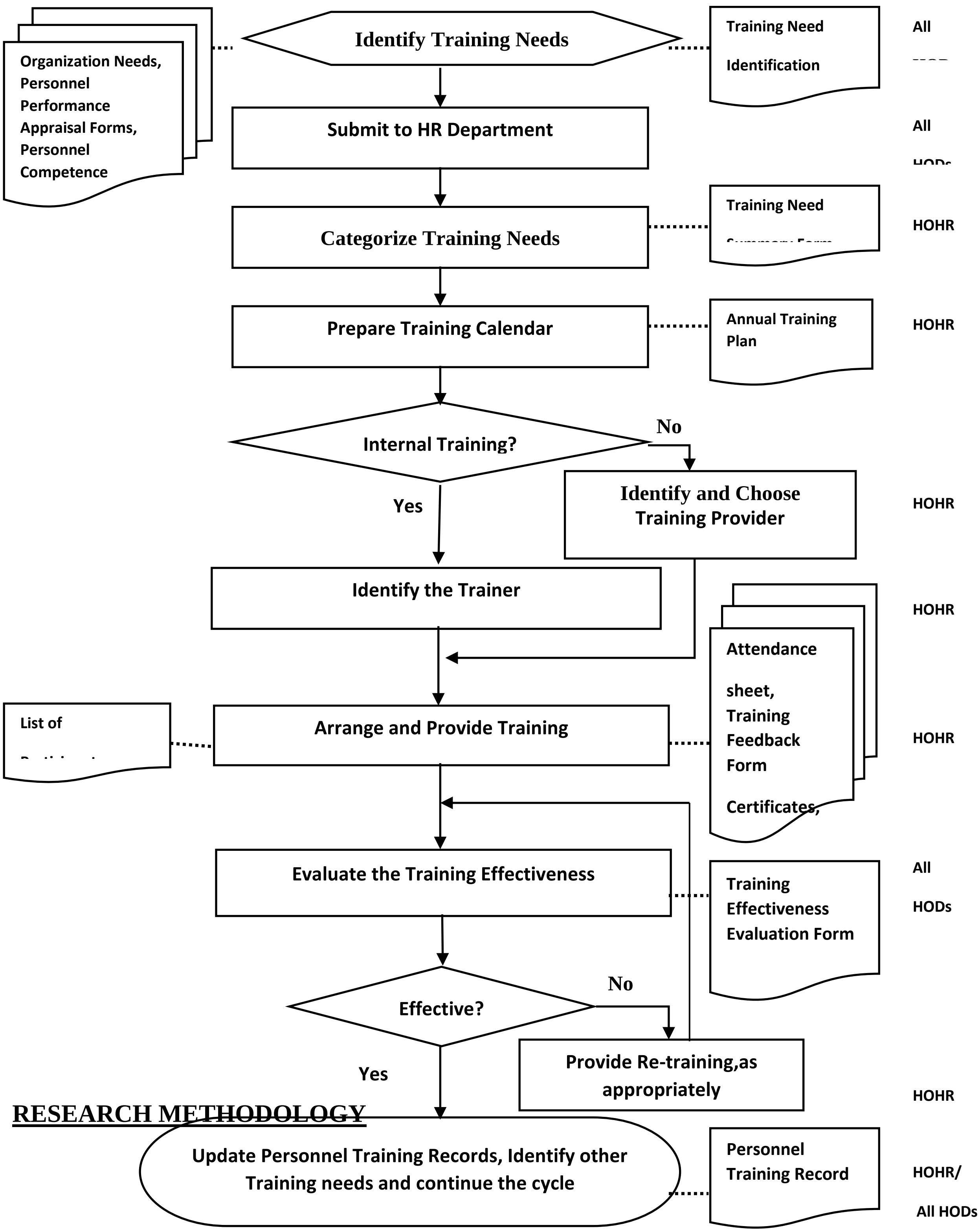
SCOPE OF THE STUDY

- The scope of the study is restricted to the employees who attended the training session in the organization.

LEARNING DIMENSION	TRAINING	DEVELOPMENT
Who	Non-managers	Managers
What	Technical-mechanical operations	Theoretical conceptual ideas

Why	Specific job-related information	General knowledge

TRAINING AND DEVELOPMENT PROCESS IN MUBEA:-



RESEARCH METHODOLOGY

Research in common parlance refers to the search for knowledge. It can be also defined as a scientific and systematic search for pertinent information on a specific topic. In fact, the search is an art of scientific investigation. In simple terms, research means, 'A careful investigation or inquiry especially through search for new facts in any branch of knowledge.'

Sampling methods: Convenience sampling

Sample size: Total 50

Sources of data :-

- Primary data:-
  - Internal data about the working of HR department gathered from the organization.
  - Interview.
  - Observation.
  - Sufficient data collected through feedback forms by the employees.
- Secondary data:-
  - Magazines, journals, brochures , etc.
  - Website of the company. [www.mubea.com].
  - Books.
  - Earlier researches on the similar topic

Tools of data collection :

To collect the primary data a questionnaire was prepared which may fulfill the objectives of the study.

Data analysis :

The primary data was analyzed through tabulation and Graphical Presentation. 'Before and after Method' was followed in analyzing employees views on training and development system in Mubea.

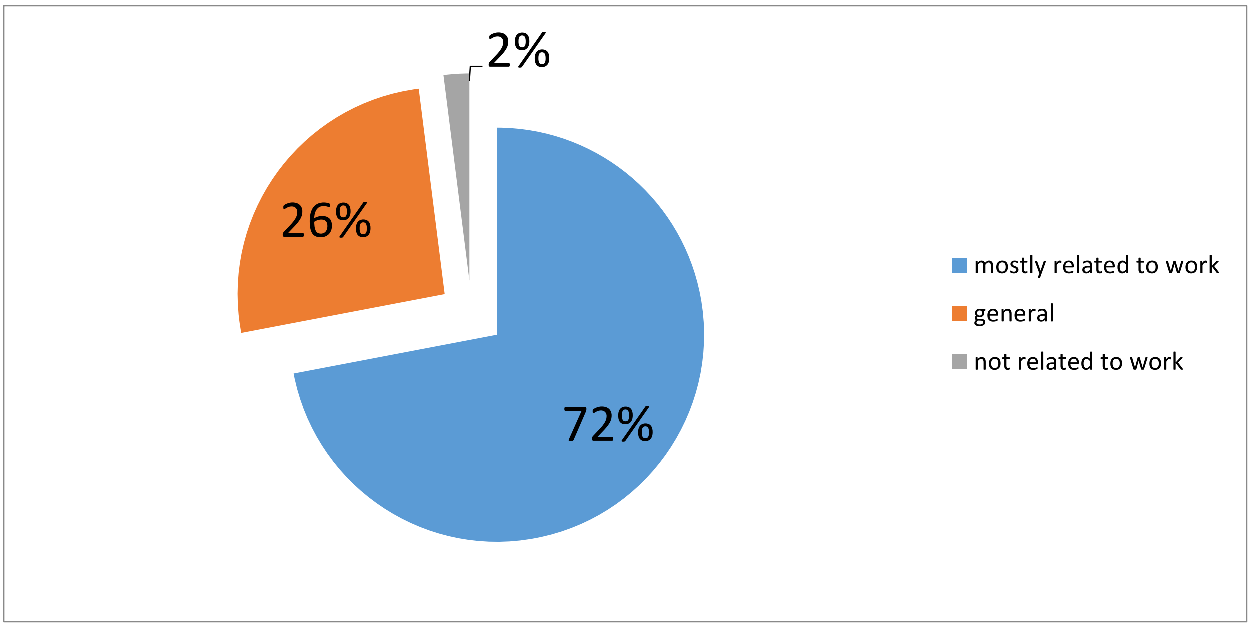
1. **NATURE OF TRAINING PROGRAMME**

OPINION	**NO.OF RESPONDENTS**	**PERCENTAGE (%)**
Strongly agree	36	72.0
Agree	13	26.0
Disagree	1	2.0

Total	**50**	**100.0**

INFERENCE

- 72% of the employees find the training program mostly related to their work.
- 26% of employees find it in general
- 2% find it not related to work.

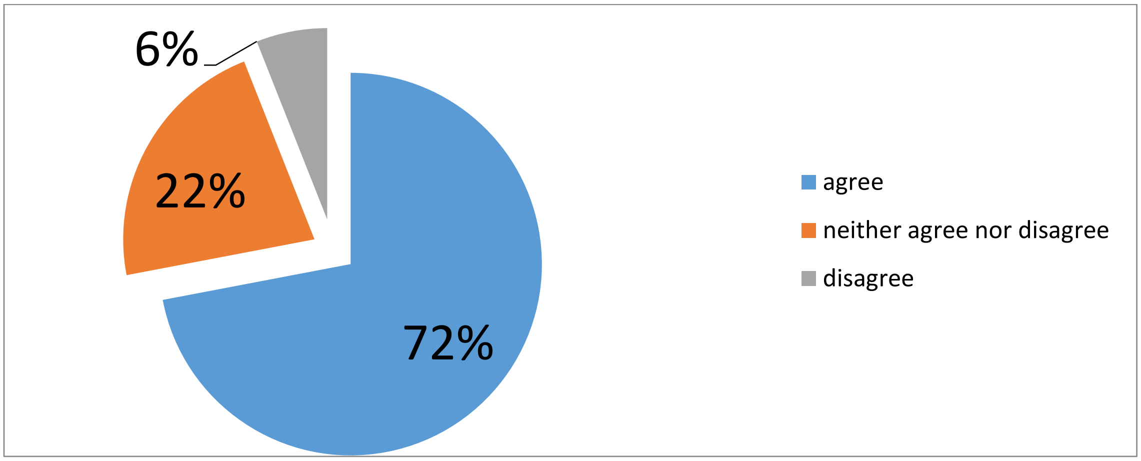


2. BETTER PERFORMANCE

OPINION	NO.OF RESPONDENTS	PERCENTAGE (%)
Agree	36	72.0
neither agree nor disagree	11	22.0
Disagree	3	6.0
Total	**50**	**100.0**

INFERENCE

- 72% of the employees feel that attending training programme leads them to perform better at work.
- 22% of the employees neither agree nor disagree and
- 6% of the employees disagree.

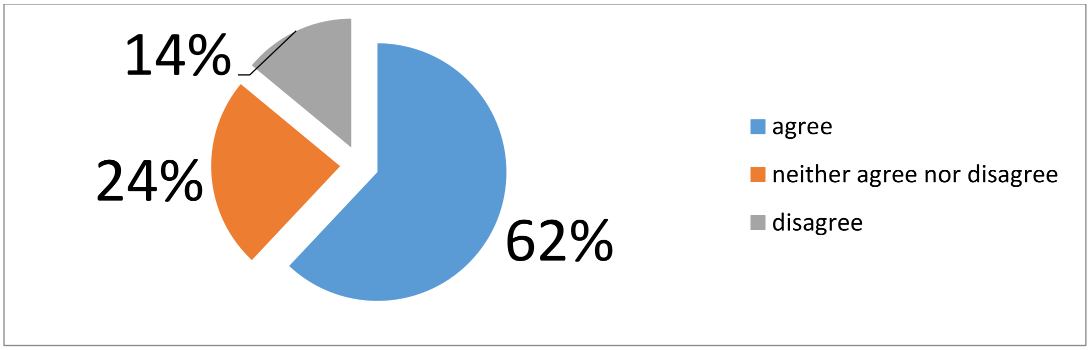


3. CHANCES OF PROMOTION

OPINION	NO.OF RESPONDENTS	PERCENTAGE (%)
Agree	31	62.0
neither agree nor disagree	12	24.0
Disagree	7	14.0
Total	**50**	**100.0**

INFERENCE

- 62% of employees agree that attending training programme leads them to the chances of promotion.
- 24% of the employees neither agree nor disagree and
- 14% of the employees disagree with it.

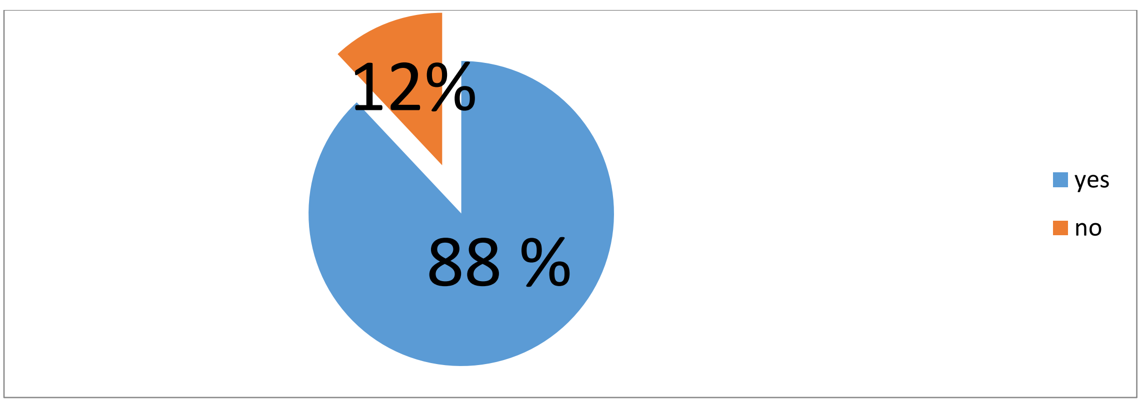


4.RELEVANCE OF TOPICS IN TRAINING PROGRAMME

OPINION	NO.OF RESPONDENTS	PERCENTAGE (%)
Yes	44	88.0
No	6	12.0
Total	**50**	**100.0**

INFERENCE

- 88% of the employees find the topics relevant to the training programme and
- 12% of the employees don't find it relevant.



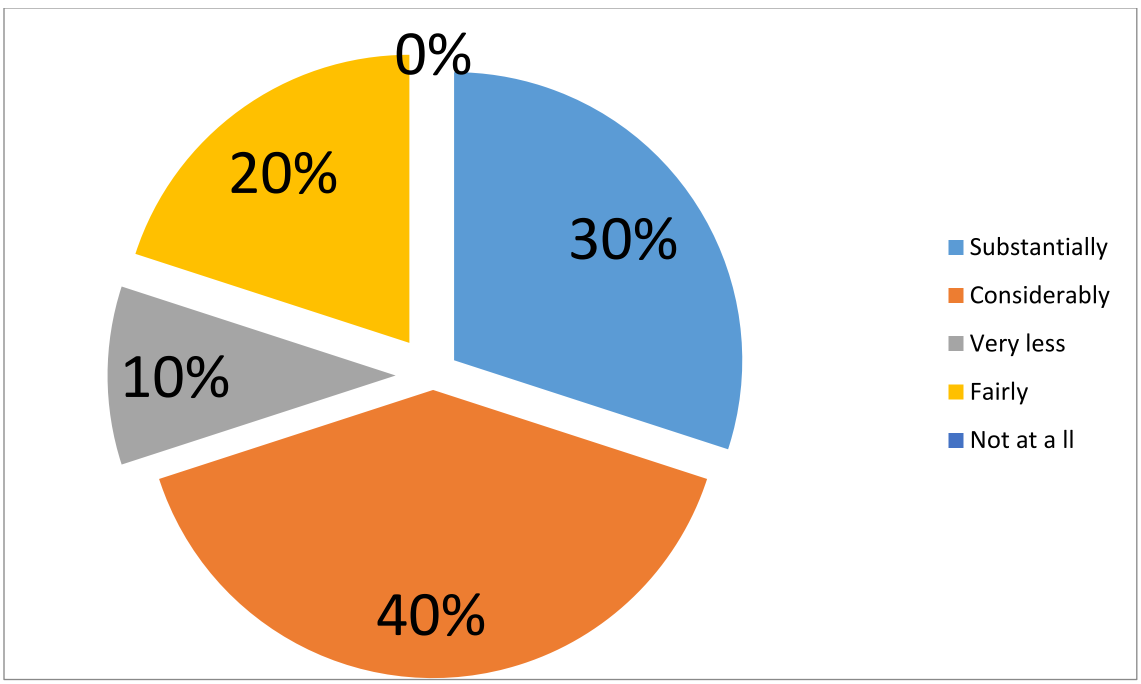
5. THE TRAINING INTERESTING & INFORMATIVE

OPINION	NO. OF RESPONDENTS	PERCENTAGE
Substantially	**15**	**30**
Considerably	**20**	**40**

Very less	**5**	**10**
Fairly	**10**	**20**
Not at all	**0**	**0**
Total	**50**	**100**

INFERENCE

- 30% believes that the training interesting & informative.
- 40% believes considerably.
- 10% believes very less.
- 20 % believes it fairly good.

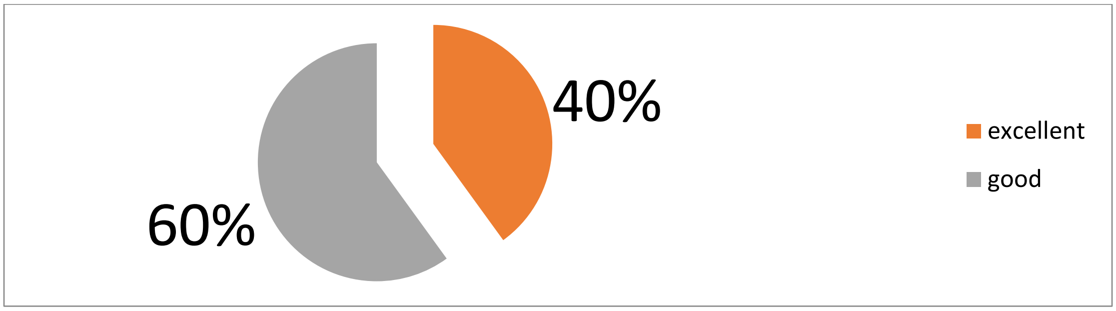


6. STRUCTURE OF TRAINING PROGRAMME

OPINION	NO.OF RESPONDENTS	PERCENTAGE (%)
Excellent	20	40.0
Good	30	60.0
Total	**50**	**100.0**

INFERENCE

- 40% of the respondents find the quality of the training programme to be excellent.
- 60% of the respondents find it good.

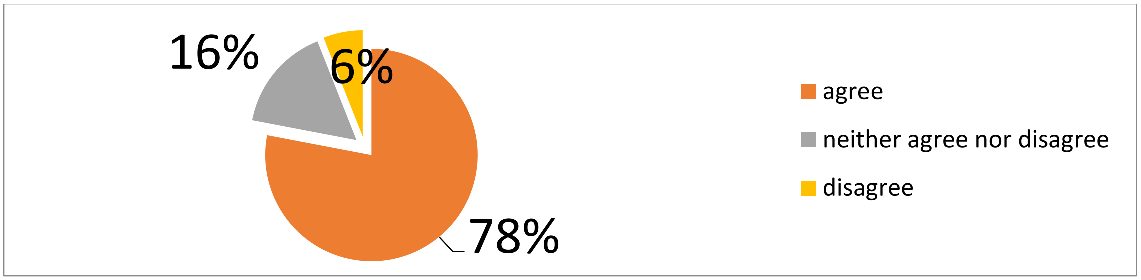


7. TECHNICAL SKILLS

OPINION	NO.OF RESPONDENTS	PERCENTAGE (%)
Agree	39	78.0
neither agree nor disagree	8	16.0
Disagree	3	6.0
Total	**50**	**100.0**

INFERENCE

- 78% of the employees agree that training programme helps them to pick up new technical skills.
- 16% of the employees neither agree nor disagree
- 6% of the employees disagree.

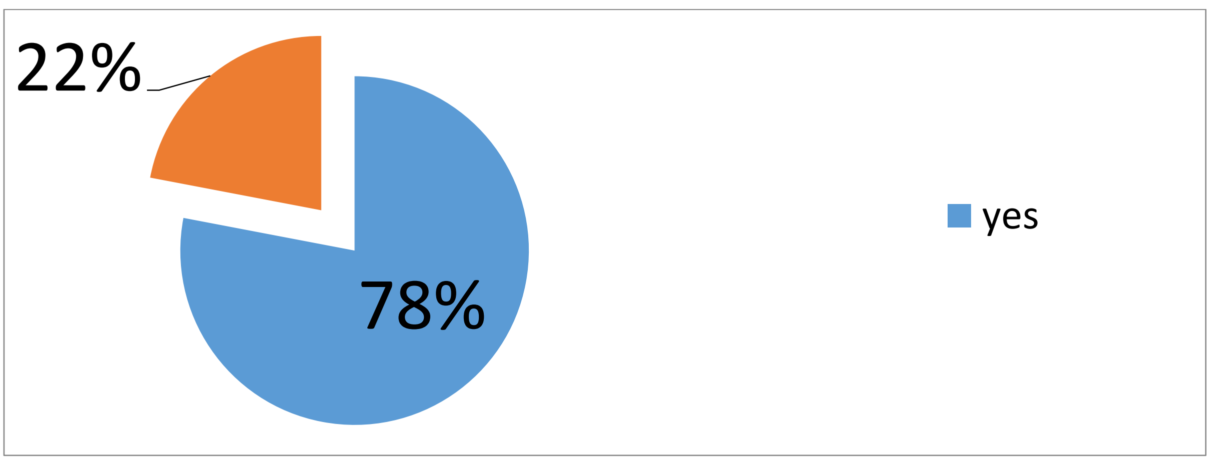


8. TOPICS COVERED EASY TO UNDERSTAND

OPINION	NO.OF RESPONDENTS	PERCENTAGE (%)
Yes	39	78
No	11	22
Total	**50**	**100**

INFERENCE

- 78% accept that the topics covered in the training programme are easy to understand and
- 22% of the respondents don't accept with it.



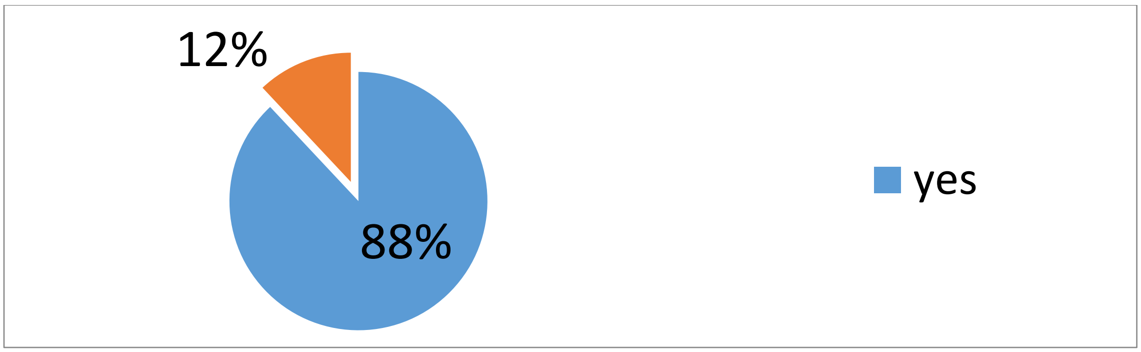
9. TOPICS COVERED WITHIN GIVEN TIME

OPINION	NO.OF RESPONDENTS	PERCENTAGE (%)

Yes	44	88.0
No	6	12.0
Total	**50**	**100.0**

INFERENCE

- 88% of the respondents accept that the topics taken for the training programme are covered within the given time and
- 12% of the respondents don't accept with it.



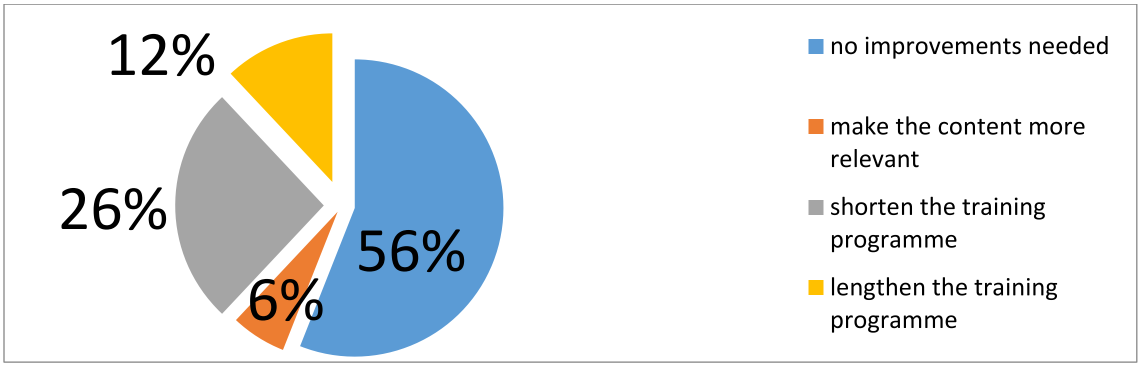
10. SUGGESTIONS OR IMPROVEMENTS

OPINION	NO.OF RESPONDENTS	PERCENTAGE (%)
no improvements needed	28	56.0
make the content more relevant	3	6.0
Shorten the training programme	13	26.0
lengthen the training programme	6	12.0
Total	**50**	**100.0**

INFERENCE

- 56% of the employees feel no improvement is needed

- 6% of the employees suggest making the content more relevant
- 26% of the employees suggest shortening the period of training.
- 12% of the employees suggest lengthening the training programme



FINDINGS AND SUGGESTIONS

- Employees agreed that Training enhanced their technical skills.
- Maximum employees agreed that it results in better performance.
- Most of the employees feel that there are chances of promotion after attending training Program.
- Most of the employees found topics relevant for the training programme.
- Topics covered were easy to understand.
- Most of the employees said that the training was satisfactory & needed no major improvement in the same.

SUGGESTIONS

- MUBEA Automotive India Pvt. Ltd should automate their training and development process.
- The policy should be formulated for the selection of internal trainers.
- Internal audit for training and development is necessary.
- Expert faculty members from across the world should be assigned.

CONCLUSION

Training programme's main objective is to improve the productivity of the company's employees which in turn will improve the company's profitability.

Through training programmes, the employees' skill levels are upgraded which will make the employees more productive.

The training programme is set up to help employees get used with new roles and responsibilities usually after promotion.

When an employee gets promoted from one level to the next level, the skills required to do his/her job changes and training programmes are essential in equipping the employee with the new skills.

The training programme is also a way for the company to showcase to its employees that it cares for employees' self-development.

Employees' feedback on the training programme is essential to understand the effectiveness of the training programme. Most times, employees better understand the kind of training programme that would help them.

It is important to get employees' opinion before the creation of new training programmes.

Mubea Automotive has developed training tools and techniques to facilitate effective learning. Mubea provides a good infrastructure and environment for their trainees.

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"Isolation, Partial purification and characterization of xylanase enzyme produced by soil bacteria"

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The project is focused on the Isolation, Partial purification and characterization of xylanase enzyme produced by soil bacteria In this study, xylanase producing bacteria was isolated from two different soil samples and was screened by congo red assay method. The isolate which had given the maximum clearance zone around the colonies was from soil sample-2 at 10^{-5} dilution. This isolate was selected for xylanase production which were maintained on nutrient broth culture. Xylanase production was carried out by submerged fermentation with different production parameters and its maximum activity was found by DNSA method. The maximum activity was given by carbon source parameter i.e rice bran. Xylanase was partially purified by ammonium sulphate precipitation method fallowed by dialysis and protein estimation was done by Lowry's method.

The characterization of partially purified xylanase enzyme was done by effect of different temperature on enzyme activity, effect of different pH on enzyme activity and maximum activity was found at temperature 40˚C and pH 9. Molecular weight determination by SDS-PAGE and molecular weight was around 63kDa. it shows that partially purified enzyme and crude enzyme have same molecular weight.

it conclude that xylanase from soil bacteria have successfully produced with optimization of cultural condition in submerged fermentation.

key words : Enzyme, Bacteria, Xylanase, screening, SDS-PAGE

INTRODUCTION :

The soil microorganisms known to produce xylanase enzyme by degrading xylan present in the cell walls of biomass. They could effectively be exploited in agro waste management and generation of renewable sources of energy. Present study focuses on the isolation of xylanolytic bacteria from different soil samples to estimate their xylanase activity in relation to soil quality. Various agricultural wastes were screened and analyzed for efficient production of xylan by alkaline hydrolysis. Xylanolytic bacteria were isolated from various soil samples and characterized (Nair et al., 2016).

The substrate of xylanase, xylan, is the second most-abundant polysaccharide in nature, accounting for approximately one-third of the renewable organic carbon on earth , and it constitutes the major component of hemicellulose, a complex of polymeric carbohydrates, including xylan, xyloglucan, glucomannan and arabinogalactan. Xylan is primarily present in the secondary cell wall and together with cellulose (1,4-β-glucan) and lignin (a complex polyphenolic compound) make up the major polymeric constituents of plant cell walls. Within the cell wall structure, all three constituents interact via covalent and non-covalent linkages, with xylan being found at the interface between lignin and cellulose, where it is believed to be important for fiber cohesion and plant cell wall integrity (Motta et al., 2013).

Xylanases have the ability to bind carbohydrates other than xylan, which has been observed in structures of endo-xylanases from glycoside hydrolase families. The carbohydrate-binding modules have great potential for applications in lignocellulosic residues.(Alvarez et al., 2016).

Xylanases, can be used for the clarification of juices, they increase the performance of and enhance the maceration process as well as reduce the degree of viscosity. Xylanases may improve the extraction of coffee, vegetable oils and starch. Xylose resulting from hydrolysis of xylan can be converted to xylitol, a sweetener that has applications in the pharmaceutical and food industries. In the baking industry xylanase can improve the quality of bread, by increasing volume. These enzymes can also be applied in the preparation of animal feed to improve the nutritional properties of agricultural silage and grain. It also has been applied in the poultry diet improving the weight gain and feed conversion.. Xylanases can also be used in cereals as a pretreatment for substrates rich in arabinoxylan. Arabinoxylans are soluble in water and thus increase the viscosity of the solution. This problem can occur in brewing, however, the xylanases improve the extraction of fermentable sugars for processing by reducing the viscosity and improving the filterability of the fluid. The xylooligosaccharides released by xylanases can be used in pharmaceutical, agricultural and food products, as prebiotics (Alvarez et al., 2016).

Microbial xylanases have a wide range of commercial application in food, feed, textile, and paper processing. (Harris et al., 2016). Xylanase production can be carried out using agriculture waste materials those are used as substrate which provide carbon and mineral nutrients to the organisms under the controlled conditions. Production process of any enzyme is affected by nutritional and physiological factors such as carbon source, nitrogen source, additives, pH of the media, incubation temperature, agitation rate. Higher production of industrial enzymes by optimizing these parameters is of prime importance, because an improper optimization of these factors leads to a lower production of enzyme (Master et al., 2015).

Submerged fermentation

The production of xylanase was conducted using submerged fermentation and solid state fermentation. submerged fermentation is currently universal in the development of industrial enzymes in most fermentation process of industrial field. In the case of submerged fermentation both the microorganism and substrate are involved in submerged state in the liquid medium, where a large quantity in the form of solvent is present. since the contents are in submerged state in the liquid medium, the transfer of heat and mass are more effective and efficient. Methods for the designing of fermentation equipment and for the evaluations of its performance are greatly improved by increased knowledge of factors affecting the oxygen transfer in submerged fermentation system that required some degree of aeration. 80% to 90% xylanase are produced in submerged culture because of the microbial biomass and substrate that are homogeneously distributed in a liquid medium.(Hooi et al., 2015).

Purification of xylanase enzyme

Ammonium sulfate precipitation

Ammonium sulfate precipitation is one of the most commonly used method for large and laboratory scale protein purification and fractionation that can be used to separate proteins by altering their solubility in the presence of a high salt concentration.. Proteins are usually stored in ammonium sulfate because it inhibits bacterial growth. With the addition of ammonium sulfate, proteins unfolded by denaturants can be pushed into their native conformations. This can be seen with the folding of recombinant proteins.

The solubility of proteins varies according to the ionic strength of the solution, thus according to the salt concentration. At low ion concentrations (<0.5 M), the solubility of proteins increases with increasing salt concentration. As the salt concentration is further increased, the solubility of the protein begins to decrease. At a sufficiently high ionic strength, the protein will precipitate out of the solution. When the ammonium (NH4+) and sulfate (SO42−) ions are within the aqueous solution they are attracted to the opposite charges evident on the compound that is being purified. This attraction of opposite charges prevents the water molecules from interacting with the compound being purified, leading to the precipitation or "salting out". The ammonium sulfate solubility behavior for a protein is usually expressed as a function of the percentage of saturation. A solubility curve can be determined by plotting the log of the experimentally determined solubility, expressed as mg/mL, versus the percentage saturation of ammonium sulfate. (https://en.wikipedia.org/wiki/Ammonium_sulfate_precipitation).

Dialysis

Dialysis is a separation technique that facilitates the removal of small, unwanted compounds from macromolecules in solution by selective and passive diffusion through a semipermeable membrane. In biotechnologies, this technique is a commonly used method for desalting and buffer exchange of proteins despite the slow speed and large volumes of buffers often required, and is typically performed overnight, especially for large samples (Nath et al., 2016).

Characterization of xylanase enzyme

In this study the attempt is made to isolate, screen, and characterize the xylanase producing bacteria from soil samples. To determine the maximum xylanase activity in various media and the effect of pH, temperature optima on xylanase enzyme production. DNSA method was carried out to study the maximum activity of Xylanase. Crude extract was fractioned by Ammonium sulphate precipitation followed by dialysis. The partially purified enzyme was subjected to protein estimation and further used for characterization of xylanase enzyme. Molecular weight of the partially purified Xylanase was determined by SDS-PAGE (Vignesh et al., 2016).

The biochemical characteristics of purified xylanases produced by fungi, bacteria and yeasts are the molecular weight of these enzymes is between 15-145 kDa, while the optimal pH and temperature are between 4-6 and 40-70 ° C, respectively. The isoelectric point for xylanases is between 3 and 10. These characteristics suggest that microorganisms have different strategies for the expression of xylanases in different environmental conditions, for the degradation of xylan(Alvarez et al., 2016).

SDS-PAGE

Sodium dodecyl sulfate polyacrylamide gel electrophoresis (SDS-PAGE) is a technique for separating proteins based on their ability to move within an electrical current, which is a function of the length of their polypeptide chains or of their molecular weight. The SDS coats the proteins, mostly proportional to their molecular weight, and confers the same negative electrical charge across all proteins in the sample. Glycosylated proteins may not migrate at their expected molecular weight since their migration is based more on the mass of their polypeptide chains, not the sugars that are attached. The most widely used gel system for separating a broad range of proteins is SDS-PAGE, which uses stacking gel component and the resolving gel where varying acrylamide gel percentages are used to separate the proteins based on their mass weight. This classic system uses a discontinuous buffer system where the pH and ionic strength of the buffer used for running the gel (Tris pH 8.3) is different from the buffers used in the stacking gel (Tris, pH 6.8) and resolving gel (Tris, pH 8.8) (Kumar et al., 2012).

The Study entitling “Isolation, partial purification and characterization of xylanase enzyme produced by soil bacteria” has been undertaken with objectives -

Objectives -

A) To isolate xylanase producing bacteria from soil.

B) Partial purification and characterization of xylanase enzyme.

METHODS

Isolation of bacterial colonies

Soil sample obtained from Modern college of Agricultural Biotechnology, Paud, Tal.- Mulshi, Dist.- Pune. Field was used for isolation of bacteria. For isolation of bacterial colonies, 1g soil was suspended in 9 ml sterilized water. This suspension was diluted 10-1, 10-2, 10-3, 10-4, 10-5, 10-6, 10-7, 10-8 From each dilution 0.05ml of suspension were plated on xylan agar medium. Xylan agar plates were incubated at 37˚C for 2-3 days. (Kumar et al., 2018).

Screening of bacteria for xylanase production

Five colonies were picked up from xylan agar plates and subcultured on another xylan agar plates. Plates were incubated at 37˚C for 2 days. After appearance of bacterial colonies poured down 5 ml 1% Congo red solution on each plate and kept for 20-30 minutes. After an hour, the petri plates were washed with 1M NaCl solution. The plate were showing highest yellow zone of hydrolysis around the colonies were selected for further study. (Shanthi et al., 2018).

Optimization of cultural conditions for xylanase production

To scale up xylanase production, cultural conditions were optimized as described below:

Preparation of inoculum

The strain from soil sample dilution 10-5 showing highest yellow zone of hydrolysis was stored and maintained on nutrient broth culture and slants at 4˚C and used for further studies.

Effect of carbon source on xylanase production

Three agricultural extract as carbon sources were used to determine their effect on xylanase production. Each 500 ml Erlenmeyer flask containing 250 ml fermentation media (pH-6.0) contained either of these carbon source viz. rice bran, Soybean waste and banana peal. 2. The fermentation medium was inoculated with 1 ml inoculum and submerged fermentation carried out at 37˚C for 96 hrs.

Extraction of crude xylanase enzyme

After 96 hrs of submerged fermentation at 37˚C, fermented culture was centrifuged at 10,000 rpm for 15 min at 4˚C. The supernatant was used as crude enzyme for further studies.

Xylanase assay (DNSA method)

The most common way to follow xylanase activity is to determine the reducing sugars formed from selected type of xylan. Xylanase in the sample hydrolyzed the substrate and amount of released reducing carbohydrate determined spectrophotometricallyusing.

Dinitrosalicylic(DNS) acid (Miller, 1959)

Procedure-

1 ml of 1% xylan solution (in 0.05 M, pH 7.0 phosphate buffer) mixed with 1 ml crude enzyme from each sample. Blank set, where no crude enzyme added. Samples were incubated for 15 min at 60˚C. The reaction was stopped by addition of DNS. The mixture was heated for 10 min in boiling waterbath and cooled in cold water. Absorbance of sample was measured at 575nm against blank. A standard curve of xylose ranging from 0 to 1000 µg/ml was constructed and then determined the released xylose in the samples from standard curve. One unit of xylanase activity is defined as the amount of xylanase liberating 1µg of xylose equivalent under the experimental conditions in 1 min.

Partial purification of crude xylanase enzyme

The crude enzyme was partially purified using conventional purification techniques.

1 Ammonium Sulfate Precipitation

The crude enzyme was subjected to precipitation at various ammonium sulphate concentrations i.e. 40%, 60%, 80% at 4˚C for four hours with continuous stirring. 80% ammonium sulphate precipitation shown highest precipitation was allowed to settle overnight at 4˚C. later on, centrifuged at 10,000 rpm for 10 min and precipitate dissolved in 0.05M phosphate buffer (pH 6.0) and sample were taken for dialysis.(Harris et al., 2016)

2 Dialysis

After precipitation dialysis bag was put in boiling water for 5-10 minutes. Dialysis bag was removed and tied at one end, from another end ammonium sulphate precipitated sample was added. Added sample subjected to dialysis in 0.05 M phosphate buffer for 24 hrs at 4˚C. Then sample was removed from dialysis bag and stored at 4˚Cfor further characterization. (Master et al., 2014)

Protein determination (Lowry's method)

The protein content of the purified xylanase was determined by Lowry method using Bovine Serum Albumin (BSA) as a standard. (Lowry et al., 1951)

Characterization of xylanase enzyme

1. Effect of temperature on xylanase activity

0.1 M phosphate buffer of pH 7.0 was prepared. Enzyme extract added to reaction mixture was incubated at different temperature ranging from 30˚C to 80˚C. Enzyme activity was measured at 575 nm on UV spectrophotometer as described earlier (3.2.4.2).(Hassan et al., 2013)

2. Effect of pH on xylanase activity

0.05 M Sodium phosphate buffer (pH 5.0, 6.0, 7.0, 8.0, 9.0, 10.0) was prepared. Enzyme extract was added to reaction mixture Enzyme activity was measured at 575 nm on UV spectrophotometer.(Hassan et al., 2013)

3 Molecular weight determination (SDS-PAGE)

SDS plates were arranged with spacer and sealed externally with cello tape. Later on SDS plates were thin sealed internally with solidifying agar. First the separating gel was poured between two plates with help of micropipette. Separating gel was polymerized, add 1 ml of n-butanol to form uniform layer in the gel. later on stacking gel was added over the separating gel and immediately insert comb and allow it to solidify. After stacking gel was polymerized the comb was removed. First well was loaded with 5µl standard protein ladder. 15µl enzyme sample mixed with 3µl of loading buffer and loaded into respective wells. Electrophoresis apparatus was connected to power supply. The gel was allowed to run at 50 V until the dye reaches the stacking gel and then the voltage was increased to 150 V until the dye reaches the bottom of the gel. Gel was then removed and subjected to coomasive brilliant blue staining using staining solution provided in the kit for about 20 min and then destained by destainer.Bands were observed. (Roy et al., 2014)

Results and discussion :

Isolation of bacterial colonies

The soil sample was plated on xylan agar media plates. The sample showed good bacterial growth at 37±2˚C in xylan agar medium at the pH 7.0. These colonies were further screened for the production of xylanase enzyme in screening medium with xylan as substrate.

Screening of bacteria for xylanase production

Screening by congo

The xylanase producing bacteria were screened based on the zone of clearance which formed around the colonies. These colonies were visualized by 0.1% congo red solution ,giving red colour to plates and destained by 1M NaCl solution.

Production of xylanase producing bacteria

The xylanase producing bacteria were produced in nutrient broth culture and slants. The loopful suspension of bacterial isolates having highest xylanolytic activity from soil sample dilution 10-5 was stored and maintained on nutrient broth culture at 4˚C in cold conditions. The loopful suspension of bacteria isolates were streaked on slants and stored at 4˚C in cold conditions for further studies.

Submerged fermented samples of different carbon sources

The bacterial strain showing highest zone of hydrolysis on xylan agar were maintained on nutrient broth culture and was grown in submerged fermentation medium. Submerged fermentation for xylanase production carried out with production parameter viz. Effect of different carbon source

Extraction of crude xylanase enzymes

After submerged fermentation samples was centrifuged in cooling centrifuge. supernatant was used as crude enzyme.

Xylanase Assay (DNSA method)

Effect of carbon source on xylanase production

The use of purified xylan as substrate is uneconomical for large scale production of xylanase. So effect of some agricultural residue as carbon source was determined. From results, it is observed that rice bran showed the highest production of xylanase, followed by soybean waste and banana peel. As the use of rice bran showed highest production, it can be considered that agricultural source are economically viable and are able to give yield of xylanase enzyme

Partial purification of xylanase enzyme

Ammonium sulphate Precipitation

The crude enzyme filtrate was precipitated with different concentrations of ammonium sulphate such as 40%,60% and 80% it was observed that 80% concentration of ammonium sulphate showed enhanced performance of enzyme precipitation.

The ammonium sulphate precipitation showed high precipitation at 80% ammonium sulphate saturation.

After centrifugation of ammonium sulphate precipitated sample enzyme pellets were observed shown in fig.10.

Fig.No.8: Crude xylanase enzyme with 40%, 60% and 80% saturation of ammonium sulphate.

Fig.No.10: Enzyme Pellets

Fig.No.9: Ammonium sulphate precipitation with 80% saturation.

Dialysis

The obtained enzyme was dialyzed using dialysis bag (12kda cut off). Purified xylanase was obtained with help of the dialysis.

Characterization of xylanase enzyme

Effect of temperature on xylanase activity

Enzyme assay was carried out in the temperature range varying from 30˚C to 80˚C to find out the optimum temperature at which the enzyme shows maximum activity. The purified xylanase showed maximum activity at 40˚C and minimum activity at 80^0C.

Effect of pH on xylanase activity

Enzyme assay was carried out in the pH range varying from pH 5 to 10 to find out the optimum pH at which the enzyme shows maximum activity. The purified xylanase showed maximum activity at pH 9.0 and minimum activity at pH 5.

Molecular weight determination (SDS-PAGE)

The molecular weight of the enzyme was determined by using SDS-PAGE. Crude enzyme shows more bands than purified enzyme and molecular weight of xylanase enzyme 63 KDa.

SUMMURY AND CONCLUSION

The present investigation on Isolation, partial purification and characterization of xylanase enzyme produced by soil bacteria were carried out with an aim to find out a microbial isolate producing appreciably good amount of xylanase. The enzyme has been purified and characterized for its commercial use in various industries.

In this study, bacterial culture was isolated from soil sample and was screened by congo red assay method. The isolate showing highest yellow zone of hydrolysis around the colonies was from soil sample 10-5dilution. This isolate was selected for xylanase production which were maintained on nutrient broth culture and loopful suspentation of bacteria were streaked on slants .

Xylanase production was carried out by submerged fermentation with production parameter i.e. Effect of carbon source so effect of agricultural residue as carbon source was determined. From results, it is observed that rice bran showed the highest production of xylanase, followed by soybean waste and banana peel. Maximum activity was found by DNSA method.

Xylanase was partially purified by ammonium sulphate precipitation method fallowed by dialysis.

The protein concentration of crude and purified xylanase showed 0.800 and 1.000 mg/ml concentration respectively. when determined by Lowry method.

The characterization of partially purified xylanase enzyme was done by effect of different temperature on enzyme activity, effect of different pH on enzyme activity and maximum activity was found at temperature 40˚C and pH 9. Molecular weight determination by SDS-PAGE and molecular weight was around 63KDa.

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Role of Information Technology in Transforming Indian Agriculture.

WaghmareM.N[1]., Y.C. Sale[2] and B.N. Pawar[3]

Introduction

Agriculture is an important sector of the Indian economy as it contributes about 17 per cent to the total gross domestic product (GDP) and provides employment to over 65 per cent of the population. Indian agriculture has registered impressive growth over the last few decades.

Indian agrarian economy is characterized by low degree of market integration and connectivity, accessibility of reliable andtimely information by the farmers on prices of commodities. To fulfill theexpectations of the conscious buyers, price and quality, globalization andliberalization and maintain the viability of small and marginal farm to retain them inthe farming, application of technology in agriculture has become inevitable.The timely availability of right information and its proper utilization is as critical asthe availability of major inputs required for farming until the produce reaches theconsumer.The application of Information and Communication Technology (ICT) can play apivotal role in efficient dissemination of information. The ICT can deliver fast,reliable and accurate information in a user-friendly manner for practical utilization bythe end user. The information disseminated facilitates the farmers to decide what andwhen to plan, how to cultivate, when and how to harvest, what post-harvestmanagement practices to follow, when and where to market the produce etc. (USAID,2010).

ICT has been considered as a tool that can be used to achieve development goals in developing countries. These technologies may help to fight against illiteracy, disease, unemployment, poverty, agriculture and other development problems. Agriculture plays a vital role in the society and the economy of the country. Nowadays, more and more new advanced technologies are used for agricultural development, such as satellites, the Internet, mobile phone and social media. Agriculture needs continuous diffusion of new technology to meet global food security, poverty reduction and environment sustainability. According SECC data (2011), in India total households is 24.39 crore, out of 17.91 crore lived in rural area, among them 10.69

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core called deprived households (Kurukshetra, September 2015). Farming is very difficult for----

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people though are lives under poverty line. To mitigate the global needs and reforms agriculture production, Green Revolution took placed during the mid of 1960s.

ICT help to provide knowledge to the door step of farmers. It provides information related to weather/climate information, fertilizers consumption, online land registration, pest management and price output in the markets etc. Every level of government offices are connected with a network, to provide information to the farmers. Agriculture expert, Village Agriculture Workers, development officers and stake holder are teaching farmers, to adapt new methods of agriculture. In India teledensity has rapidly increased, in rural area teledensity is increased twice as per 2015 government report (Kurukshetra, February 2016). Rural farmers access information regarding agriculture through Short Message Service (SMS), Voice over call on their mobile phone. The Central government collaborating with the state government has been introduced in various ICT Centres equipped with PCs, telephone, internet, broadband connection and with development officer e.g. e-choupal, IFFCO-ISRO GIS project, Gyandoot project, AMARKET,VISTANET etc. Knowledge based information provided through various web and mobile based web portal, farmer‟s web portal (www.farmer.gov.in), mkisan portal (www.mkisan.gov.in), Kisan Call Centres. These portal are facilitating knowledge based information and advisory through subject experts. Maximum percentage of inhabitant make livelihood through agriculture. To address the information needs of farmers, relevant content is a key component of ICT projects. The extent to which content is customized and localized to a farmer‟s condition influences its relevance. The benefit of ICTs is yet to reach all the farmers, especially those who are marginal or sharecropper and living in remote part of the country are not getting this service or its better to say they are not availing this due to poor economic conditions, communication barrier and social constraint. Indian government emphasizes on "Digital India" programme. This scheme aim to empower citizens with e-access to government services and livelihood related services. By the end of 2020 the Digital India programme envisages that 2,50,000 Indian villages will enjoy broadband

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connectivity and universal phone connectivity. The study has focused how the development officers and stake holders use ICTs as access and utilization tools are the focus of the study. The study also focuses on use of ICTs by information providers and how they diffuse information to access utilization of agriculture the rural farmers ofWarnanagar area access information and utilize the benefit of ICTs in agriculture development.

Objectives The objectives of the study are;

1. To find out the ICTs application in agriculture in Warnanagar area.

2.To find out role of ICTs in agriculture development.

Methodology

The present study has been completed with collecting both primary as well as secondary data. Secondary Data Collection: The secondary data has been collected through different source of materials, portals, websites and other exiting records:

a. National and state government agriculture portal.

b. Different Schemes and Projects on ICT under Government of Maharashtra.

c. Block agriculture reports.

The other relevant data has been collected from various books, magazines, official records, research paper, internet, journals, news articles and other exiting sources of data. The Warnanagarblock play significant role in sugarcane production from Kolhapur district of Maharashtra. About 80% of people are directly connected with agriculture and agro based industries which provide livelihood to the inhabitants of the block. The selected area of sample from Warnanagarblock comprises 8 different villages and sample is persons, who are big and small farmers. The size of the sample is 90 consists of: Farmers 80, Government officials8, Stake holder (Private agents of seeds and fertilizer companies) 2. The sample was drawn through simple random sampling methods. Through stratified random sampling methods 10 farmers have been selected from each village, there have eight revenue villages.

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Data are analyzed in qualitative and quantitative methods. Data collected from both panchayat are averagely analyzed. To know the difference a comparative analysis has also been done. To test the quantity of data SPSS software has been used.

Results

From the survey it is observed that farmers are having multiple media habits don‟t confine with single media. An average 23% consumes only on electronic media(TV and radio), 6 % only folk media, 48 % both electronic and folk, 4.80% print and electronic, 3.15% print, electronic and folk, 4.90 % electronic and internet, 0.75% only print and 7.15 % all types of respectively. Here more than 12 % of farmers have used Internet. Hence influence of electronic media (TV and Radio) and folk media is higher than other media.

Table 1. Farmers Media habits in the study area (%)

Sr. No.	Particulars	Percentage (%)
1	Electronic media	23
2	Folk media	6
3	Both electronic and folk	48
4	Print and electronic	4.80
5	Print, electronic and folk	3.15
6	Electronic and internet	4.90
7	Only print	0.75
8	All types	7.15

Farmer's media consumption is shown in Table 2. It was learned that farmers only spending on entertainment average percentage is 43.20 % and 3.70 % only news programme, both entertainment and news are 38.61 %, entertainment and others 0.82 %, news and

Table 2. Farmers content access through media in the study area (%)

Sr. No.	Particulars	Percentage (%)
1	Entertainment	43.20
2	News	3.70

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3	Both entertainment and news	38.61
4	Entertainment and others	0.82
5	News and Agro based	2.02
6	All above	16..33

agriculture related information around 2% and all types of programme are16.33%. Though are information oriented they willfully go through the agro based information and news channel. As a result, 18.35 % of farmers are curiously searching information as per their needs through media. India‟s one of the completely agro based channel. The channel has broadcasting only agriculture based programmes, but an average 39.21 % people are known about the channel, while 60.33% farmers have no idea about its existence and importance.

Table 3. Sources of climate / weather information in the study area (%)

Sr. No.	Particulars	Percentage (%)
1	Friends / observation	58.70
2	Media	5.60
3	ICTs	1.35
4	Friends / observation and media	28.35
5	ICTs and media	12.05

From Table No. 3 depictedthat that, 58.70 % of farmers get climate/weather related info with the observation and asking from educated friends or ICTs users. 5.60 % of farmers have learns through media i.e. news or weather forecast of radio or television or newspapers. Only 1.35 % through the help ICTs application, 28.35 % throughout various sources like friends, relatives, and family members those are ICTs users, observation and tools of media, 12.05 % of them access through media and ICTs application. Hence, 1.35+12.05=13.40 % an average of farmers using ICTs application for gets weather/climate info.

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Table 4. Sources of information of new practices and innovative methods (%)

Sr. No.	Particulars	Percentage (%)
1	Friends	24.22
2	Media	0.88
3	Agriculture officials	6.05
4	ICTs	2.85
5	Friends and Agriculture officials	57.65
6	Media and Agriculture officials	3.70
7	Friends, media and Agriculture officials	4.75
8	Friends and media	5.85

It is infirmed the Table 4 that the information is transfer from one to many through inter-personal communication. An average 24.22 % of famers get information about government policy, programme, announcement, distributions etc from friends, while 0.88 % learns only through media, 6.05 % from agriculture officials (Village Level Workers and other government officials), and 2.85% directly through ICTs applications, 57.65% with the help of friends and agriculture officials, 3.70% media and agriculture officials, 4.75 % through friends, media, and agriculture officials, 5.85% with the help of friends and media, and directly through ICTs application 3.15%. Therefore farmers are accessing information regarding government, policy programme and facilities with the help of ICTs applications, that percentage is 8.60%.

Conclusions

Media usage is higher among the farmers and more or less farmers habits on multiple types of media. Among them around 12% farmers are using internet. An average 18% of them access media for agro based knowledge, left percentage of them using for other purpose such as, entertainment, news, and other types of contents. Among the media users, around 36 % know about the DD Kisan Channel. Those are know about the DD Kisan Channel 60.50 % percent are watching the channel regularly, among them 95.25% said that all the content are relevant for agriculture extension. Climate info play crucial role for the cultivation. Here an average 12% of

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farmers" using ICTs application to know about climate/weather info. Some of them are getting information from the ICTs, media, and by the observation. In Warnanagar basically farmers are learned cultivation techniques from the ancestors and friends. ICTs help them some extent to learn cultivation process. Basically information is transporting from extension offices to the farmers, the percentage of the study area is 50.55 %. 4.75% are access through the ICTs applications. New innovation techniques, use of modern technologies, high yielding seeds, usage of improve quality of fertilizers, pesticides management and other techniques-generally diffuse from one to more and again more to more. In Warnanagar 8.35 % of farmers access all types of information through the help of ICTs applications. At the initial stage extension officers and experts are gain trends through ICTs tools, in next stage they teach farmers through field visit, demonstration and workshop. Mobile phone works as tools of ICT, an average 85.60 % farmers using mobile phone. Among them 29.40 % having smart phone when 61.60% having normal phone. Mobile phone generally using here for communication with friends of relatives and the percentage is39 %, and 22 % using for communication and entertainment, an around 40 % using for gather information regarding agriculture. Out of the mobile users 65% of mobile users never read messages which reach in inbox, but 35% critically reading the messages. An average 38% of farmers receive messages from various portal, government offices or registered websites regarding farming needs. Internet users hike slowly in Kolhapur, lack of proper broadband connectivity, weak mobile network strength create barriers to access internet. In spite these 58.35% of farmers using internet, out of 22.3% smart phone users. Among the 58% internet users, 62.50% farmers browse agriculture related content throughout internet.

The electronic National Agricultural Marketing (eNAM) initiative of the Government of India is emerging as a viable solution to the highly fragmented and inefficient supply chain about agricultural marketing in India. Internet technology has provided the possibility for cost reduction and demand enhancement along the food supply chain through the use of e-trading.The use of technology has been playing a key role in many strategic initiatives where attempts have been made to capitalize the benefits of e-business to strengthen consumer and supplier relationships and hence to establish new markets. Agribusiness organizations have capitalized on the many advantages of e-business to improve the marketing of their products. The high reliance

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on accurate and timely information and large physical distances between producers and consumers in this country has made this sector encouraging to the benefits of e-business.

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Screening of Grains for Development of Instant Sprouts Meal as a Convenience Food and its Quality Evaluation

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Abstract

In the time of Fast Moving Consumer Goods (FMCG), people are facing physio-health issues led by nutrient deficient diet, physical inactivity and sedentary lifestyle. In response to current circumstance, scientific investigation was carried out to develop convenience food mitigating need of an hour. Hence, the efforts have been made to screen the grains on the basis of soaking, germination, dehydration and rehydration time to develop instant sprouts meal. Furthermore, screened grains were proportionated to formulize recipefor instant sprouts meal.As per the screening study green gram, moth beans, horse gram, lentils, chickpea and pearl millet showed resembling time of soaking, germination, dehydration and rehydration time as 6 to 10 hrs, 8 to 24 hrs, 90 to 300 min and 7 to 8 min respectively and so selected for further study. Amongst the formulation trials, green gram 20%, moth beans 20%, horse gram 15%, lentils 15%, chickpea 15%, pearl millet 15%, carrot 1.5 and spice mix 3.5% was finalised on the basis of sensory evaluation and carry forwarded for chemical analysis and results are noted as, moisture 6.93%, Protein 33.28%, Fat 1.20%, Carbohydrate 55.62%, Dietary fiber 13.52%, Ash 2.97%, Calcium 44.11mg/100g and Phosphorus 120mg/100g. Ultimately it could be concluded that, the instant sprouts meal stands a best option for germination as a tedious process in high altitude areas, and a nutritive convenience food.

Keywords: Soaking, Germination, Dehydration, Rehydration, Instant Sprouts Meal

Introduction

In the generation where time and health are the real assets, hence it's necessary for consumers to make the right choice of food. However, the food consumer often fails to choose the right food and land up consuming food that is easily available but unhealthy. This results in the development of health conditions like cardiovascular diseases, depression, obesity, diabetes, renal disorders etc.

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According to World Health Organization (WHO) malnutrition is a cellular imbalance between the supply of nutrients and energy and the body's demand for them to ensure growth, maintenance, and specific functions. The Protein Energy Malnutrition (PEM) is a major public health condition that moderately affects 80% children creating problems in their vital stage of development and mortality owing to low intake of protein (Zubin and Ee, 2009). It is documented that low intake of fibre results in irregular digestion and elevated cholesterol which increase the chances of colorectal cancer (EricaKannall, 2019).

On the date, most of industrial population is depend on convenience foods for their daily need.The urbanization of society,modern lifestyles, and increased income of middle man are some of basic facts behind increasing the use of convenience foods. The demand for convenience foods is at peak from 1999 and it has engaged the retail the market of value US$4000 billion. Moreover, today, at any given time more than ten thousands of various types of convenience foods are offered for sale to consumers throughout the world. And are providing advantages like, readily convenient, available, inexpensive, taste, minimal processing and RTE foods (Tillotson, 2003).

Sprouts are the product of germination process, developed by soaking and germination in water or on another medium, harvested before prior to actual development of roots and shoots, to be consumed whole. As per the American Association of Cereal Chemists (AACC) and United States Department of Agriculture (USDA), malted or sprouted grains are containing all the bran, germ, and endosperm of grains as long as sprout growth does not exceedkernel length and nutrient values have not lessened.

Worldwide, each altitudinal and latitudinal treelineshaving shorter growing season because of lower temperature throughout year around 6-8^{0}C ordinarily thoughtabout to be a thermal boundary for various metabolic activities in grains and hence prevents germination (Vapaavuori et al., 1992).

With a clear intent and considering all above things, an efforts have been made to develop such a product which will meet the requirement of highly engaged time bound people as well as high altitude society. With the same context various locally available grains viz. different legumes and cereals were screened on the basis of soaking, germination, dehydration and rehydration time for development of instant sprout meal. The developed instant sprout meal was analyzedfor various quality characteristics.

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Materials and Methods

1. Procurement of ingredients

The materials used for development of the product included various grains and legumes in major and minor quantities. The materials which build the major composition are Mung bean and Moth beans Whereas Lentil, Chickpea, Horse gram and Pearl millet are of minor content. The raw materials were procured from Local market in LoniKalbhor, Pune, India.

2. Packaging

Packaging material used for product was chosen such that it had low WVTR and OTR properties to ensure that there was to prevent uptake of moisture and loss of colour, flavour and texture. Polypropylene of 100 micron was used as the primary packaging material and Paper bag (22cm×11cm) of 100 GSM was used as secondary packaging material.

3. Equipment and Machineries

Equipment and machineries used for production were weighing balance, sealing machine, steamer, cabinet dryer and sprouting chamber.

4. Screening of Grains for Development of Instant Sprouts meal

4.1 Screening on the basis of Soaking time

The selected grains were soaked at room temperature and time was calculated in hrs to complete the soaking. The soaking accomplishment was checked by pressing the grains by two fingers.

4.2 Screening on the basis of Germination time

Germination of grains was carried at room temperature, constant relative humidity by sprinkling water after specific interval of time. The length of rootlets was measured and accordingly completion of process was decided.

4.4 Screening on the basis of Dehydration time

The germinated grains were dehydrated at 60^0 C for required time in cabinet dryer.

4.5 Screening on the basis of Rehydration time

The dried grains were rehydrated by boiling in water and time was calculated accordingly.

5 Standardization of Instant Sprouts meal

Standardization was done by using screened grains, dehydrated carrot shreds and spice mixture as per following recipes.

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Table no. 1 Standardization of Instant Sprouts meal

Sample No	Grains							
	Green gram	**Moth Beans**	**Horse gram**	**Lentils**	**Chickpea**	**Pearl Millet**	**Carrot**	**Spice Mix**
1	10%	10%	5%	5%	10%	3%	0.5%	2.5%
2	15%	15%	10%	10%	20%	5%	1%	3%
3	20%	20%	15%	15%	15%	15%	1.5%	3.5%
4	25%	25%	20%	20%	25%	15%	2%	4%

6 Development of Instant Sprout meal

A) Soaking and Germination of Grains

Receiving of grains

↓

Weighing

↓

Washing

↓

Soaking in water
(Soaking time varies according to the grains)

↓

Drainage of water

↓

Wrapping grains in cotton/muslin cloth

↓

Germination
(Germination Time varies according to the grains)

↓

Sprouted grains

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B) Steaming and Dehydration of Germinated Grains

Weighing of sprouts

↓

Steam the sprouted grains
(Steaming time varies according to the grains)

↓

Cooling

↓

Spread uniformly on trays

↓

Dehydration at 60^0C

↓

Dehydrated sprouted grains

↓

Packaging

↓

Storage

7. Chemical Analysis of Instant Sprouts meal

The chemical analysis of instant sprouts meal pertaining to components viz. moisture,protein, fat, carbohydrate, dietary fiber, ash, calcium and phosphorus was determined as per standard methods depicted by FSSAI, (2016) and AOAC, (2005).

8. Sensory Evaluation of Instant Sprouts meal

Sensory evaluation was carried out as per nine point Hedonic Scale by semi-trained panelists for multiple formulations noted above.

Result and Discussion

1.Screening of Grains for Development of Instant Sprouts meal

Grains have various physiochemical properties like solubility, foaming and emulsifying capacities, water and oil holding capacities and other properties. These are dependent on molecular size, structure and charge distribution of the protein molecules. These characteristics

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directly affect various unit operations like soaking, sprouting, dehydration and rehydration properties (Zhongqinet al, 2017). In order to put all the unit processes in synchronized pattern, it's necessary to screen the grains and legumes for development of product.

1.1 Screening on the basis of Soaking Time

Soaking is a unit operation necessary for the seed realize that it is the appropriate time for germination. Soaking boosts the moisture rate, remove the protective coating of seed and promotes softening of seed (Anonymous, 2019). The parameters that affect soaking time of grains are Seed Weight, Hydration Capacity, Swelling capacity and Seed viability (Bhokare andJoshi , 2015).

Warm filtered water was used for soaking of grains in order to breakdown phytic acid and other minerals. The grains considered for screening are Brown Rice, Pea, Kidney Bean, Moth Bean, Green Gram, Lentil, Chick Pea and Pearl Millet. The soaking time studied is framed in the following table.

Table no. 2 Determination of Soaking Time for Grains

Sr. No.	Grains	Soaking Time @ Room Temperature			
		6 Hrs	8 Hrs	10 Hrs	12 Hrs
1	Brown Rice				√
2	Peas			√	
3	Wheat				√
4	Kidney Beans			√	
5	Moth Beans		√		
6	Mung Gram		√		
7	Lentils		√		
8	Horse Gram		√		
9	Chick pea		√		
10	Pearl Millet	√			

*Each value is an average of three determinations

It was studied that Brown Rice and Wheat require 12 hours to soak, whereas Pea and

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Kidney beans require 10 hours of soaking. The seed weight of these grains is more as compared to the rest. Mung bean, Moth bean, Lentil, Horse gram, Chick Pea and Pearl Millet soak within 8 hours as their hydration and swelling capacity is higher than the grains which require more soaking time.

1.2Screening on the basis of Germination Time

Germination is proven to improve the nutritional value of the legume. This process involves changes in nutritional, biochemical and sensory properties. Germination facilitates breakdown of carbohydrates into simpler sugars by activation of endogenous enzymes such as α- amylase thereby improving digestibility. Lipid content of grains slightly increases during soaking but gradually decreases after germination (Smith et al., 2018). These changes are accompanied by increase in the biological value of protein and amino acids with greatest increase in glutamic and aspartic acid. The studied noted that Vitamin C, Riboflavin, Niacin, Choline and Biotin content fairly elevated from 2.5 to 4.5 folds. Germination promotes activation of phytates which causes hydrolysis of phytates and increases the bioavailability of iron (Vander Stoep, 1981).Antioxidant activity varied 14-15% after germination and significant differences were observed in total polyphenols and flavonoids (Ravi Kumar and Vijaykumar, 2017).

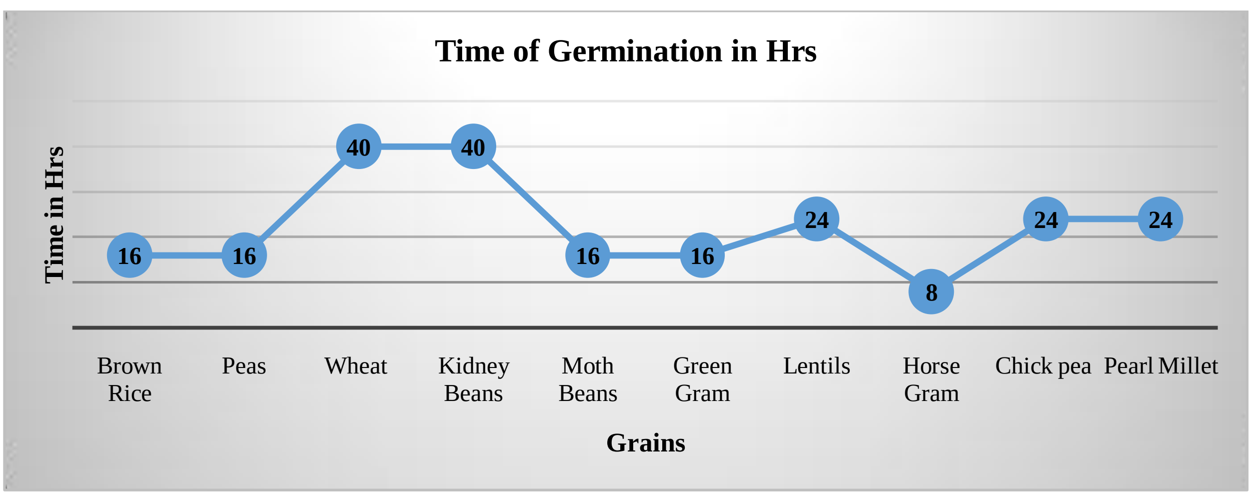

Fig. 1 Germination Time of Grains

Germination is influenced by various factors of which seed dormancy is a decisive intrinsic factor which causes variability in germination time of various grains. The end point scrutinized for the germination of grains was sprouts of 0.5 cm length. The table given below

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compares the germination time of various grains studied.

The germination time of Brown rice, Pea, Wheat and Kidney bean is considerably high ranging from 32-40 hours, due to its tick bran layer and seed coat. Whereas Moth bean, Mung bean, horse gram, lentil, chickpea and pearl millet take 8 hours to 24 hours to germinate.

1.3 Screening on the basis of Dehydration Time

Dehydration is a scientific process of removal of water from food commodities under controlled conditions of temperature, relative humidity and time. The selected grains were dehydrated at 60^0C for time required to attain desired moisture content, and the data is stipulated in following graph.

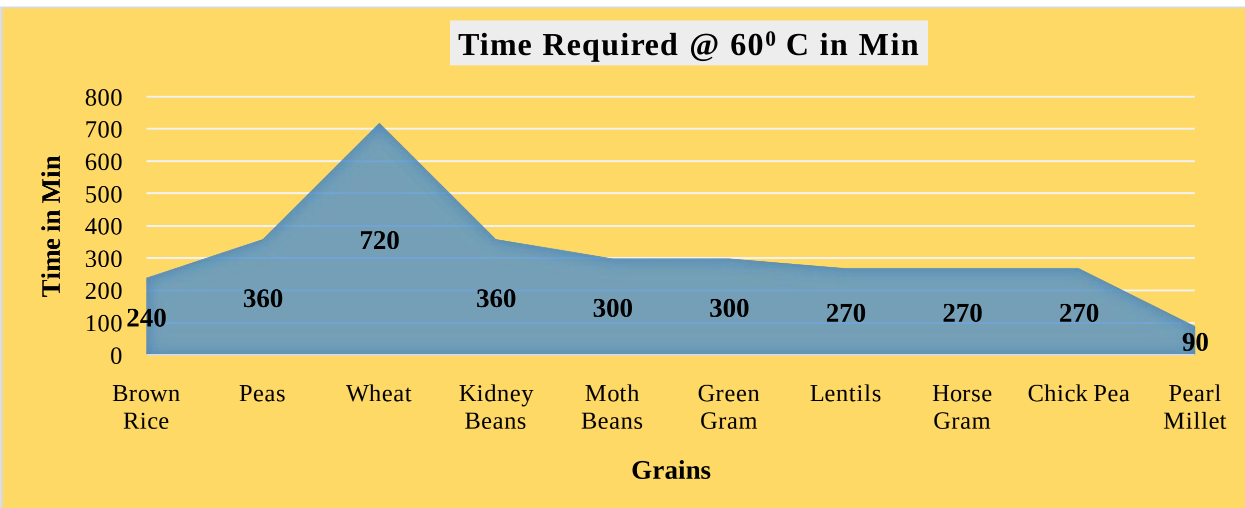

Fig. 2 Dehydration Time of Grains

According to fig no. 2, it could be observed showed that dehydration time varies from 90 min to 720 min, which creates a huge barrier to select random grains for processing. Thus, the grains requires resembling time for dehydration were elected for further processing viz. pearl millet, chick pea, horse gram, green gram, moth beans and lentils. The wheat was eliminated from screening process as it was requiring too much time for dehydration at such a temperature.

1.4Screening on the basis of Rehydration Time

The chosen grains were further fetched for final screening based on rehydration time, which indicates a post facto characteristics of grains and its suitability for inclusion in final recipe of instant sprouts meal.The rehydration time of grains is affected by various physico-chemical

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properties of grains, and the results are narrated in below fig no3.

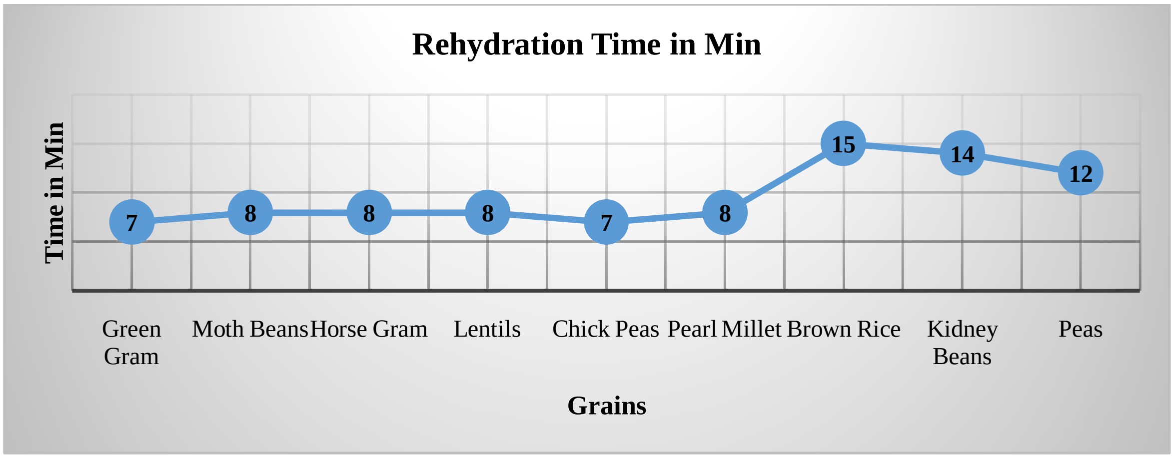

Fig no 3. Rehydration Time of Grains

The rehydration time for grains was varied and found mismatching from only 7 min to 15 min. An ultimate selection of grains was based on rehydration time and thus it makes us responsible to segregate and select the most appropriate grains for development of instant sprouts meal.

2 Chemical Analysis of Instant Sprouts meal

The final recipe of instant sprouts meal was analyzed for chemical composition and the results are noted in below table no. 3.

Table no. 3 Chemical composition of Instant Sprouts Meal

Sr. No.	Test	Value per 100 g	Test Method
1	Moisture(g)	6.93	FSSAI Manual
2	Protein(g)	33.28	FSSAI Manual
3	Fat(g)	1.20	FSSAI Manual
4	Carbohydrate(g)	55.62	IS:1656:2015
5	Dietary fiber(g)	13.52	IS:11062:2010
6	Ash (g)	2.97	FSSAI Manual
7	Calcium	44.11mg	AOAC 944.03
8	Phosphorus	120mg	Spectrophotometer
9	Energy	366.40Kcal	By Calculation

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*Each value is a determination of three tests

According to table no 3 it could be visualized that the instant sprouts meal is a varied nutrient combination, and good source of protein, dietary fiber and minerals. The whole composition scenario depicts as moisture 6.93%, Protein 33.28%, Fat 1.20%, Carbohydrate 55.62%, Dietary fiber 13.52%, Ash 2.97%, Calcium 44.11mg/100g and Phosphorus 120mg/100g.

3 Sensory evaluation of Instant Sprouts meal

The sensory evaluation of instant sprouts meal was conducted by nine point Hedonic Scale, and the results are recorded in below table no. 4.

Table no 4. Sensory evaluation of instant sprouts

Sample	Colour and Appearance	Texture	Odour	Mouth feel	Taste	Flavour	Overall Acceptability
S1	7.5	7	7.5	7	7	6	7.5
S2	6.5	7	6	7	7	7	7
S3	8	7.5	9	8	9	9	9
S4	7	7	6	6	7	6	8

As per the results of sensory evaluation, the sample S3 stands best followed by other and thus was finalized for further investigation. The finalized combination was green gram 20%, moth beans 20%, horse gram 15%, lentils 15%, chickpea 15%, pearl millet 15%, carrot 1.5 and spice mix 3.5%.

Conclusion

The motive behind development of instant sprouts meal was clear and elaborative, to innovate such a product that will meet an yearnings of rushing people as a convenience food, a people who struggles for a tedious process of germination at immiscible altitudes and ultimately of those who are nutrient deficient by providing a boosting source of nutrients. Moreover, the developed product has a great potential to commercialize at vast scale which will create an opportunity for entrepreneurship.

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Workers Perception about Pesticides and Their Ill Effects on Health.

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This paper examines the workers perception about pesticides and their ill effects on health.The study was conducted at Dr. BalasahebSawantKonkanKrishi Vidyapeeth farms in South Konkan Coastal Zone region. The sample constituted of 120 farm growers from 8 farms. The respondents were interviewed with the help of specially designed schedule. It was revealed that, majority of the farm workers (75.00 per cent) opined that, pesticides are 'very harmful', while 23.33 per cent workers pointed out 'moderately harmful' and very few (1.67 per cent) of them said that 'not harmful'. It was also revealed that, all of the farm workers had atleast one symptom of acute pesticide poisoning in the present and previous year immediately after applying or handling pesticides. The most frequently reported symptoms were headaches(70.83 per cent), burning sensation in eyes and face (59.16 per cent), itching (57.50 per cent), sleeplessness and insomnia difficult to breathing (10.83 per cent) and excessive sweating (9.16 per cent), were also reported by the farm workers. The findings concluded that, overall perception level of farm workers about pesticide use and their ill effects on health was found to be satisfactory. It was observed that the perception of farm workers about pesticide use and their ill-effects on health pointed out the need of proper information and knowledge about safety measures during pesticide application for reducing health hazard.

Key words: Workers, Perception,Pesticides, South Konkan, Ill-effects

1. Introduction

Pesticides are chemical compounds that are used to kill pests, including insects, rodents, fungi and unwanted plants, which are widely used in agriculture. Pesticides help in increasing crop production but their in-discriminant use adversely affects the environment and human health. Being one of the principle polluters, victims of pollution, farmers and farm workers are at the top of this risk. The World Health Organization (WHO) and the United Nation Environment Program estimate pesticide poisoning happen rates of per 2-3 minute, with approximate 20,000 workers dying from exposure every year, the majority of the farm workers acknowledge that pesticides are harmful to their health (71.00 per cent) and environment (65.00 per cent).(Kumari; 2013).

Dolores Huerta said, farm workers who know how to do a number of different jobs, whether it be pruning, picking, crafting, and spraying, they see themselves as professionals, and they take a lot of pride in that work. They don't see themselves as doing work that is demeaning. But farm workers are at a very high risk of occupational diseases and injuries dur to exposure to pesticides resulting from inadequate education, training and safety systems. Higher level of education gives pesticides user better access to information and more

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knowledge of the risk associated with pesticides and how to avoid exposure and follow recommended safety and application guidelines. The primary reasons for pesticides injuries and poisoning among agricultural workers include inappropriate use, inadequate knowledge and awareness about handling of pesticides and protective measures. (Magauzi et al. 2011).

Present study focuses on the understanding of the awareness regarding various aspects involved in the handling of pesticides.

2. Objective of the study

Workers perception about pesticides and their ill effects on health.

3. Methodology

The study was purposively conducted at Dr. BalasahebSawantKonkanKrishiVidyapeeth farms at Dapoli, Wakawali, Bhatey, Shirgaon, Lanja (Dist- Ratnagiri), Mulde, Vengurle and Girey (District- Sindhudurg) in South Konkan Coastal Zone of Konkan region. The list of farm workers who undertake the job of spraying of chemicals over the years were obtained from in-charge of various research stations. From the list 120 workers were selected randomly for the study. The data was collected with the help of a specially designed interview schedule by keeping in view the objective of the study. Collected data was classified, tabulated and analysed by using various statistical method. 'Ex-post facto' research design was used to conduct the present study.

4. Result and Discussion

The respondent's perception about pesticide use and their ill effects on health were recorded through personal interview of farm workers. The responses of pesticide applicators to the questions related to this aspect have been recorded in the following table 1.

Table 1. Responses of farm workers during pesticide use.

Sl.no	Particulars	Response (N=120)			
		Yes		No	
		Number	Per cent	Number	Per cent
1.	Do you have any information about pesticide exposure and their harmful effects on your health?	89	74.17	31	26.83
2.	Do you know lack of knowledge, inadequate understanding of toxicity level, unscientific handling practices and poor personal protective mechanisms are directly affects on your health?	116	96.67	4	3.33
3.	Do you take any preventive measures for avoiding pesticide exposure and health risk?	100	83.33	20	16.67
4.	If had any incidence of pesticide poisoning on farm and availability of medical help immediately after the	116	96.67	4	3.33

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	incidence?				
5.	Do you know any first aid measure?	106	88.33	14	11.67

The represented in above table shows that, majority (74.17 per cent) of farm workers have information about pesticide exposure and their harmful effects on health. Large number (96.67 per cent) of workers pointed out lack of knowledge, inadequate understanding of toxicity level, unscientific handling practices and poor personal protective mechanisms directly affect on health. Most (83.33 per cent) of the workers take preventive measures for avoiding pesticide exposure and 16.67 per cent workers do not have any idea about preventive measures. Majority (96.67 per cent) of them experienced some sort of incidence during and after pesticide application but they had medical help after the incidence. Further it was noticed that, 88.33 per cent workers had knowledge about first-aid as first-aid kit is available on every farm.

The opinion of farm workers regarding harmful level of pesticide is given in the following table 2:

Table 2. Opinion of farm workers regarding harmful level of pesticide.

Sl.no	Category (level)	Respondents (N=120)	
		Frequency	Percentage
1.	Not harmful	2	1.67
2.	Moderately harmful	28	23.33
3.	Very harmful	90	75.00
	Total	**120**	**100**

The data presented in table 2 revealed that, majority (75.00 per cent) of farm workers opined that, pesticides are 'very harmful', while 23.33 per cent workers pointed out 'moderately harmful' and very few (1.67 per cent) of them said pesticides are 'not harmful'.

The pesticide exposure and health hazards experienced by farm workers are presented in the following table 3.

Table 3. Pesticide exposure and health hazards experienced by farm workers.

Sl. No.	Particulars	Number	Percentage
1.	Headache	85	70.83
2.	Itching	69	57.50
3.	Skin rashes	22	18.33
4.	Burning sensation in eyes/ face	71	59.17
5.	Blurred vision	15	12.50
6.	Weakness	23	19.17
7.	Excessive sweating	11	9.17
8.	Difficulty in breathing	13	10.83
9.	Nausea/vomiting	21	10.00

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10.	Sleeplessness/insomnia	31	25.83

The data presented in table 3, revealed that, all of the farm workers had atleast one symptom of acute pesticide poisoning in the present and previous year immediately after applying or handling pesticides. The most frequently reported symptoms were headaches (70.83 per cent), burning sensation in eyes and face (59.16 per cent), itching (57.50 per cent), sleeplessness and insomnia (25.83 per cent), skin rashes (18.33 per cent), blurred vision (12.50 per cent), difficulty in breathing (10.83 per cent) and excessive sweating (9.16 per cent), were also reported by the farm workers. In such incidence they took medical help on farm itself or from nearby doctor.

It can be said that, overall perception level of farm workers about pesticide use and their ill effects on health was found to be satisfactory.

5. Conclusion

It was observed that the perception of farm workers about pesticide use and their ill-effects on health pointed out the need of proper information and knowledge about the pesticide exposure, toxicity level of pesticides and also information regarding use of safety measures during pesticide application for reducing health hazards.

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Process Standardization for Preparation of Green Chickpea (*Cicer Arietinum* L.) *Burfi*

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Abstract

Burfi is most popular *khoa* based sweet all over India and likely to attain global status. A number of ingredients, such as nuts, fruits, pulses etc. incorporated in *burfi* to enhance the acceptability of *burfi* to the masses as well as choosy classes.Chickpea is important pulse crop, of the family *Leguminaceae,* it is a good source of carbohydrates and protein, and the protein quality of chickpea is considered to be better than other pulses. It is observed that original plain *burfi* is also lacking in some nutrients and fiber. Considering the nutritional importance and health benefits of chickpea, it was planned to standardize the process for preparation of green chickpea (*Cicer arientinum* L.) *burfi*, using desi green chickpea.

In the optimization of compositional variables, green chickpea *burfi* samples prepared by adopting optimized processing steps using three levels of green chick pea viz., @2(H_1), 4(H_2) and 6(H_3) per cent and two levels of sugar viz., 25 (S_1) and 30 (S_2) per cent. The experiment was optimized as per Factorial Completely Randomized Design. The results showed that out of six treatment combinations, the colour and appearance, flavour, and overall acceptability score was recorded maximum for 4 per cent green chickpea and 25 per cent sugar of *khoa* (H_2S_1).The standardized formulated (4% green chickpea and 25% sugar of *khoa*) greenchickpea *burfi*hadmoisture16.23percent,fat20.32percent,protein15.21percent,reducingsugar19.41percent,non-reducingsugar22.84percent,crudefiber0.30,ash2.67,acidity(%LA) 0.51 and pH 6.20.The quality of *burfi* from the best combination of green chickpea and sugar was further evaluated for suitable fat level in milk viz., 5(F_1), 6(F_2) and 7(F_3) per cent. The product made frommilkcontaining6percentfatsignificantly($P<0.05$)improvedbodyandtexture,flavour and overall acceptability score over the product made from milk containing 5 per cent fat and 7 per centfat.

Forstoragestudytwosampleswasmadei.e.(T_0)*burfi*withoutgreenchickpeaand(T_1) *burfi* added with green chickpea. During storage of *burfi*, the sensory scores for all attributes were decreased significantly ($P<0.05$) in *burfi* samples. The overall acceptability score was decreased from 7.92±0.01 to 6.15±0.01 and 8.26±0.01 to 6.17±0.01 in T_0 and T_1 respectively atthe endofstorageperiod(upto6thdays).Overallacceptabilityscoreof6.0astheminimum desirable for an “acceptance” of product, on the basis of sensory evaluation, the *burfi* incorporated with green chickpea (T_1) and *burfi* without chickpea that is control (T_0) could be stored up to 6th days at room temperature 30±1°C. During storage due to the loss of moisture content the other parameters such as fat, protein, reducing sugar, non-reducing sugar, total ash was slightlyincreased. The standard plate count, yeast and mould count of both samples increased during storage. The SPC counts were increased from 2.92 to 3.81 and 3.76 to 4.33 $\log_{10}$/g in T_0 and T_1, respectively. The growth rate of bacteria was higher in chickpea *burfi* (T_1) than control sample (T_0). There was increase in yeast and mould count from 1.34 to 1.38 and 1.40 to 1.44 $\log_{10}$/g in T_0 and T_1 respectively. The coliform count was found to be nil in both samples upto 6th day ofstorage.

Introduction

India has emerged as the highest milk producing country in world. Milk has unique position in the diet of almost all people in the world. *Khoa* is one of the most important heat desiccated product, it is used as the base material for a large variety of sweet delicacies. *Burfi* is most popular *khoa* based sweet all over India and is preferred one as a premium sweet with a long shelf life of around 7 to 10 days at room temperature. It contains a considerable amount of milk solids. It is an item of choice in daily menu of children and adults. *Burfi* is popular milk- based confection in India and likely to attain globalstatus.The important steps involved in the preparation of *burfi* are desiccation of milk into *khoa* of different consistencies, incorporation of sugar and further desiccation to get the desired consistency and texture. The coloring and flavoring materials, if any are added in the initial or final stages of preparation. The product while still hot and possessing a semisolid consistency is poured into previously prepared molds and then cooled. After cooling, the mass is cut into pieces of required size and shape (BIS 1999). Various forms are made with varying types of additives depending upon regional preference. However, good quality *burfi* is characterized by moderately sweet taste, soft, and slightly greasy body and smooth texture with finegrains.

Burfi may be blended with varieties of nutritionally rich fruits to enhance it’s taste and aroma. There are many varieties of *burfi*, depending on the ingredients mixed with it viz., kaaju *burfi* (made with cashew nuts) and pista *burfi* (made with pistachio) etc. and fruits/ spices added to it, viz., mango *burfi*, coconut *burfi* and cardamom *burfi,* fig *burfi*, sweet orange *burfi*, wood apple *burfi* etc. In some parts of India cereal or pulse are mixed in *burfi* preparation, the most popular are besan *burfi*, moong *burfi*, rava *burfi*, doda*burfi.*

Pulses occupy a unique position in every known system of farming all over the world. Among pulses chickpea (*Cicer arietinum* L.), is the premier pulse crop of India and consumed all over the world. The origin of the chickpeas is thought to have been Levant and ancient Egypt, which is logical since the plant prefers temperate and semiarid regions. It is the member of family Leguminaceae and sub family Papilionaceae. India is the largest chickpea producing countrywithanapproximately productionof6.38MTduring2006-2009.Worldwideover14.2 millions tons of chickpea were harvested in 2014 according to the Food and Agriculture Organization (FAO) of the United Nations. There are two distinct types of cultivated chickpea, Desi and

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Kabuli. Desi (*microsperma*) types have pink flowers, anthocyanin pigmentation on stems, seeds are small, angular with rough brown color testas. The kabuli (*macrosperma*) types have white flowers, lack anthocyanin pigmentation on stem, seeds are relatively large, smooth and cream colored testas. The proximate composition of desi chickpea seed is: protein16.7to30.57percent,fat2.9to7.42percent,crude fiber3.7to13percent,reducingsugar2.61to4.77percent,non-reducing sugar 1.12 to 1.89 per cent and ash 2.04 to 4.2 per cent (Wood and Grusak 2007) [62].

Chickpea is a good source of carbohydrates and protein, together constituting about 80% of the total dry seed mass in comparison to other pulses. The protein quality is considered to be better than other pulses. Chickpea has significant amounts of all the essential amino acids except sulfur containing types, which can be complemented by adding cereals to daily diet. Starch is the major storage carbohydrate followed by dietary fiber, oligosaccharides and simple sugars like glucose and sucrose. Lipids are present in low amounts but chickpea is rich in nutritionally important unsaturated fatty acids like linoleic and oleic acid. β-sitosterol, campesterol and stigmasterol are important sterols present in chickpea oil. Calcium, magnesium, phosphorus and especially potassium are also present in chickpea seeds. It is a good source of important vitamins such as riboflavin, niacin, thiamin, folate and the vitamin A precursor, β-carotene. Chickpea has several potential health benefits and, in combination with other pulses and cereals, it could have beneficial effects on some of the important human diseases like cardiovascular disease, type 2 diabetes, digestive diseases and some cancers. Overall, chickpea is an important pulse crop with a diverse array of potential nutritional and health benefits (Jukanti *et al*., 2012)[18].

There is a growing demand for chickpea due to its nutritional value. Green chickpeas have a more flavorful taste than canned garbanzo beans. They are harvested early and frozen quickly before the natural sugars turn to starch. Green chickpeas are higher in beneficial nutritional categories than common canned blonde garbanzo bean. They are high in fiber, and naturally low in saturated fat, cholesterol and sodium, promoting a healthy heart. Green Chickpea beans contribute to satiety, helping to maintain a healthy weight. They are an excellent source of folate (Vitamin B9) and contain antioxidant vitamins A and C along with good-for-your phytonutrients. They are an all-natural non-allergenic fresh source of protein. The main protein found in chickpeas, similar to other legumes, are albumins and globulins. Smaller amounts of glutelins and prolamines are also present. Green chickpea are NON-GMO. Gluten free and allergen free. Green chickpeas are unique and flavorful taste, making them an exciting, versatile and convenient food product. Consuming green chickpeas in moderation may have additional benefits beyond improving nutrient profile of meals by delaying gastric emptying and slowing carbohydrate absorption.

Green chickpeas also contain dietary bioactives such as phytic acid, sterols, tannins, carotenoids and other polyphenols such as isoflavones whose benefits may extend beyond basic nutrition requirements of human. Green chickpea has a low glycemic index. Diets high in fiber, low in energy density and glycemic load and moderate in protein are thought to be particularly important for weight control. Green chickpeas significantly improve insulin resistance and prevent postprandial hyperglycemia and hyperinsulinemia (Yang *et al*., 2007) [63]. Green chickpea is traditionally incorporated into many culinary creations because of their nut like flavor and versatile sensory application in food. Considering the nutritional importance of green chickpea, the effort has been made to preparation of *burfi* by using greenchickpea.

Materials and Methods

The present investigation was carried out at the Division of Animal Husbandry and Dairy Science, Rajarshee Chhatrapati Shahu Maharaj College of Agriculture, Kolhapur. The whole fresh clean buffalo milk was obtained from the Dairy farm RCSM College of Agriculture, Kolhapur. Good quality cane sugar was procured in single lot from local market of Kolhapur city. Green chickpea (Desi) was procured in single lot from local market of Kolhapur city (M.S.) and stored under refrigeration temperature for better keepingquality.

Preparation of green chickpea paste

Green chickpea was procured in single lot from local market of Kolhapur city (M.S.) and stored under refrigeration temperature. Green chickpea seeds were removed from the chickpea pods and washed under running tap water. The chickpea seeds were dried in open air and required quantity of green chickpea was crushed in mortar and pestle to get fine paste form. This green chickpea paste was used for preparation of green chickpea *burfi*.

Preparation of green chickpea *burfi*

The green chickpea *burfi* was prepared as per the method suggested by Aneja *et al*. (2002) [4] for preparation of plain *burfi* with certain modification. Initially buffalo milk was taken and filtered through muslin cloth, then the milk was standardized to 6 per cent fat.

The standardized milk was then transferred in open pan/*karahi* over a brisk fire. The milk was stirred continuously and side of *karahi* was also scrapped to avoid any scorching or charring of milk solids at the bottom of *karahi*. Vigorous stirring with the help of stirrer was accomplished by scrapping process till the product reached pasty consistency, then temperature was lowered. As the product reached pat formation stage (i.e. leaving the sides of *karahi*), the crushed green chickpea paste was added @ 2, 4 and 6 per cent and sugar @ 25 and 30 per cent of *Khoa*, respectively. The contents were properly mixed and worked on gentle heat for about 5 to 8 minutes to get desired consistency. The product was taken off the flame, transferred into a tray (30x30x1.5 cm) and was allowed to cool and set at room temperature in hygienic condition till it became slightly hard (fig.1).

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Receiving of fresh buffalo milk
↓
Preheating (38-40ºC)
↓
Filtration
↓
Standardization (6% fat)
↓
Heating in open pan with continuous stirring and scrapping while boiling
↓
Khoa (Pat formation stage)
↓
Addition of Green chickpea paste (@ 2, 4 and 6% of *khoa*) and sugar (25 and 30% of *Khoa*)
↓
Contents properly mixed and worked on gentle fire (5-8 min.)
↓
Spreading the mixture in a stainless steel tray (30x30x1.5cm)
↓
Cooling (10-12 hrs at room temperature)
↓
Cutting
↓
Packaging in laminate paper board box
↓
Storage (30±1ºC)

Fig.1 Flow diagram for preparation of Green chickpea *burfi*.

Optimization of Ingredients

For preparation of green chickpea *burfi*, initially three litre of standardized buffalo milk (6 per cent) was used. The quantity of *khoa* obtained from three litre of *khoa* was weighed and same weight will be considered every time to calculate the quantity of ingredients.

Optimization of green chickpea and sugar levels

For this purpose, green chickpea was added at 2, 4, 6 per cent of the *khoa*, while sugar was added at 25 and 30 per cent of the *khoa*. Thus, in all six treatment combinations indicated below were formed andstudied.

H_1S_1 - Green chick pea 2 per cent and sugar 25 per cent
H_1S_2 - Green chickpea 2 per cent and sugar 30 per cent
H_2S_1 - Green chickpea 4 per cent and sugar 25 per cent
H_2S_2 - Green chickpea 4 per cent and sugar 30 per cent
H_3S_1 - Green chickpea 6 per cent and sugar 25 per cent
H_3S_2 - Green chickpea 6 per cent and sugar 30 percent

All these six treatment combinations were analysed for sensory and chemical quality. The best product combination was selected on the basis of sensory quality ofproduct.

Observation and assessment

The results obtained from the present investigation as well as relevant discussion have been summarized under following heads:

1) **Effect of level of green chickpea and sugar on sensory attributes of *burfi***

The sensory evaluation of green chickpea *burfi* is presented in Table 1.

The maximum score for colour and appearance was obtained in the treatment H_2S_1 (8.00) followed by H_2S_2 (7.95), H_1S_1 (7.75), H_1S_2 (7.60), H_3S_1 (7.25) and H_3S_2 (7.02).Further, the statistical effect between the level of green chickpea, sugar and interaction was significant. From the data it is seen that, with increased or decreased level ofgreen chickpea the colour of finished product either become dark or dullgreenwhichwerenotlikedbythejudges.Jadhav(2017) also reported that, the higher level of besan imparts dark unacceptable colour and uneven and low level imparts dull general appearance which decreases acceptability of *burfi*. Similarly, the increased level of sugar resulted in dark brown colour to the *burfi*. Such trend with respect to addition of woodapplepulpandforsugarwasnoticedbySakate(2000)and Reddy *et al*. (1983), respectively.

The average scores for body and texture attribute of green chickpea *burfi* prepared under each treatment were lowest in

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H_3S_2 (7.00) and highest in H_1S_1 (8.18). The observed behavior of treatment could be explained in terms that the soft body of *burfi* was liked by the judges. Body and texture were observed to be smooth in *burfi* having 25 per cent sugar while, with 30 per cent sugar level *burfi* was slightly sticky. The higher level of green chickpea incorporation resulted in moist, sticky, loose body and grainy texture which was not appealing to the judges. Golande *et al.* (2012) [13] also reported that the increased the level of sweet orange juice, lower rating was observed due to, increased level of added sweet orange juice above certain level (10 parts of sweet orange) which formed granular texture in the *burfi* by increasing acidity which was disliked by the judges. Jadhav (2017) [17] observed that the higher level of besan showed moist, sticky, loose body and grainy texture which was was not liked byevaluators.

Mean score for flavour was 7.70, 7.63, 8.00, 7.80, 7.40 and 7.25 for the burfi samples prepared under H1S1, H1S2, H2S1, H2S2, H3S1 and H3S2, respectively. It is well known that the development of a typical nutty flavour to the burfi is by means of presence of fat and release of flavoring components due to heating of protein. The combined effect of these components particularly on flavour of the burfi was most desirable when green chickpea at 4 per cent and sugar 25 per cent level were adjusted in the product.

Further, the level of 2 and 6 percent chickpea in burfi was not liked and judges commented the 2 per cent chickpea level burfi had low flavour and 6 per cent chickpea level had slightly unpleasant flavour. Use of 30 per cent sugar gives more sweetness to burfi because green chickpea already contains total sugar 10.7 per cent so that 25 per cent sugar level selected. Jadhav (2015) [17] also reported that, the khoa burfi with higher level of besan was rancid in taste, whereas, the low level did not render adequate flavour to burfi.

Overall acceptability score was maximum for green chickpea burfi containing 4 per cent chickpea and 25 per cent sugar. Panel of five judges was gives, maximum score for all sensory attributed to the green chickpea burfi containing 4 per cent green chickpea and 25 per cent sugar.

Table 1: Effect of level of green chickpea and sugar on sensory (score*) attributes *burfi*

Treatment	Sensory attributes			
	Colour and appearance	**Body and texture**	**Flavour**	**Overall acceptability**
H_1S_1	7.75±0.03	8.18±0.03	7.70±0.01	7.87±0.04
H_1S_2	7.60±0.03	7.95±0.04	7.63±0.01	7.72±0.01
H_2S_1	8.00±0.02	7.90±0.04	8.00±0.01	7.96±0.01
H_2S_2	7.95±0.02	7.63±0.01	7.80±0.02	7.79±0.01
H_3S_1	7.25±0.03	7.20±0.03	7.40±0.02	7.28±0.02
H_3S_2	7.02±0.02	7.00±0.03	7.25±0.02	7.09±0.01

*Means ± SE of three replications

Table 2: ANOVA for Sensory attributes of *burfi* using different level of chickpea and sugar

Sensory Property	Sources of variation	d.f.	MSS	F value	CD
Colour and Appearance	Between chickpea level (H)	2	1.102	375.11	0.07*
	Between Sugar level (S)	1	0.091	29.50	0.05*
	Interaction (H×S)	2	0.013	4.11	0.10*
	Error	10	0.003	--	--
Body and Texture	Between chickpea level (H)	2	1.466	2687.00	0.03*
	Between Sugar level (S)	1	0.245	449.08	0.02*
	Interaction (H×S)	2	0.002	3.39	NS
	Error	10	0.001	--	--
Flavour	Between chickpea level (H)	2	0.501	344.24	0.04*
	Between Sugar level (S)	1	0.088	60.55	0.04*
	Interaction (H×S)	2	0.006	4.43	0.06*
	Error	10	0.001	--	--
Overall Acceptability	Between chickpea level (H)	2	0.859	2665.67	0.02*
	Between Sugar level (S)	1	0.125	387.93	0.01*
	Interaction (H×S)	2	0.001	2.22	NS
	Error	10	0.000	--	--

*P<0.05 NS= Non-significant

2) Effect of Levels of Green Chickpea and Sugar on Physico-chemical Qualities of*Burfi*

Moisture content of green chickpea burfi varied from 16.20 to 15.21 per cent and it increased with increase chickpea level and decreased with increase in sugar level. Burfi with 6 per cent chickpea and 25 per cent sugar level (H3S1) had maximum moisture while, burfi with 2 per cent chickpea and 30 per cent sugar (H1S2) had minimum moisturecontent. Narwade (2003) also reported that increased level of sugar content resulted in decreased moisture content of peda. Sakate et al. (2004) reported the moisture content in the range of 15.59 to 19.70 per cent in wood apple burfi. Navale et al. (2014) also reported that, increase in addition of wood apple pulp, there was increase in moisture content of burfi. Kamble (2010) observed that, moisture content

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increased in burfi with increased level of pineapple pulp.

Fat content of green chickpea burfi ranged from 20.30 to 19.31 per cent. The maximum fat content was observed in burfi formulated with 6 per cent green chickpea and 25 per cent sugar. Whereas, minimum was observed in burfi containing 2 per cent green chickpea and 30 per cent sugar. These observations indicate that as chickpea level increases the fat increased and sugar level increased fat content decreased.Increase the level of green chickpea increased the fat content in burfi. Kadam (2008) also reported that, increase level of mango pulp the fat content in burfi also increased. This finding are in accordance with Patil et al. (2015) who reported that increase in the level of date paste increase in fat content of burfi. These observations indicate that as chickpea level increases the fat increased and sugar level increased fat content decreased. These finding are in accordance with the finding of Sakate et al. (2004) and Kotade (2001) who reported fat in range of present finding. However, Sharma et al. (1992) reported 26.28 per cent of fat in besan burfi, which was considerably higher than present finding.

The protein content was in the range of 14.16 to 16.41 per cent. The maximum protein content (16.45%) was obtained in burfi formulated with 6 per cent green chickpea and 25 per cent sugar (H3S1). Lower protein was reported in ((H1S2) green chickpea burfi with 2 per cent chickpea and 30 per cent sugar. The protein content is increased with increase in chickpea level and decreased with increase in sugar level. Jadhav (2015) reported that increase in addition of besan level (chickpea flour) the protein content in burfi also increases.This finding was in accordance with Kamble (2010) who reported that increase in the level of fig level increased in protein content of burfi. Kamble (2010) found that, increase the sugar level decrease the protein content in fig burfi.

Reducing sugar content in chickpea burfi under treatment H1S1, H1S2, H2S1, H2S2, H3S1 and H3S2 was 19.25, 19.21, 19.41, 19.04, 19.71 and 19.21 per cent, respectively. Increase in reducing sugar content with increase in chick pea level. Statistically it was observed that the effect of green chickpea level had positive significant effect on increase in reducing sugar content of green chickpea burfi. The sugar also had significant effect on reducing sugar but in negative way. Statistically it was observed that the effect of green chickpea level had positive significant effect on increase in reducing sugar content of green chickpea burfi. The sugar also had significant effect on reducing sugar but in negative way. The typical trend observed for reducing sugar content of various treatment combination may be attributed to the fact that green chickpea contains reducing sugar. Wood and Grusak (2007) reported that desi green chick pea seed contain reducing sugar 2.61 to 4.77 per cent. These reports support the present trend of increase in reducing sugar content with increase in chickpea level. Sakate et al. (2004) also reported that increase the level of addition of wood apple pulp, the reducing sugar content was also increased in burfi. This finding was in accordance with Kadam (2008) who reported that, increase level of mango pulp, increased in reducing sugar content of burfi. Kamble (2010) also observed that, increase in sugar level there was decrease in reducing sugar content of burfi.

Sample containing 2 per cent green chickpea and 25 per cent sugar (H1S1) had minimum content of non-reducing sugar, that is 22.68 per cent. Whereas, it was maximum i.e. 27.32 percent in formulation with 6 per cent green chickpea and 30 per cent sugar (H3S2). From the observed trend of non-reducing sugar, it is very clear that increase in sugar level resulted in increase in non-reducing sugar of green chickpea burfi. Whereas, it was maximum in formulation with 6 per cent green chickpea and 30 per cent sugar. From the observed trend of non-reducing sugar, it is very clear that increase in sugar level resulted in increase in non-reducing sugar of green chickpea burfi. The present finding was accordance with reports of Sakate et al. (2004) and Kotade (2001) in burfi prepared by using fruits.

Crude fiber content in green chickpea burfi under treatment H1S1, H1S2, H2S1, H2S2, H3S1 and H3S2 was 0.15, 0.13, 0.30, 0.27, 0.45 and 0.41 per cent. Highest crude fiber reported in H3S1 that was 0.45 per cent and minimum H1S2. The increase in green chickpea level increase in crude fiber content. The effect of green chickpea and sugar was significant.

The highest ash content (2.75 per cent) was observed in burfi prepared using 6 per cent chickpea and 25 per cent sugar (H3S1). The lower ash content (2.56 per cent) was observed in (H1S2) 2 per cent green chickpea and 30 per cent sugar. The effect of green chickpea and sugar was significant. These reports support the present trend of increase in ash content with increase in green chickpea level. These reports support the present trend of increase in ash content with increase in green chickpea level. The increase in chickpea level increase in ash content and increase in sugar level decrease in ash content. The present finding are in accordance with the reports of Kamble (2010) for fig burfi and Patil et al. (2015) for date burfi.

The acidity (% LA) of green chick pea burfi was ranged from 0.49 to 0.53. The lowest acidity in burfi added with 2 per cent green chickpea. The highest acidity was recorded in burfi with 6 per cent green chickpea. Increase in chickpea level increase in acidity. The effect of green chickpea was significant but sugar has non-significant effect. The interaction effect was non-significant. Patil (2012) was reported the titrable acidity of date burfi increased with increase in level of date. This finding are in accordance with Kadam (2008) and Navale et al. (2014) who reported that increase in level of mango pulp and wood apple pulp the acidity was increased in burfi, respectively.

The pH of green chickpea added burfi was ranged from 6.23 to 6.18. The lowest pH was recorded for formulation which has 6 per cent green chickpea. The highest pH recorded for formulation which has 2 per cent green chickpea. The effect of sugar was non-significant.

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Table 4.5 Combined effect of green chickpea and sugar level on physico-chemical constituents of *burfi*

Treatment	Physico-chemical constituents								
	Moisture (%)	Fat (%)	Protein (%)	Reducing sugar (%)	Non-reducing sugar (%)	Crude fiber (%)	Ash (%)	Acidity (%LA)	pH
H_1S_1	16.20 ±0.01	20.30 ±0.01	14.16 ±0.02	19.25 ±0.01	22.68 ±0.02	0.15 ±0.01	2.59 ±0.01	0.49 ±0.04	6.23 ±0.01
H_1S_2	15.10 ±0.02	19.10 ±0.02	14.01 ±0.01	19.21 ±0.07	26.17 ±0.02	0.13 ±0.01	2.56 ±0.01	0.49 ±0.04	6.23 ±0.01
H_2S_1	16.23± 0.02	20.32 ±0.01	15.21 ±0.02	19.41 ±0.02	22.84 ±0.01	0.30 ±0.01	2.67 ±0.01	0.51 ±0.01	6.20 ±0.01
H_2S_2	15.14± 0.02	19.24 ±0.02	15.12 ±0.01	19.04 ±0.05	26.76 ±0.01	0.27 ±0.01	2.65 ±0.02	0.51 ±0.01	6.20 ±0.01
H_3S_1	16.27 ±0.01	20.34 ±0.01	16.45 ±0.01	19.71 ±0.04	22.87 ±0.03	0.45 ±0.03	2.75 ±0.04	0.53 ±0.04	6.18 ±0.02
H_3S_2	15.21 ±0.02	19.31 ±0.02	16.41 ±0.02	19.21 ±0.06	27.32 ±0.03	0.41 ±0.01	2.70 ±0.02	0.53 ±0.04	6.18 ±0.02

Means ± SE of threereplications

Table: 4.6 ANOVA for Physico-chemical constituents of *burfi* using different level of chickpea and sugar

Chemical Constituents (%)	Sources of variation	d.f.	MSS	F value	CD
Moisture	Between chickpea level (H)	2	0.012	2.64	NS
	Between Sugar level (S)	1	5.260	1127.33	0.07*
	Interaction (H×S)	2	0.001	0.16	NS
	Error	10	0.018	--	--
Fat	Between chickpea level (H)	2	0.025	11.92	0.05*
	Between Sugar level (S)	1	5.424	2600.43	0.04*
	Interaction (H×S)	2	0.012	5.76	0.08*
	Error	10	0.002	--	--
Protein	Between chickpea level (H)	2	6.772	157784.28	0.008*
	Between Sugar level (S)	1	0.084	1948.65	0.006*
	Interaction (H×S)	2	0.026	605.19	0.01*
	Error	10	0.000	--	--
Reducing sugar	Between chickpea level (H)	2	0.107	82.50	0.04*
	Between Sugar level (S)	1	0.411	318.07	0.03*
	Interaction (H×S)	2	0.083	64.52	0.06*
	Error	10	0.001	--	--
Non-	Between chickpea level (H)	2	0.682	11110.06	0.01*

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reducing sugar	Between Sugar level (S)	1	70.302	1145193.07	0.008*
	Interaction (H×S)	2	0.338	5504.60	0.01*
	Error	10	0.000	--	--
Crude Fiber	Between chickpea level (H)	2	0.128	1493.40	0.01*
	Between Sugar level (S)	1	0.004	51.95	0.009*
	Interaction (H×S)	2	0.000	4.18	0.01*
	Error	10	0.000	--	--
Ash	Between chickpea level (H)	2	0.036	1300.66	0.006*
	Between Sugar level (S)	1	0.006	199.70	0.005*
	Interaction (H×S)	2	0.000	15.03	0.009*
	Error	10	0.000	--	--
Acidity (%LA)	Between chickpea level (H)	2	0.002	219.03	0.004*
	Between Sugar level (S)	1	0.000	0.00	NS
	Interaction (H×S)	2	0.000	0.00	NS
	Error	10	0.000	--	--
pH	Between chickpea level (H)	2	0.003	79.37	0.007*
	Between Sugar level (S)	1	0.000	0.00	NS
	Interaction (H×S)	2	0.000	0.00	NS
	Error	10	0.000	--	--

*P<0.05 NS=Non-significant

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3) Optimization of FatLevel

a) Effect of level of fat on sensory attributes of green chickpea*burfi*

The score for colour and appearance ranged from 7.67 to 7.80. The product made from milk containing 6 per cent fat significantly (P<0.05) improved body and texture, flavour and overall acceptability over the product made from milk containing 5 per cent fat and 7 per cent fat. The overall acceptability scores for the product prepared from 5, 6 and 7 per cent fat containing milk were 7.32, 8.12 and 7.96 respectively. In low fat (5 per cent) product, judges experienced slightly less mouth feel, rough body and course texture, slightly dull appearance and rated as liked moderately to liked very much. Such observation is also noted by Sachdeva and Rajorhia, (1992).

Table 3 Effect of level of fat on sensory attributes of green chickpea *burfi*

Treatment	Scores for sensory attributes			
	Colourand appearance	Body and texture	Flavour	Overall acceptability
F1	7.67±0.01	7.05^{a}±0.02	7.24^{a}±0.01	7.32^{a}±0.01
F2	8.17±0.03	8.14^{c}±0.01	8.07^{b}±0.01	8.12^{c}±0.02
F3	7.80±0.03	7.90^{b}±0.03	8.20^{c}±0.02	7.96^{b}±0.01
CD (P<0.05)	NS	0.10	0.10	0.004

From the foregoing results, it was concluded that there was marginal difference in sensory score for green chickpea burfi prepared from milk with 6 and 7 per cent fat. Morever, burfi with high fat content will be quite expensive. In view of this buffalo milk with minimum 6 per cent fat is recommended for preparation of green chickpea burfi. Sachedeva and Rajorhia (1982) have also reported a optimum level of 6 per cent fat in milk for preparation of burfi, which corroborate with results of present investigation. Kamble and patange (2014) also optimized 6 per cent fat in milk for preparation of fig burfi.

4) Sensory evaluation of Stored Green Chickpea Burfi

On first day, scored 7.46 ± 0.01 for control and 8.20 ± 0.02 for chickpea burfi, which was higher than control, which gave an indication that the samples were highly acceptable with respect to colour and appearance. The colour and appearance scores were decreased from 7.46±0.01 to 6.11±0.01 and 8.20±0.02 to 6.16±0.02 in T0 and T1, respectively. Overall, the storage period, treatment given and their interaction showed a significant (P<0.05) effect on colour and appearance scores. The rate of decline in

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colour and appearance scores for control burfi (T0) is slightly higher than chickpea burfi (T1) and rated 6.11±0.01 for T0 and 6.16±0.02 for T1 of 6th days of storage.The rate of decline in colour and appearance scores for control burfi (T0) is slightly higher than chickpea burfi (T1) the score 6.11±0.01 for T0 and 6.16±0.02 for T1 of 6th days of storage, because they became drier in appearance and lacked the greasy appearance on the surface of product desired. The present observation is in accordance with Vijayalkashmi et al. (2005). Decreased in the score for colour and appearance during storage of fig burfi was also reported by Kamble (2010).

Body and texture score were found to be decreased from 7.85±0.01 to 6.13±0.01 and 8.15±0.02 to 6.16±6.16 in T0 and T1 respectively. Statistically, the effect of period, treatment and their interaction were also significant (P<0.05). The rate of decline in body and texture score was slower in green chickpea burfi as compare to control.There was slightly decrease in score for body and texture in T0 and T1, due to at room temperature the integrity of grains remained intact, but the grains become harder and chewier becoming conspicuous in the product as the moisture content reduces. Declined body and texture score of burfi during storage also reported by Reddy (1985) and Solanki et al. (2002) and Kamble (2010) and Shrivas et al. (2018) for burfi.

The flavour score for stored green chickpea burfi were decreased significantly (P<0.05) during storage at 30±1C. The rate of decline was higher in T1 than T0 samples. The score for flavour was found to be decreased from 8.45±0.02 to 6.21±0.01 and 8.43±0.01 to 6.19±0.02 in T0 and T1 respectively. Despite decreasing trends, the samples had score between 6 was liked slightly like on 6th day. Despite decreasing trends, the samples had score between 6 was liked slightly like on 6th day. The decrease in flavour score may be attributed to slight loss of freshness, and flavour become stale. The decrease in flavour score of burfi during storage was also reported by Reddy (1985), Bhatele (1983) and sarkar et al. (2002) in different types of burfi samples.

The overall acceptability score was decreased from 7.92±0.01 to 6.15±0.01 and 8.26±0.01 to 6.17±0.01 in T_0 and T_1 respectively at the end of storage period. Overall acceptability scoreof6.0 as the minimum desirable for an "acceptance" of product, the product T_0 and T_1 could be stored up to 6 days at room temperature respectively.

Table 4 Changes in score* for Colour and appearance of green chickpea *burfi* during storage at 30±1^{o}C

Sensory attributes	Treatment	Storage periods(days)				
		0	2	4	6	8
Colour and appearance	T_0	7.46±0.01	7.42±0.01	7.37±0.01	6.11±0.01	--
	T_1	8.20±0.02	8.12±0.02	7.41±0.03	6.16±0.02	--
Body and texture	T_0	7.85±0.01	7.83±0.02	7.80±0.02	6.13±0.01	--
	T_1	8.15±0.02	8.11±0.01	7.85±0.02	6.16±0.02	--
Flavour	T_0	8.45±0.02	8.20±0.02	7.85±0.02	6.21±0.01	--

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	T_1	8.43±0.01	8.17±0.02	7.81±0.02	6.19±0.02	--
Overall acceptability	T_0	7.92±0.01	7.81±0.03	7.67±0.01	6.15±0.01	--
	T_1	8.26±0.01	8.13±0.02	7.69±0.01	6.17±0.01	--

*Means ± SE of three replications

Table 5 ANOVA for changes in sensory attributes of stored green chickpea *burfi* during storage at 30±1°C

Sensory attributes	Source of variation	DF	MSS	F value	CD ($p<0.05$)
Colour and appearance	Between period	4	66.41	966042.65	0.010*
	Between treatment	1	0.72	10430.44	0.006*
	Interaction	4	0.22	3154.86	0.014*
	Error	18	0.00	--	--
Body and texture	Between period	4	70.83	1733744.90	0.007*
	Between treatment	1	0.13	3263.53	0.004*
	Interaction	4	0.03	783.80	0.011*
	Error	18	0.00	--	--
Flavour	Between period	4	75.06	806269.76	0.016*
	Between treatment	1	0.00	43.86	0.007*
	Interaction	4	0.00	4.27	0.016*
	Error	18	0.00	---	--
Overall acceptability	Between period	4	70.67	3755581.16	0.005*
	Between treatment	1	0.15	7781.12	0.003*
	Interaction	4	0.05	2411.09	0.007*
	Error	18	0.00	---	--

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5) Physico-chemical Changes in Stored Green Chickpea*Burfi*

The moisture content of chickpea *burfi* of T_0 and T_1 reduced from 16.10 to 14.99 and 16.23 to 15.00, respectively. The average moisture per centage for T_0 were recorded 16.10, 15.78, 15.56 and 14.99 per cent on 0, 2, 4 and 6 days of storage, respectively. Whereas in T_1 these were 16.23, 15.85, 15.61 and 15.00 per cent for above saidperiod. . Loss in moisture content in *burfi* during storage was also reported by Khan *et al*. (2008), Gupta *et al*. (2010) and Kamble (2010) in groundnut *burfi*, coconut *burfi* and pineapple *burfi*, respectively. Shobha and Bharati (2007) reported that *burfi* had moisture content of 17.58 per cent which was steadily decreased with increase in storage period.

The fat content during storage in T_0 and T_1 were 20.15, 20.17, 20.17 and 20.18 and 20.32, 20.32, 20.35 and 20.37 respectively. The fat content was slightly increased during storage period in T_0 and T_1. The effect of storage period and treatment were found to be statistically significant ($P<0.05$). Fat content of T_0 and T_1 samples slightly increase from 20.15 to 20.18and20.32 to 20.37, respectively on storage days 0, 2, 4 and 6 days. Shrivas *et al.* (2018) also observed the increasing fat content during storage of rava *burfi*. The increase in fat content could be attributed to the decrease in moisture content with increase in storage period. The moisture loss during storage with increase in content of fat at room temperature, is a natural phenomenon as reported by severalworkers.

The protein content during storage in T_0 and T_1 were 14.37, 14.42, 14.51 and 14.54 and in T_1 were 15.21, 15.31, 15.37 and 15.41 on 0, 2, 4 and 6th day of storage, respectively. The effect of storage period and treatment were found to be statisticallysignificant ($P<0.05$). The slightly increase in protein content over storage period may be due to loss of moisture from all the samples. Similar findings were reported by Shrivas *et al.*, (2018) for rava *burfi* they reported that increase in protein content could be attributed to the decrease in moisture content with increase in storageperiod.

The reducing sugar content of fresh chickpea *burfi* samples were 19.32 (T_0) and 19.42 (T_1). The effect of storage period and treatment were found to be statistically significant ($P<0.05$). The rate of slightly increase in reducing sugar content of *burfi* from initial value of 19.32 to 19.42 from 0, 2, 4 and 6 days of storage period in T_0 and 19.42 to 19.55 in T_1 on same days of storage.

The effect of storage period and treatment were found to be statistically significant ($P<0.05$). The initial non-reducing sugar value of chickpea *burfi* were 26.36 and 22.84 in T_0 andT_1 respectively. During storage, there was slightly increase in non-reducing sugar contentof*burfi*inT_0were26.36,26.40,26.46and26.54andinT_1were22.84,22.87,22.89and22.94on0, 2, 4 and 6th days of storage period.

The acidity increased in all the samples during storage period. The effect of storage period and treatment were found to be statistically significant ($P<0.05$). The acidity was increased from 0.32, 0.36, 0.37 and 0.39 for T_0 and 0.51, 0.55, 0.57 and 0.60 for T_1 on 0, 2, 4, and 6 days of storage. The acidity is higher in T_1 as compare to T_0samples.

Earlier Palit and Pal (2005), Sarakar *et al*. (2002), and Solanki *et al*. (2002) were observed similar trend in acidity development during storage of *burfi*.

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The pH of fresh chickpea *burfi* samples was 6.03 (T_0) and 6.20 (T_1). It decreased during storage period in all samples but at different rate. The effect of storage period and treatment were found to be statistically significant (P<0.05). In T_0, the rate of decrease was rapid pH from initial value of 6.03 to 5.65 and in T_1 6.20 to 5.77 during storage at 30 ± 1^0C.The effect of storage period and treatment were found to be statistically significant (P<0.05). In T_0, the rate of decrease was rapid pH from initial value of 6.03 to 5.65 and in T_1 6.20 to 5.77 during storage at 30 ± 1^0C. Kumar *et al*. (1997) also reported decrease in pH of peda during storage for 180 days at 20°C

The effect of storage period and treatment was significant. There was slightly increase in ash content of, samples were 2.60, 2.61, 2.64 and 2.67 and 2.66, 2.69, 2.72 and 2.75 in T_0 and T_1 on 0, 2, 4 and 6 days of storage respectively.. Shrivas *et al*. (2018) and Kamble (2010) reported increased ash content of *burfi* duringstorage.

Table 6 Physico-chemical Changes in Stored Green Chickpea*Burfi*

Physico-chemical attributes	Treatment	Storage periods(days)				
		0	2	4	6	8
Moisture	T_0	16.10±0.1	15.78±0.04	15.56±0.04	14.99±0.02	--
	T_1	16.23±0.01	15.85±0.01	15.61±0.02	15.00±0.02	--
Fat	T_0	20.15±0.02	20.17±0.02	20.17±0.02	20.18±0.02	--
	T_1	20.32±0.01	20.32±0.01	20.35±0.03	20.37±0.02	--
Protein	T_0	14.37±0.02	14.42±0.02	14.51±0.02	14.54±0.03	--
	T_1	15.21±0.02	15.31±0.02	15.37±0.03	15.41±0.01	--
Reducing sugar	T_0	19.32±0.01	19.36±0.03	19.39±0.01	19.42±0.01	--
	T_1	19.42±0.01	19.46±0.02	19.50±0.01	19.55±0.01	--
Non-reducing sugar	T_0	26.36±0.02	26.40±0.04	26.46±0.04	26.54±0.09	--
	T_1	22.84±0.02	22.87±0.01	22.89±0.04	22.94±0.02	--

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Acidity(% LA)	T_0	0.32±0.01	0.36±0.01	0.37±0.02	0.39±0.02	--
	T_1	0.51±0.01	0.55±0.02	0.57±0.02	0.60±0.03	--
pH	T_0	6.03±0.06	5.96±0.01	5.80±0.02	5.65±0.02	--
	T_1	6.20±0.02	6.05±0.05	5.89±0.02	5.77±0.02	--
Ash	T_0	2.60±0.02	2.61±0.03	2.64±0.02	2.67±0.02	--
	T_1	2.66±0.02	2.69±0.02	2.72±0.03	2.75±0.02	--

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Table 7ANOVA for physico-chemical changes in green chickpea *burfi* during storage at 30±1°C

Physico-chemical attributes	Source of variation	DF	MSS	F value	CD (p<0.05)
Moisture	Between period	4	294.58	291932.83	0.03*
	Between treatment	1	0.02	21.25	0.02*
	Interaction	4	0.00	4.01	0.05*
	Error	18	0.006	--	--
Fat	Between period	4	492.26	237616.21	0.055*
	Between treatment	1	0.14	69.01	0.034*
	Interaction	4	0.01	4.48	0.078*
	Error	18	0.00	--	--
Protein	Between period	4	266.18	3022178.22	0.011*
	Between treatment	1	3.61	40935.24	0.007*
	Interaction	4	0.23	2565.59	0.016*
	Error	18	0.00	---	--
Reducing sugar	Between period	4	452.95	419984.86	0.012*
	Between treatment	1	0.06	560.79	0.008*
	Interaction	4	0.00	37.68	0.017*
	Error	18	0.00	---	--
Non-reducing sugar	Between period	4	729.91	2114011.84	0.022*
	Between treatment	1	60.65	175660.87	0.014*
	Interaction	4	3.79	10983.57	0.031*
	Error	18	0.00	--	--
Acidity (%LA)	Between period	4	0.26	3581.74	0.010*
	Between treatment	1	0.19	2652.26	0.006*
	Interaction	4	0.01	167.17	0.014*
	Error	18	0.006	--	--
pH	Between period	4	42.18	192604.11	0.017*
	Between treatment	1	0.06	296.65	0.011*

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	Interaction	4	0.01	27.33	0.025 *
	Error	18	0.00	--	--
Ash	Between period	4	8.54	82098.62	0.012 *
	Between treatment	1	0.03	271.09	0.007 *
	Interaction	4	0.00	18.30	0.017 *
	Error	18	0.00	--	--

6) Microbial Changes in Stored Green Chickpea*Burfi*

a) Standard plate count

The data regarding in standard plate count (SPC) of stored chickpea *burfi* is given in Table 8. According to BIS (IS: 5520:2005) standards laid down for *burfi*, the standard plate count should not be more than 30,000/g. The standard plate count is also called as Aerobic Plate Count. This test is not a measure of the entire bacterial population it is a generic test for organisms that grow aerobically at mesophilic temperatures (25 to 40^{0}C). It is revealed from Table 4.33 that on first day, standard plate count was 2.92 and 3.76 $\log_{10}$/g for T_0 and T_1 respectively. The SPC counts were increased from 2.92 to 3.81 and 3.76 to 4.33 in T_0 and T_1, respectively. The growth rate of microbes was higher in chickpea *burfi* (T_1) than control sample (T_0). The increase in SPC with progressive storage might be attributed to the post process contamination during handling.

Table 8 Microbial Changes in Stored Green Chickpea*Burfi*

Microbial count	Treatment	Storage periods(days)				
		0	2	4	6	8
standard plate count (log10/g)	T_0	2.92±0.02	3.01±0.02	3.40±0.04	3.81±0.02	--
	T_1	3.76±0.03	3.80±0.04	4.14±0.06	4.33±0.03	--
yeast and mould count (log10/g)	T_0	NIL	NIL	1.34±0.03	1.38±0.03	--
	T_1	NIL	NIL	1.40±0.03	1.44±0.03	--
Coliform count (log10/g)	T_0	NIL	NIL	NIL	NIL	--
	T_1	NIL	NIL	NIL	NIL	--

The mean values presented in table 9, reveals that SPC were significantly (P≤0.05) influenced by storage period. The interaction effect of storage period and treatment had shown significant effect on standard plate count of chickpea *burfi.* Sachdeva and Rajorhia (1982) reported increase in SPC during storage of *burfi* at 30±2°C and 7±2°C. Other workers also reported increasing standard plate count of *burfi* during storage Garg and Mandokhot, (1984), Misra and Kuila, (1988) and Shrivas *et al*. (2018).

Table 9 ANOVA for changes in microbial count of green chickpea *burfi* during storage at30±1°C

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Microbial count	Source of variation	DF	MSS	F value	CD ($p<0.05$)
SPC (log10/g)	Between period	4	16.48	67008.10	0.019*
	Between treatment	1	2.52	10235.62	0.012*
	Interaction	4	0.18	732.62	0.026*
	Error	18	0.00	--	--
YMC (log10/g)	Between period	4	3.48	24784.29	0.014*
	Between treatment	1	0.01	37.99	0.009*
	Interaction	4	0.00	14.25	0.020*
	Error	18	0.00	--	--

b) Yeast and mould count

For most of the Indian dairy foods such as peda, *burfi*, kalakand etc. mould growth tends to be a major problem and often most important single factor limiting their shelf life. According to BIS (IS: 5550: 2005) standards the yeast and mould count for *burfi* should not be more than 10/g of *burfi.*

The mean values regarding yeast and mould count (YMC) during storage of chickepea *burfi* are represented in Table 4.35. The YMC count was found to be nil up to 2nd day of storage. During further storage of chickpea *burfi*, increase in yeast and mould count up to 4 and 6 days in T_0 and T_1 respectively and thereafter the product was found unacceptable due to visible mould growth. There was increase in yeast and mould count from 1.34 to 1.38 and 1.40 to 1.44 $\log_{10}$/g in T_0 and T_1respectively.The colonies obtained in the present study at room temperature storage i.e. 30 ± 1^0C were white and green colonies. The number of fungal colonies obtained during present investigation were similar to various researchers who analyzed the product like pedha, *burfi*, kalakand. Biradar *et al*. (1985). Sachdeva and Rajorhia (1982), Kamble (2010) and Kuchi *et al.* (2017) reported increase in yeast and mould count during storage of *burfi* at $30\pm2^{\circ}$C.

c) Coliform Count(CC)

In the present study, coliforms count was absent in the samples of treatment T_0 and T_1 during storage. Kumar *et al.* (1997), Palit and Pal (2005) and Shrivas *et al*. (2018) also support the present finding of absence of coliform in *peda* and *burfi*, respectively during processing and storage.

Conclusion

From the present study it was concluded that, the most sensorial acceptable quality of green chickpea *burfi* can be prepared by using 6 per cent standardized buffalo milk, 4 per cent green chickpea and 25 per cent sugar of *khoa.*The standardized formulated (4% green chickpea and 25% sugar of *khoa*) green chickpea *burfi* had moisture 16.23 per cent, fat 20.32 per cent, protein 15.21 per cent, reducing sugar 19.41 per cent, non-reducing sugar 22.84

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per cent, crude fiber 0.30, ash2.67, acidity (% LA) 0.51 and pH -6.20.During storage of *burfi*, the sensory scores for all attributes were decreased significantly ($P<0.05$) in two samples. On the basis of sensory evaluation, the *burfi* incorporated with green chickpea and *burfi* without chickpea that is control could be stored up to 6th days at room temperature 30±1°C. During storage due to the loss of moisture content the other parameters such as fat, protein, reducing sugar, non-reducing sugar, total ash was slightly increased. The standard plate count, yeast and mould count in *burfi* was increased during storage. Coliform count wasabsent.

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Training Needs of Farm Input Dealer about Farm Input

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ABSTRACT

The present study on Training Needs of Farm Input Dealers About Farm Input was conducted in Akola and Wardha districts of Vidarbha region of Maharashtra state. For this study 70 dealers were purposively selected from ten tahsils from both districts with the help of proportionate sampling method. The data were collected with the help of structured interview schedule. Personal interview technique was used for data collection.All 100.00 per cent farm input dealers did 'not received' training on various aspect related to fertilizers, seeds, insecticides, pesticides and implements. Majority (68.00%) of the farm input dealers had 'medium' level of knowledge related to use of seeds, fertilizers and pesticides.In respect of training needs, farm input dealers had expressed 'high' training needs on seed technology, different insecticides and pesticides its contents, concentration to be used storage and keeping quality of insecticides, pesticides and fertilizers, etc. (97.14%), followed by advanced technical information of new agricultural inputs (94.28%), training about credit/financial management and government policies, rules regulations and taxes related agriculture having 98.57 per cent.

Results of relational analysis revealed that variables such as land holding, annual income, source of information, extension

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contact, cosmopoliteness and innovativeness were found positively and significantly correlated with training needs of farm input dealers.In case of other variables like age, social participation and knowledge had shown negative non-significant relationship with training needs of farm input dealers.

1. INTRODUCTION

Indian economy is basically an agrarian economy as about 64% of the population is dependent on agriculture and quite a large proportion of the national income is generated in this sector. Substantial progress has been made in recent years and the country has become self sufficient in food grains. However, the proportion of persons depending on agriculture has not been changed much during the last 3-4 decades in spite of the development programmes. Efforts are being made by the government under five year plan programmes to develop agriculture.

Several factors have played a role in the development of agriculture in the country. The use of high-pay inputs like high yielding varieties seeds, fertilizers, pesticides, irrigation, etc., have helped is bringing about the ‘Green Revolution’ in agriculture. Though the role of these inputs was recognized long back, there were many constraints were slowly overcome. India being a vast country with varying situation and lack of infrastructure facilities, supply of key inputs in agriculture to the doors of farmers is a difficult task. However, the major sources of supply of farm inputs to the farmers are the dealers. These dealers mostly supply seeds, fertilizers and pesticides to the farmers.

Modernization of agriculture involves mainly three things. First to evolve suitable agricultural technology, second transfer of technology and third one is acceptance or adoption of technology. The most of the farm input dealers are related to the transfer of farm technology. While trading the farm inputs, dealers advise the

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farmers about their use and application in the field. Farm input dealers by this way perform the function of the "Change Agent".

India has around three lakh agricultural input dealers (Anonymous 2011). Farm input dealers are also playing an important role in increasing agricultural production in the country. Because they affects the farmers adoption behavior regarding the use of agricultural technology. There are number of economical, social and psychological factors which influence training need of agricultural input dealers as far as selling of agricultural input is concerned. The main aim of input dealers is to sale agricultural inputs according to local needs i.e. quality seeds, fertilizers, pesticides, and input material. The marketing of agricultural inputs does not only help the dealers to increase their profitability but also facilitate to get all the input requirements under the one roof. And the subsidiary roles played by agricultural input dealers are to provide expert services, advice to farmers. These, input dealers plays a vital role to boost up the agricultural production. So it is felt necessary to study the training need of agricultural input dealers.

1.2 **OBJECTIVES**

Keeping in view the importance, scope and statement of problem of the topic, the present investigation entitled 'Training Needs of Farm Input Dealers About Farm Input in both Akola and Wardha Districts of Vidarbha Region' was undertaken with the following objectives.

1. To determine the training needs and decide the areas of training.

1.3 METHODOLOGY

The study was conducted purposively in Wardha and Akola districts in Vidarbha region of Maharashtra State.The Wardha district consists of eight tahsils. Out of these five tehsils were selected on random basis namely, Wardha city, Arvi, Deoli, Hinganghat and Seloo.

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The Akola district consist of seven tehsils. Out of these five tehsils were selected on random basis namely, Akola, Pathur, Barshitakli, Balapur and Akot.A list of licenses issued to the farm input dealers in the tahsils of Wardha and Akola districts was obtained from Agricultural Development Officer, Zilla Parishad of both the districts. Ten tahsils were selected from both the districts. Thus, 10 tahsils comprises the said study, 5 Agro Service Centre from each selected tahsils were selected. In all 50 Agro Service Centre from 10 tahsils and 20 Agro Service Centre from 2 district Headquarters thus, in all 70 Agro Service Centre were selected to the study.An exploratory research design of social research was used for present study.

2. RESULTS AND DISCUSSION

2.1.1Training needs of the farm input dealers in relation to farm inputs

Training need was operationally defined as expressed opinions of the farm input dealers with respect to different training areas of farm input dealership.

Table 1. Specific training needs of farm input dealers

Sl. No.	Training areas	No. of Respondents (n=70)	
		Frequency	Percentage
A	**Technical need**		
1	Seed technology	68	97.14
2	Fertilizers types, doses, method of application and storage quality, etc.	61	87.14
3	Bio-agents importance, use, storage, utility, availability, application, etc.	64	91.42
4	Proper knowledge about technical language.	60	85.71
5	Advanced technical information of new agricultural inputs	66	94.28
6	Availability of publications and records	65	92.85
7	Different insecticides and pesticides its	68	97.14

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	contents, concentration to be used		
8	Storage and keeping quality of insecticides, pesticides and fertilizers, etc.	68	97.14
B	**Financial need**		
1	Training about credit/financial management	69	98.57
2	Government policies, rules regulations and taxes related agriculture.	69	98.57
3	Government subsidies on different agricultural input	63	90.00
4	Other	14	20.00
C	**Social need**		
1	Development of good rapport with farmers, government and private organizations.	63	90.00
2	To convey the proper information to the farmers regarding agricultural technology	67	95.71
3	Agricultural input consultancy services	61	87.14
4	Use of communicational media for marketing of agricultural inputs	66	94.28
D	**Other need**		
1	Handling of agrochemicals	64	91.42
2	Timely marketing of agricultural inputs	65	92.85
3	Display of different agricultural inputs for attraction of customers	61	87.14
4	Other	16	22.85

(Figure in parentheses indicates percentages)

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The data in Table 1, indicated that majority of respondents input dealers need training in technical need areas viz., seed technology, Different insecticides and pesticides its contents, concentration to be used Storage and keeping quality of insecticides, pesticides and fertilizers, etc. (97.14 %), followed by Advanced technical information of new agricultural inputs (94.28 %), Availability of publications and records (92.85 %), Bio-agents importance, use, storage, utility, availability, application, etc. (91.42 %), Fertilizers types, doses, method of application and storage quality, etc.(87.14%) and Proper knowledge about technical language (85.71 %).

In case of financial need high proportion of respondents need training about Training about credit/financial management and Government policies, rules regulations and taxes related agriculture having 98.5 per cent followed by Government subsidies on different agricultural input (90.00 %).

In case of social need high proportion of respondents needed training on to convey the proper information to the farmers regarding agricultural technology (95.71%) followed by use of communicational media for marketing of agricultural inputs (94.28%), development of good rapport with farmers, government and private organizations (90.00%) and agricultural input consultancy services (87.14%), respectively.

In case of other needs nearly most of the respondents need training on timely marketing of agricultural inputs (92.85%), followed by 91.00 and 87.14 per cent of the respondents need training on handling of agrochemicals and display of different agricultural inputs for attraction of customers.

By and large respondents need training more on technical area use of parasitoid and predators, different insect , pest and diseases, bio-agents, fertilizers its types, doses and application. The other training need areas were, agrochemical handling, seed technology technical information on new agricultural inputs and credit/finance management on which respondents need training for marketing of their

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inputs, for providing better expert services and advice to the farmers and for increasing their profitability also.

2.1.2 Different training needs of farm input dealers and their distribution

In order to depict the overall scenario of training need in all areas together, the respondent dealers were grouped into three categories as per the procedure explained in the chapter of methodology and is presented in Table 22.

Table 2. Distribution of the respondents according to their level of training need

Sl. No.	Training needs	Respondents(n=70)	
		Number	Percentage
1	Less	17	24.28
2	Medium	43	61.42
3	More	10	14.30
	Total	**70**	**100.00**

It revealed from Table 2, that majority (61.42 %) of the respondents had 'medium' training need on various aspects of fertilizer, seed, pesticides, machinery and implements, animal feed and chemicals and their use While 24.28 per cent of the respondents had 'less' training need. Followed by 14.30 per cent of the respondents had 'more' training need. The average training need score of respondents was 17.11.

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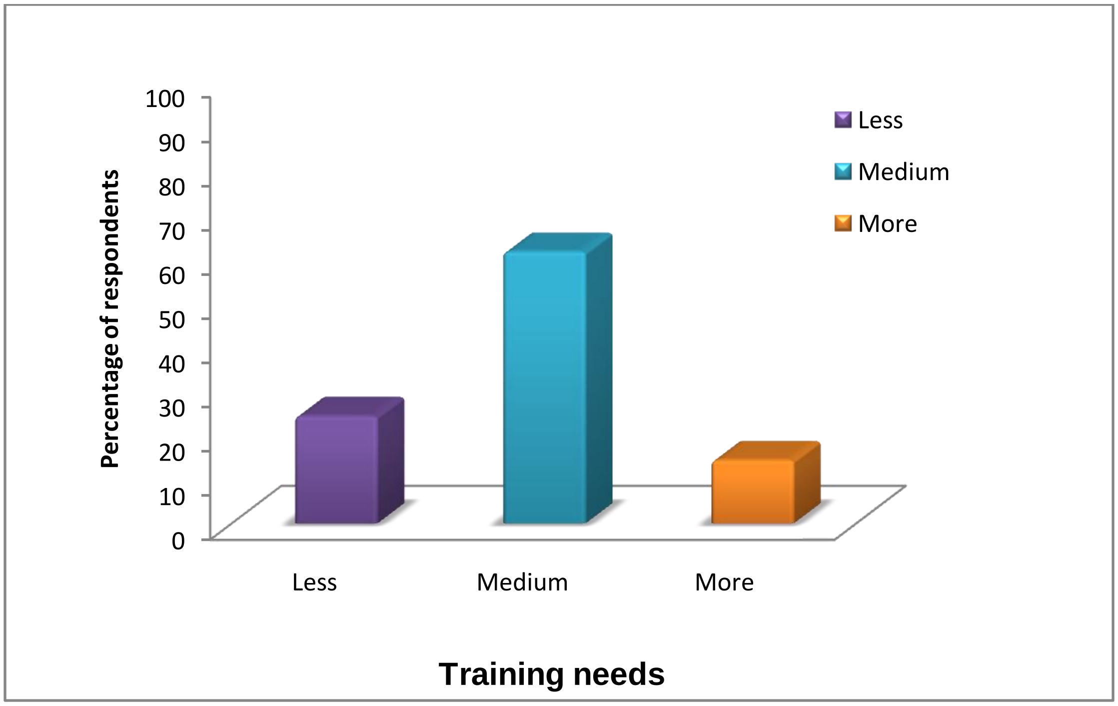

Fig. 1 Distribution of the respondents according to their level of training needs

These findings indicates that majority of the respondents has 'medium' training needs who had sufficient experience of the business.

2.3 SUMMARY AND CONCLUSION

A. SUMMARY

1. Training needs of agricultural input dealers

Majority of the respondents farm input dealers (61.42 %) had 'medium' level of training need on various aspects of fertilizer, seed, pesticides, machinery and implements, animal feed and chemicals and their use, whereas (24.28 %) of the respondents had less training need and (14.30 %) had more training need. The average training need score of respondents was 17.11.

Great majority of the respondents expressed their training need about seed technology, different insecticides and pesticides its contents, concentration to be usedstorage and keeping quality of insecticides, pesticides and fertilizers, etc. (97.14

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%), followed byadvanced technical information of new agricultural inputs (94.28 %),training about credit/financial management and government policies, rules regulations and taxes related agriculture having 98.57 per cent.

Most of the respondents need training on timely marketing of agricultural inputs (92.85 %), followed by 91.00 and 87.14 per cent of the respondents who need training on handling of agrochemicals and display of different agricultural inputs for attraction of customers.

B. CONCLUSION

These findings revealed that, majority of the farm input dealers were 'middle' age, with 'medium' experience in farm input dealing, source of information, social participation, innovativeness and cosmopoliteness. Majority of the respondents were 'graduate' and most of them had 'medium' land holding and annual income. All the farm input dealers did 'not received' training on various aspects related to fertilizers, seeds, insecticides, pesticides and implements. Majority (68.00 %) of the farm input dealers had 'medium' level of knowledge related to use of seeds, fertilizers and pesticides. In respect of training needs, farm input dealers had expressed 'high' training needs on seed technology, different insecticides and pesticides its contents, concentration to be usedStorage and keeping quality of insecticides, pesticides and fertilizers, etc., followed byadvanced technical information of new agricultural inputs,training about credit/financial management and government policies, rules regulations and taxes related agriculture. 'Competition with other input dealers, followed by transportation, non availability of clientsand inadequate credit facilities,non availability of labors, lack of knowledge about mode of chemicals, non availability of selling organizations and sometime prices of agricultural input goes high', were the major constraints faced by them.

3. IMPLICATIONS

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1. The study has brought out useful information about the personal, socio-economic characteristics of the farminput dealers from the districts of Akola and Wardha districts of Vidarbha region. The information can be used by the input supplying agencies for identifying the prospective farm input dealers and thus, can minimize their efforts for locating the people to promote the use of other farm input.
2. It was observed that, the training need of the farm input dealers from Akola and Wardha districts of the Vidarbha region was high about needs on seed technology, different insecticides and pesticides its contents, concentration to be used storage and keeping quality of insecticides, pesticides and fertilizers, etc., followed by advanced technical information of new agricultural inputs, training about credit/financial management and government policies, rules regulations and taxes related agriculture. Therefore, efforts are needed to develop useful training module by the extension agencies of State Department of Agriculture, State Agriculture Universities and Private companies.

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Formulation and Quality Evaluation of Multigrain Bhakari Premix Fortified with Defatted Soya Flour

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ABSTRACT

The present investigation was undertaken with the objective to study preparation and standardization of multigrain bhakari premix by using various grains viz., sorghum, finger millet, amaranth, oats and defatted soy flour. The efforts have been made to formulate the nutritional multigrain bhakari premix with the varying concentration of sorghum, finger millet, amaranth and oats flour. The results of multigrain bhakari premix revealed that the carbohydrate content was decreased whereas, the protein content was increased. Amongst all the sample, the sample containing 30% sorghum flour and 23.33% of finger millet, amaranth and oat flour each of total flour was selected for further fortification by using defatted soy flour on the basis of quality characteristics and sensory evaluation by trained penal members. The different functional properties and quality characteristics of fortified multigrain bhakari premix were determined. Further it was concluded that good quality of fortified multigrain bhakari premix can be prepared by using 23% sorghum, 23.33% finger millet, 23.33% amaranth, 23.33% oats flour and 7% defatted soy flour with good overall acceptability, nutritional profile and techno-economically feasibility and can be commercially exploited.

Keyword: Sorghum, Multigrain bhakari premix, defatted soy flour, grains etc.

1. Introduction:

Cereals possess good amount of protein and it is vehicle for delivering proteins to at risk populations due to its world wide spread consumption, stability and versatility. The concept of cereal-legume complementation by blending cereal with legume flour can be applied to increase protein content. The changing lifestyle of people with changing dietary patterns can lead to increasing precedence of disease like type 2 diabetes, coronary heart disease, cancer, periodontal disease and obesity (Bulusu *et al.*, 2007).

Finger millet possess various health benefits and it's attributed to its polyphenol content. It has 81.5% carbohydrates, 9.8% protein, 4.3% crude fibre and 2.7% minerals (Chethan and Malleshi, 2007). The sorghum and millets have considerable potential in food and beverage and they are gluten free and suitable for celiac diseases. Soybean contains 40% protein, 20% lipid, 35% carbohydrate and 5% ash on a dry weight basis. Amaranth (*Amaranthaceae*) grain is gluten free, contains high quality protein and rich source of fiber and minerals like calcium and iron. Amaranth grain has good amount of bioactive compounds with different health beneficial components like phytosterols, polyphenols, saponins and squalene (Ballabio *et al.*, 2011). Oat

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bran flour contains high amount of β-glucan which helps in reducing type 2 diabetes. The USFDA permitted oat soluble fibre has ability to control risk of heart disease, 0.75 g/serving β-glucan is required, the highly viscous β-glucan helps in lowering blood cholesterol and the intestinal absorption of glucose (Tapola *et al*., 2005). Soybean is rich source of protein with high levels of lysine and other micronutrient (Aleem *et al*., 2012).

The multigrain premix is mixture of cereals, pulses, oilseeds and millets. Pulses like green gram, chickpea and pea provides high amount of protein and essential amino acids like lysine, arginine, leucine, isoleucine which are limiting in other grains (Indrani *et al*., 2010). According to research diet rich in plant based foods mainly wholegrain cereals are beneficial to protect from several degenerative diseases such as diabetes, cardiovascular diseases, few types of cancers, metabolic syndrome and Parkinson's disease. Thus, to solve the problem on malnutrition and food insecurity, dietary quality should need to consider (Singh and Raghuvanshi, 2012).

The physicochemical benefits of multigrain in prevention, protection or treatment against several chronic ailments were established and this relationship can be visualized in day-to-day life, for example calcium is important to prevent osteoporosis (Lanham-New, 2008). Folate helps in prevention of infants neural tube defects (Czeizel *et al*., 2013) and role of increasing fibre and decreasing dietary fat from grains in the prevention of colon cancer etc (Lattimer and Haub, 2010). Improper dietary practices affects health due to significant alteration of nutrients. It is an opportunity for innovative products and development of specific food component which can act as candidate agents for developing nutraceutical compounds and by their health beneficial properties, whole grain cereal can be considered as nutraceutical.

In most of the regions of India bhakari is consumed as a staple food therefore fortification of finger millet flour, amaranth flour, soybean flour, oats flour with sorghum flour increases nutritional value and sensory attributes of the product. Thus, present investigation was undertaken to develop the multigrain bhakari premix from different grains like finger millet, amaranth, sorghum and oats flour with fortification by using defatted soyaflour to increase nutritional quality, sensory attributes, consumer acceptability and commercial exploration of the product.

2. Materials and Methods:

The present investigation has been carried out at MIT College of Food Technology, MITADT University, Pune. The required raw materials such as sorghum, finger millet, amaranth, oats and defatted soybean flour were procured from local market.

2.1 Physico-chemical characteristics of raw materials

The different physical and chemical characteristics of grains and finished premix were determined as per the method given by the Ranganna (2011).

2.2 Formulation of multigrain premix

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The multigrain premix was prepared by blending appropriate amount of sorghum flour, amaranth flour, finger millet flour and oats flour. Different levels of grains flour were taken to make product nutritionally enriched and presented in table 1.

Table 1: Formulation of multigrain bhakari premix

Formulation of multigrain bhakari premix (g/100)							
Sr. No.	**Flour**	**MBP$_0$**	**MBP$_1$**	**MBP$_2$**	**MBP$_3$**	**MBP$_4$**	**MBP$_5$**
1	Sorghum	100	50	40	30	25	20
2	Finger millet	-	16.66	20	23.33	25	26.66
3	Amaranth	-	16.66	20	23.33	25	26.66
4	Oats	-	16.66	20	23.33	25	26.66

Where, MBP$_0$= Control Sample, MBP= Multigrain Bhakari Premix

2.3 Fortification of multigrain bhakari premix by using defatted soy flour

The multigrain premix prepared by using the different levels of sorghum, finger millet, amaranth and oats as 30g, 23.33g, 23.33g and 23.33 g resp. (MBP$_3$) was selected depending upon the highest sensory score and this formulation was selected for further improvements. The multigrain premix are again fortified with the different levels of defatted soy flour to improve nutritional quality of the product. Hence, the recipe for the preparation of the control and all other samples of multigrain premix with the different levels of the defatted soy flour are presented in the following Table 2.

Table 2: Formulation of defatted soy flour fortified multigrain bhakari premix

Defatted soy flour fortified multigrain bhakari premix (g/100gm)						
Sr. No.	**Flours**	**SFP$_0$**	**SFP$_1$**	**SFP$_2$**	**SFP$_3$**	**SFP$_4$**
1	Sorghum	30	27	25	23	20
2	Finger millet	23.33	23.33	23.33	23.33	23.33
3	Amaranth	23.33	23.33	23.33	23.33	23.33
4	Oats	23.33	23.33	23.33	23.33	23.33
5	Soybean	-	03	05	07	10

Where, SFP$_0$ = Control Sample, SFP= Soybean Fortified Premix

2.4 Preparation of multigrain bhakari Premix

The multigrain bhakari premixes were prepared with standardised proportion of multigrains. The control sample was formulated only by using the sorghum flour. The processing methodology or steps are representd in figure 1.

Sorghum Amaranth Finger millet Oats

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Cleaning	Cleaning	Cleaning	Cleaning
⇩	⇩	⇩	⇩
Sorting and grading	Sorting and grading	Sorting and grading	Sorting and grading
⇩	⇩	⇩	⇩
Ground to fine flour	Ground to fine flour	Ground to fine flour	Ground to fine flour

⇩

Mixing of flour and defatted soybean flour

⇩

Flour is sifted through a sieve

⇩

Packed in airtight container

Figure 1: Preparation of multigrain bhakari premix

2.5 Preparation of Bhakari by using multigrain premix

The bhakari were prepared by using the multigrain premix as given in the Table 1 and Table 2. The multigrain bhakari were prepared as per the method given by Chavan *et al*., (2018) with slight modification.

2.6 Organoleptic evaluation of developed product

Sensory evaluation of finished product was evaluated by 10 semi-trained panel members by using 9 point hedonic scale (Meilgard *et al*., 1999).

2.7 Textural analysis of multigrain bhakari

Stable Micro System TAXT2plus Texture Analyser was used for texture profile analysis (TPA) of multigrain bhakari. TPA is “two-bite” test, which includes the first and second compression cycles. The test is configured so that the TPA parameters, hardness, adhesiveness, springiness, cohesiveness and gumminess were calculated. The parameters used in TPA are depicted in Table 3.

Table 3. Texture profile analyser parameters

Sr. No.	Test mode	Measure force in compression
1	Test mode	Compression
2	Load cell	60kg
3	Pre-test speed	3.0 mm/sec
4	Test speed	3.0 mm/sec
5	Post-test speed	5.0 mm/sec
6	Target mode	Percent
7	Distance	40mm
8	Trigger force	5g

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3. Results and Discussions

3.1 Physicochemical properties of different grains

The data depicted in table 4 revealed that the 1000 kernel weight was found highest in soybean (120g) followed by amaranth (48.32g) and lowest was recorded in finger millet (15.13g) due to its size variation large deviation was recorded in 1000 kernel weight. 1000 kernel weight is important factor to evaluate grain yield. The size of sorghum, finger millet, amaranth, oats and soybean was found to be 3.527, 1.414, 0.940, 1.026 and 5.67 respectively. The bulk density and true density was found highest in oats (0.980 g/ml) and amaranth (1.33 g/ml) respectively. The true and bulk density plays a significant role in drying, design of silos and storage bins, separation of undesirable materials, seed purity determination and grading.

Sphericity is used to describe the shape of a grain. The resistance of bulk grain to air flow is the function of porosity and kernel size. The percent sphericity of oats (36.57) was found highest followed by sorghum (20.59), amaranth (1.24), finger millet (0.96) and soybean (0.836). The percent porosity of sorghum, finger millet, amaranth, oats and soybean was noted as 31.53, 35.04, 37.59, 23.43 and 38 respectively. The angle of repose found highest in oats (42.53^{o}), followed by soybean (36.54^{o}).

The findings in table 4 showed that the carbohydrate content was found highest in finger millet (73.6g) followed by sorghum (72.09g) whether, lowest carbohydrates content was recorded in defatted soy flour (31.92g). The protein content was found highest in defatted soy flour i.e. 51.46g and lowest in finer millet i.e. 9.1g. However, fat content was lowest in sorghum, finger millet, amaranth, oats and defatted soy flour was found to be 3.46 g/100g, 2.3 g/100g, 7 g/100g, 6.9 g/100g and 0.43g/100g respectively. The physical and chemical properties of sorghum flour, oats flour, amaranth and defatted soy flour are comparable with the results reported by the Youssef *et al*., (2016) and Mburu *et al*., (2012).

Table 4. Physicochemical properties of different grains

Physical properties						
Sr. No.	**Parameters**	**Sorghum**	**Finger millet**	**Amaranth**	**Oats**	**Soybean**
1	1000 kernel weight (g)	32.50	15.13	48.32	36.16	120.0
2	Geometric mean diameter (mm)	3.527	1.414	1.414	1.026	5.67
3	Bulk density (g/ml)	0.769	0.769	0.833	0.980	0.625
4	True density (g/ml)	1.11	1.17	1.33	1.28	1.00
5	Sphericity (%)	20.59	0.96	1.24	36.57	0.836
6	Porosity (%)	31.53	35.04	37.59	23.43	38.00
7	Angle of repose(^{o})	33.02	30.02	26.58	42.43	36.54
Chemical properties						
8	Moisture (%)	11.22	11.89	12.01	8.59	11.65

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9	Carbohydrate (g)	72.09	73.6	65	66.3	31.92
10	Protein (g)	10.62	9.1	14	16.9	51.46
11	Fat (g)	3.46	2.3	7	6.9	0.43
12	Energy (Kcal)	361.98	351.5	379	394.9	337.39
Minerals content						
13	Calcium (mg/100g)	13	350	159	54	241
14	Iron(mg/100g)	3.36	3.9	7.6	4.72	9.24
15	Magnesium(mg/100g)	165	168.4	248	177	290
16	Manganese(mg/100g)	1.605	24.09	3.4	4.916	3.018
17	Phosphorus(mg/100g)	289	238	557	523	674
18	Potassium(mg/100g)	363	408	508	429	2384
Vitamins Content						
19	Thiamine(mg/100g)	0.33	0.43	0.1	0.76	0.69
20	Riboflavin (mg/100g)	0.09	0.18	0.2	0.13	0.25
21	Niacin(mg/100g)	3.68	1.01	0.9	0.96	2.61
22	Pantothenic acid(mg/100g)	0.36	-	1.5	1.34	1.99

* Each value is an average of three determinations

Minerals content determines amount of specific inorganic components present in food. Table 4 revealed that calcium content in sorghum, finger millet, amaranth, oats and defatted soy flour was found 13 mg/100g, 350 mg/100g, 159 mg/100g, 54 mg/100g and 241 mg/100g respectively. The iron content was found highest in defatted soy flour i.e. 9.24 mg/100g whether, lowest in sorghum i.e. 3.36 mg/100g. Iron is required for proper function of haemoglobin and also important in other processes in the body. Magnesium plays an important role proper function of kidney, heart and muscles. The magnesium content in sorghum, finger millet, amaranth, oats and defatted soy flour were found 165 mg/100g, 168.5 mg/100g, 248 mg/100g, 177 mg/100g and 290 mg/100g respectively.

Further, the determined manganese content was recorded highest in finger millet (24.09 mg/100g) as compared to the other samples. Manganese is considered as essential nutrient which helps in physiological processes. The phosphorus content in sorghum, finger millet, amaranth, oats and defatted soy flour was determined as 289 mg/100g, 238 mg/100g, 557 mg/100g, 523 mg/100g and 674 mg/100g respectively. Phosphorous helps to growth and repair body cells and tissue.

The potassium content was higher in defatted soy flour (2384 mg/100g) and lower in sorghum (363 mg/100g). Potassium is important mineral which helps to regulate fluid balance, muscle contraction and nerve signals. The zinc content of sorghum, finger millet, amaranth, oats and defatted soy flour were found 1.67 mg/100g, 2.81 mg/100g, 2.9 mg/100g, 3.97 mg/100g and 2.46 mg/100g respectively. Zinc is required for DNA synthesis, immune function, metabolism and growth and it may reduce inflammation and your risk of some age-related diseases.

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The vitamin B_1 content in grains flour like sorghum, finger millet, amaranth, oats and defatted soy flour were found to be 0.33 mg/100g, 0.43 mg/100g, 0.1 mg/100g, 0.76 mg/100g and 0.69 mg/100g respectively. Thiamine perform important role in muscle contraction and conduction of nerve signals and also help body cells change the carbohydrate into energy.

The riboflavin content was found highest in defatted soy flour (0.25 mg/100g) followed by finger millet (0.18 mg/100g) and lowest was recorded in sorghum 0.09mg/100g. The niacin and Pantothenic acid were found highest in sorghum and soybean flour as 3.68 and 1.99 mg/100g respectively. Riboflavin is important vitamin helps in growth whereas niacin is required for digestive system, **s**kin and nervous system functioning. Pantothenic acid helps to make red blood cells and also helps to convert food into energy. The vitamin B_5 content in sorghum, amaranth, oats and defatted soy flour was found 0.36 mg/100g, 1.5 mg/100g, 1.34mg/100g and 1.99 mg/100g whereas. The results presented in table 7 are close with the data presented by the Dayakar *et al.*, (2017).

3.2 Proximate analysis of multigrain bhakari premix

The different grains are rich in different nutrients which ultimately contribute to a nutritional value of prepared premix. The results pertaining the chemical analysis are depicted in Table 5.

Table 5. Proximate analysis of multigrain bhakari premix

Proximate analysis of multigrain bhakari premix (g/100g)									
Sr. No.	**Parameters**	**Control**	**MBP_1**	**MBP_2**	**MBP_3**	**MBP_4**	**MBP_5**	**SE**	**CD at 5%**
1	Moisture (%)	11.5	11.7	11.6	11.7	11.4	11.6	0.0638	0.1921
2	Carbohydrate	72.09	69.99	69.61	69.17	68.99	68.75	0.0062	0.0185
3	Protein	10.62	11.73	11.96	12.17	12.29	12.4	0.0172	0.0519
4	Fat	3.46	4.24	4.42	4.56	4.66	4.74	0.0043	0.013
5	Energy	361.98	365.04	366.06	366.4	367.06	367.26	0.0109	0.0328
Mineral and vitamins content (mg/100g)									
6	Calcium	13.00	100.28	117.8	135.23	144.00	202.54	0.3341	1.005
7	Iron	3.46	5.68	4.58	4.79	4.89	4.99	0.007	0.021
8	Magnesium	165.00	181.34	184.68	187.92	189.6	191.18	0.210	0.633
9	Manganese	1.60	2.19	2.61	2.42	2.48	2.53	0.024	0.072
10	Phosphorus	289.00	324.42	331.60	338.61	342.25	345.72	0.210	0.632
11	Potassium	363.00	405.57	414.20	422.67	427.00	452.37	0.265	0.799
12	Zinc	1.67	1.97	2.04	2.10	2.13	2.16	0.018	0.055
13	Thiamine	0.332	0.378	0.388	0.397	0.404	0.408	0.0006	0.0017
14	Riboflavin	0.096	0.128	0.138	0.144	0.149	0.152	0.0003	0.0009

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15	Niacin	3.68	2.33	2.06	1.79	1.66	1.49	0.0092	0.0278
16	Pantothenic acid	0.36	0.65	0.71	0.77	0.80	0.82	0.0098	0.0295

*Each value is an average of three determinations

The data recorded in the table 5 indicates that the multigrain premix showed the noticeable difference in the protein and carbohydrate content. The negligible difference was recorded in the moisture content among all the samples. The highest carbohydrate content was recorded in control flour (72.09 g/100g) while lowest in MBP_5 (68.75 g/100g). The carbohydrate content was found to be decreased as the concentration of finger millet, amaranth and oats flour increased. However, it could be observed that the protein content was increased from 10.62 to 12.4 g/100g as the sorghum flour level was reduced with gradual increase in the concentration of other grains flour. Highest protein content was observed in sample MBP_5 (12.4 g/100g).

The fat content in multigrain premix sample was recorded in the range from 3.46 to 4.74 g/100g. Energy content was found lowest in control sample (361.98 kcal/100g) whereas as highest in MBP_5 (367.26 kcal/100g). The drastic calcium content was found to be increases as compared to control flour due to increase in the concentration of finger millet, amaranth and defatted soy flour. The iron content among all the premix samples was recorded in between 3.46 to 5.68 mg/100g. The magnesium content was found lowest in control flour i.e. 165 mg/100g whereas, highest in MBP_5 191.18 mg/100g. The manganese, Phosphorus, Potassium and zinc content was found to be increased as the level of grains flour increased from control to MBP_5.

The estimated results recorded in table 5 showed that thiamine content was found in the range from 0.332 to 0.408 mg/100g among all the premix samples. There was significant difference in riboflavin content was found i.e. 0.096, 0.128, 0.138, 0.144, 0.149 and 0.152 mg/100g in control, MBP_1, MBP_2, MBP_3, MBP_4 and MBP_5 respectively. The niacin content in multigrain bhakari premix decreases as increase the concentration of multiflours as sorghum flour found rich in niacin. The niacin concentration in control, MBP_1, MBP_2, MBP_3, MBP_4 and MBP_5 was found 3.68, 2.33, 2.06, 1.79, 1.66 and 1.49 mg/100g respectively. The Pantothenic acid content was found lowest in control (0.36 mg/100g) while highest in MBP_5 (0.82 mg/100g).

3.3 Organoleptic evaluation of multigrain bhakari prepared by using multigrain premix

The sensory responses noted by the sensory panel member are tabulated in table 6.

Table 6. Sensory evaluation of multigrain bhakari prepared by using multigrain premix

Sensory evaluation of multigrain bhakari									
Sr. No.	**Attributes**	**MBP_0**	**MBP_1**	**MBP_2**	**MBP_3**	**MBP_4**	**MBP_5**	**SE**	**CD at 5%**
1	Color and appearance	7.9	7.7	7.5	7.5	7.0	6.5	0.0667	0.2007
2	Flavour	7.5	8.0	8.0	8.0	7.6	7.2	0.033	0.100
3	Taste	6.9	7.2	7.2	7.8	7.6	7.4	0.081	0.245
4	Texture	7.3	7.1	7.3	7.3	7.0	6.5	0.0397	0.119

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5	Overall acceptability	7.4	7.5	7.5	7.65	7.3	6.9	0.0615	0.185

*Each value is an average of ten determinations

The organoleptic evaluation showed that best taste was observed in case of sample MBP_3 (7.8) as compared to the control sample. Increase in multigrain concentration taste was found to be increased up to certain level and then decreases. From the investigation the sample MBP_3 found highest overall acceptability (7.65) amongst the other sample. So sample MBP_3 was selected for further fortification by using defatted soy flour.

3.4 Proximate analysis of Multigrain bhakari premix fortified with defatted soy flour

The different parameters were analysed and the data pertaining to proximate composition are summarized in table 7.

Table 7. Proximate analysis of multigrain bhakari premix fortified with defatted soy flour

Proximate analysis of fortified multigrain bhakari premix (g/100g)								
Sr. No.	**Parameters**	**SFP_0**	**SFP_1**	**SFP_2**	**SFP_3**	**SFP_4**	**SE±**	**CD at 5%**
1	Moisture (%)	11.7	11.6	11.6	11.7	11.6	0.071	0.215
2	Carbohydrate	69.17	67.86	67.16	66.26	65.06	0.007	0.0215
3	Protein(g/100g)	12.17	13.38	14.20	15.02	16.24	0.0021	0.0063
4	Fat(g/100g)	4.56	4.40	4.36	4.30	4.21	0.0239	0.0721
5	Energy (kcal/100g)	366.40	364.56	364.68	363.82	363.09	0.0165	0.0496
Mineral content (mg/100g)								
6	Calcium	135.23	142.07	146.63	151.19	158.03	0.0103	0.031
7	Iron	4.79	4.96	5.09	5.20	5.38	0.017	0.053
8	Magnesium	148.64	191.67	194.17	196.67	200.42	0.012	0.036
9	Manganese	2.42	2.46	2.49	2.51	2.56	0.0039	0.0119
10	Phosphorus	338.61	350.16	357.86	365.56	377.11	0.0117	0.0353
11	Potassium	422.67	483.30	527.42	564.14	624.77	0.0343	0.1033
12	Zinc	2.10	2.12	2.14	2.16	2.18	0.0193	0.058
B-complex vitamin content (mg/100g)								
13	Thiamine	0.397	0.408	0.415	0.422	0.433	0.0004	0.0012
14	Riboflavin	0.15	0.149	0.15	0.155	0.160	0.0034	0.0102
15	Niacin	1.79	1.75	1.736	1.715	1.683	0.0079	0.0238
16	Pantothenic acid	0.77	0.81	0.85	0.88	0.93	0.0063	0.019

*Each value is an average of ten determinations

The observations recorded in table 7 revealed that the negligible difference was found in moisture content amongst all the fortified samples. The multigrain bhakari premix fortified with increasing concentration of defatted soy flour showed the major change in the carbohydrate and

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protein percent. As the concentration of defatted soy flour increased the carbohydrate content was decreased and the lowest reading was shown by sample SFP_4 (65.06g/100g). However, the drastic increase in protein content was noted and it was found in the ranges 12.17 to 16.24g/100g for control to SFP_4 sample respectively. The fat content ranges from 4.21 g/100g to 4.56 g/100g. The fat content was reported lowest in SP_4 (4.21 g/100g) and highest in SFP_1 (4.56 g/100g). The energy value obtained in SFP_0, SFP_1, SFP_2, SFP_3 and SFP_4 was 366.40 kcal/100g, 364.56 kcal/100g, 364.68 kcal/100g, 363.82 kcal/100g and 363.09 kcal/100g respectively.

The results of minerals content presented in table 7 showed that calcium, magnesium, phosphorus and potassium concentration was increased whereas little changes in iron, manganese and zinc content were recorded as the concentration of defatted soy flour increased from 3% to 10%. The minerals content was found to be highest in SFP_4 whereas lowest in SFP_0. The iron content ranges from 4.75 to 5.29 mg/100g. The phosphorous content was found highest in SFP_4 sample (377.06 mg/100g) whereas, lowest in SFP_0 (338.61 mg/100g). The potassium content was found highest in SFP_4 (624.71 mg/100g) followed by SFP_3 (564.09 mg/100g). The negligible or little increase was noted in iron, manganese and zinc.

The data presented in table 7 showed that thiamine content in $SFP_{0,}$ $SFP_{1,}$ $SFP_{2,}$ $SFP_{3,}$ SFP_4 was estimated 0.397, 0.408, 0.415 0.422 and 0.433 mg/100g respectively. The riboflavin was found highest in SFP_4 (160 mg/100g) while, lowest in control sample (0.15 mg/100g). The niacin and Pantothenic acid content was recorded highest in SFP_0 and SFP_4 as 1.79 and 0.93 mg/100g whereas, the lowest in SFP_4 and SFP_0 as1.683 and 0.77 respectively.

3.5 Sensory evaluation of fortified multigrain bhakari premix with defatted soy flour

The average scores recorded by judges are presented and discussed in Table 8.

Table 8. Sensory evaluation of fortified multigrain bhakari premix with defatted soy flour

Sensory evaluation of fortified multigrain bhakari								
Sr. No.	**Attributes**	**SFP_0**	**SFP_1**	**SFP_2**	**SFP_3**	**SFP_4**	**SE±**	**CD at 5%**
1	Color and appearance	7.5	7.5	7.4	7.4	6.0	0.0459	0.1383
2	Flavour	8.0	8.0	8.3	8.5	6.9	0.0394	0.1187
3	Taste	7.8	8.2	8.2	8.2	7.5	0.0422	0.126
4	Texture	7.3	7.3	7.1	7.1	6.5	0.0615	0.185
5	Overall acceptability	7.6	7.7	7.7	7.8	6.7	0.0258	0.0777

*Each value is an average of ten determinations

It is seen from the sensory evaluation results noted in table 8 that there was no significant difference was reported by the panelist upto the sample SFP_3 after that all other sensory

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attributes was found to be decreased. Flavour and taste of multigrain bhakari fortified with soy flour was found to be increased as the concentration of the defatted soy flour increased up to the level of 7%. Whereas, the colour and texture was noted to be decreased as the concentration of the defatted soy flour increased. The overall acceptability of fortified multigrain bhakari could be attributed to the different characters of colour, taste, flavour and texture of the final product. All the combinations of multigrain bhakari premix fortified with defatted soy flour valued in between like moderately to like very much. Highest score for overall acceptability was noted for the sample SFP_3 (7.8).

3.6 Texture profile analysis (TPA) of fortified multigrain bhakari by using TA¬XT2 Texture analyzer

The texture of the fortified multigrain bhakari was determined by using the TA-XT2 texture analyzer. The texture parameters such as hardness, springiness, cohesiveness, gumminess and chewiness were determined by using compression test with the cylindrical probe and two bite/cycle test. The results obtained are tabulated in the Table 9.

Table 9. Texture profile analysis (TPA) of fortified multigrain bhakari

Texture profile analysis (TPA)								
Sr. No.	**Textural parameters**	**SFP_0**	**SFP_1**	**SFP_2**	**SFP_3**	**SFP_4**	**SE±**	**CD at 5%**
1	Hardness (kg)	8.63	9.12	9.98	10.02	10.88	0.012	0.0362
2	Adhesiveness (kg/second)	-0.008	-0.006	-0.004	-0.003	-0.002	0.0003	0.0008
3	Springiness	0.92	0.82	0.82	0.79	0.74	0.026	0.0078
4	Cohesiveness (kg)	0.893	0.806	0.807	0.798	0.761	0.0003	0.0008
5	Gumminess (kg)	7.706	7.350	8.053	7.995	8.279	0.0019	0.0057

*Each value is an average of three determinations

The hardness of the fortified multigrain bhakari was measured based on the peak of the compression curve. The addition of defatted soy flour increases the hardness of multigrain bhakari. The highest hardness was recorded in the sample SFP_4 (10.88 kg) fortified with 10% of defatted soy flour. Cohesiveness is the ratio of area under the second bite curve before reversal compression to that under the first bite curve. The cohesiveness of the defatted soy flour fortified samples was found to be decreased from SFP_0 to SFP_4 sample.

The adhesiveness and springiness of fortified multigrain bhakari was found to be decreased linearly as the level of defatted soy flour increased. Gumminess is related to primary parameters of hardness and cohesiveness and is obtained by multiplication of these two parameters. Among all sample SFP_4 (8.279 kg) showed the highest reading for the gumminess, while as the concentration of the defatted soy flour increased the gumminess was found to be increased and found to be lowest in case of control sample i.e., SFP_0 (0.734kg).

4. Conclusion

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In light of the facts and figures of the present investigation it can be concluded that the good quality multigrain bhakari premix can be prepared by using sorghum, finger millet, amaranth and oats. Further, the protein content can be increased by the fortification of defatted soy flour. A good quality fortified multigrain bhakari premix can be prepared by using 23% sorghum, 23.33% finger millet, 23.33% amaranth, 23.33% oats flour and 7% defatted soy flour with good overall acceptability, nutritional profile and techno-economically feasibility and can be commercially exploited.

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Potential of Millets for Development of Gluten Free Extruded Products

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Abstract

Millets offer nutritional security and there is a need for promoting millets as they are highly nutritious. These have been important staple food in human history, particularly in Asia and Africa. Millets are comparative with major cereals like wheat and rice with respect to nutritional value and parts of diet of poor due to less cost. Millets contains vitamins, minerals, sulphur containing amino acids and some phytochemicals and therefore described as nutritious millets, which release sugars slowly and thus have a low glycaemic index and can do ideal foods for diabetes and also gluten free, ideal for celiac peoples. Market available macaroni products are wheat based, macaroni is prepared by extrusion. Food extrusion is a process by which a set of mixed ingredients are forced through an opening in a perforated plate or die with a design specific to the food, and are then cut into a specific size by blades. Millets mainly sorghum (*sorghum bicolor)*, pearl millet (*Pennisetum glaucum*) and finger millet (*Eleusine coracana*) can be used in development of gluten free mineral enriched extruded products.

Keywords: Millets, gluten free, extrusion, pearl millet, finger millet.

1. INTRODUCTION

Agriculture minister Radha Mohan Singh proposed to the United Nations Food and Agriculture Organization to declare the year 2019 as international year of millets, which will promote cultivation by amending cropping patterns of areas which are especially susceptible to climate change. Increasing the Minimum Support Price (MSP) of millets by 50% greater than the cost of production, the Government of India has taken a vigorous step towards promotion of millets.

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Bringing back these nutritious cereals in the food platter of rural and urban population, rich as well as poor consumers would augment the production of these cereals and worldwide efforts towards speeding up this would be highly beneficial.

Sorghum (*sorghum bicolor)*, is an important crop worldwide, used for food as grain and in sorghum syrup, animal fodder, the production of alcoholic beverages, and biofuels. Most varieties are drought- and heat-tolerant, and are especially important in arid regions, where the grain is one of the staples for poor and rural people.

India's first biofortified sorghum (jowar), with significantly higher iron and zinc than regular sorghum, was launched. Developed by ICRISAT it was released for cultivation by Vasantrao Naik Marathwada Krishi Vidyapeeth (VNMKV), Maharashtra. The improved variety ICSR 14001, released as 'Parbhani Shakti' by VNMKV, offers a cost-effective and sustainable solution to address micronutrient deficiency. It helps a major concern like high anemia rates among women and children in India.

Dr Peter Carberry, Director General (Acting), ICRISAT, said, "Our belief statement emphasizes that all people have a right to nutritious food. Biofortification is an important approach we take as it is cost-effective and sustainable. It addresses hidden hunger with no additional cost to its regular consumers and often sorghum is the cheapest cereal available in the market."

"Parbhani Shakti developed through several years of work through conventional breeding has an average grain Iron concentration of 45 ppm and Zinc 32 ppm. This is considerably higher than varieties that are currently being cultivated in India (Approx 30 ppm Iron and 20 ppm Zinc). Besides, it has higher protein (11.9%) and low phytate content (4.14 mg/100 g) compared to 10% protein and 7.0 mg/100 g phytate content in most sorghum cultivars. Low-phytate means increased bioavailability of nutrients.

Finger millet (*Eleusine coracana*) also known as *tamba,* is a staple cereal grain in some parts of the world with low income population. The grain is characterized by variations in colour (brown, white and light brown cultivars); high concentration of carbohydrates, dietary fibre,

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phytochemicals and essential amino acids; presence of essential minerals; as well as a gluten-free status. Finger millet (FM) in terms of nutritional composition, ranks higher than other cereal grains, though the grain is extremely neglected and widely underutilized. Finger millet grains are said to contain essential minerals such as calcium (Ca) and phosphorus (P).

3. Potential health benefits of millets

Millet is more than just an interesting alternative to the more common grains. The grain is also rich in phytochemicals, including phytic acid, which is believed to lower cholesterol, and phytate, which is associated with reduced cancer risk (Coulibaly *et al*., 2011).Millets have many nutraceutical properties that are helpful to prevent many health problems such as lowering blood pressure, risk of heart disease, prevention of cancer and cardiovascular diseases, decreasing tumour cases etc. Other health benefits are increasing the time span of gastric emptying, provides roughage to gastro intestine Millet is an alkaline forming food. Alkaline based diet is often recommended to achieve optimal health, meaning when it combines with digestive enzymes. The soothing alkaline nature of millet helps to maintain a healthy pH balance in the body, crucial to prevent illnesses. (Sarita and Ekta Singh 2013)

Millet is gluten-free, therefore an excellent option for people suffering from celiac diseases often irritated by the gluten content of wheat and other more common cereal grains. It is also useful for people who are suffering from atherosclerosis and diabetic heart diseases. Celiac disease is an immune-mediated enteropathy triggered by the ingestion of gluten in genetically susceptible individuals. (Sarita and Ekta Singh 2013). Chandrasekara and Shahidi (2010) reported in their studies on free-radical quenching activity of finger millet (*Eleusine coracana*), that nonprocessed brown finger millet had the highest radical quenching activity than the processed one and postulated that tannins and phytic acid were responsible for the activity (Devi *et al*., 2011; Quesada *et al*., 2011; Kamara *et al*., 2012).

Millet foods have significant health benefits, Which act as a potential prebiotic and can enhance the viability or functionality of probiotics. The nutritional significance of millets

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demands for an examination of the nutritional characteristics and functional properties of different millet cultivars as well as developing value added products from millets. (Issoufou *et al.*, 2013)

3. Food extrusion

Extrusion cooking technology, a high temperature short time (HTST) processing being utilized progressively in the food industries for the development of new products such as cereal based snacks, including dietary fiber, baby foods, breakfast cereals and modified starch from cereals (Pardeshi and Chattopadhyay, 2014; Pawar *et al.*, 2014).

Food extrusion is a form of extrusion used in food processing. It is a process by which a set of mixed ingredients are forced through an opening in a perforated plate or die with a design specific to the food, and are then cut into a specific size by blades. The machine which forces the mix through the die is an extruder, and the mix is known as the extrudate. The extruder consists of a large, rotating screw tightly fitting within a stationary barrel, at the end of which is the die. Extrusion enables mass production of food via a continuous, efficient system that ensures uniformity of the final product. Food products manufactured using extrusion usually has a high starch content. These include some pasta, breads (croutons, bread sticks, and flat breads), many breakfast cereals and ready-to-eat snacks, confectionery, pre-made cookie dough, some baby foods, full-fat soy, textured vegetable protein, some beverages, and dry and semi-moist pet foods.

Extrusion cooking is a multi-functional thermal/mechanical process, which has drawn wide attention in agro-food processing industries. This process has various beneficial effects like destruction of antinutritional factors, gelatinization of starch, increased soluble dietary fiber and reduced lipid oxidation. On the other hand, Maillard reaction also influence in the nutritional value of the food by the interaction between protein and sugars. The raw material and their composition along with the process condition also influence the nutritional value of the food. The extrusion cooking is widely applied for cereal and protein processing such that the mild

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extrusion condition (low temperature, low residence time and high moisture) improves the nutritional quality of food largely. (Baskar and Aiswarya 2016).

4. Millet extruded products.

Millets' based cold extruded products (vermicelli and pasta) prepared from Five small millets' (barnyard, foxtail, kodo, little and proso). Small millets flour, wheat and soy flours were used in the ratio of 50: 40: 10 for the development of cold extruded products. (Ranganna *et al.*, 2014)

Ready-to-eat snack food is prepared from multi millet based composite formulations of u Sorghum fine semolina, finger millet fine semolina, Foxtail millet Fine semolina, Pear millet fine semolina, corn, Bengal gram flour and rice flour blends in various proportions . Pre-conditioning was done to prepare the flours for extrusion cooking and moisture content was adjusted for 21-23% for all the formulations. Extrusion cooking was carried out using a twin screw extruder at optimized extrusion parameters viz., temperature: 110˚C and 140°C for two different heating zones. Physical properties of the extrudate viz., mass flow rate, bulk density, tap density, expansion ratio, moisture retention and nutrient analysis along with storage stability with two different packaging of the products were also analyzed. The organoleptic qualities of extruded samples were analyzed by panellists on a 7 point hedonic scale. The results indicated that composite flour (flours in the ratios of 12.5:12.5:12.5:12.5:35:8:7) could be used to produce quality extrudates with acceptable sensory properties. (Dayakar *et al*., 2018).

CONCLUSIONS

Fortifying millets can enhance the nutrient availability and product developments.In the present era of food scarcity there exists a need to diversify the use of these millets by developing various millet recipes.Millet extrusion technology is gaining increasing popularity in the global agro food processing. Now a day's consumers choice for nutritionally reach, therapeutic benefits and for attractiveness especially in snack foods thus to obtain such designer all these millet extrusion is used. We can help industry to develop customized extruded food formulation and processes on

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pilot scale. Extrusion technology reduces food waste and transform under utilize millets into value added products. Hence gluten free extruded products can be prepared.

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A Study on Economics of Dahi Production and Break Even Analysis in Dairy Power Limited, Nashik, Maharashtra.

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Abstract

The study was conducted at Dairy Power Limited a milk processing plant at Nashik having the capacity of 50,000 lit/ day. During study period it was observed that Dairy Power Limited is involved in the production of various milk and milk products such as pouched milk, Dahi, Paneer, Shrikhand, Flavoured milk, Butter milk, Ghee, Lassi, khoa, Amrakhand, etc. The investigation was carried out to study the cost and returnsof Dahi production and to analyze the Break even point. During study it was found that the total production of Dahi was 10,80,000 kg which was above the recommended breakeven level. The breakeven level of Dahi was found to be 1,90,938.89 kg. The cost of production of Dahi was found to be Rs. 51.57 per kg. The B:C ratio was 1.16 while margin of safetyin terms of units and monetary terms was 8,89,061.11 kg and Rs.5,33,43,666.15.The profit generated from the sale of dahi was Rs.91,03,818.59. A comparison of unit production cost with unit price received by the plant for Dahi has revealed that it has been the profitable proposition in the Dairy Power Limited.

Key Words: Dairy Power Limited, Dahi Production, Cost and Returns, Breakeven Analysis, Profitability.

Introduction

Dairy industry plays a dynamic role in India's agro-based economy. Dairy is now a highly specialized field today that involves production, procurement, storage, processing and distribution of dairy products. The dairy industry involves processing of raw milk into products such as consumer(Processed) milk, curd, paneer, shrikhand, buttermilk, lassi, flavoured milk, butter, cheese, yogurt, ice cream, ghee etc. using processes such as chilling, pasteurization and homogenization.

India is the largest producer and consumer of milk in the world. India ranks first in the world milk production. Milk production of India during 2017-18 is 176.3 million tonnes with per capita availability of milk at a level of 375 grams per day in 2017-18. Indian dairy industry of late has become the major growth area and goes far beyond being an important agri-business sector of the national economy. Besides being the largest milk producing country with 5%

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annual increase in milk production, India has a large market of dairy products due to constantly increasing demand for variety of milk products in the urban as well as rural sectors.

Dairy Power Limited is also one of the fastest growing milk processing industries. It is located at songooan, Post saikheda, near Niphad, Nashik. It is growing industry of Nashik District and has major share of milk and milk products in Nashik. Hence,Dairy Power Limited was selected for the study of following objectives.

Objectives of the study:

1) To study the cost of production of Dahi in Dairy Power Limited.

2) To study the profitability of Dahi in Dairy Power Limited

3) To study the breakeven analysis of Dahi in Dairy Power Limited.

Methodology

Dairy Power Limited, milk processing plant situated in Nashik having installed capacity of 50,000 Lit/day was selected for the study. During study period it was observed that dairy power processed milk into pouched milk, Dahi, Paneer, Shrikhand, Flavoured Milk, Butter milk, Ghee, Lassi, Khoa, Amrakhand. Further Dahi was selected for study about cost and returns and break even analysis.The study in Dairy power limited was conducted for the financial year 2018-19.

For calculating the cost of processing of dahi required data were collected by taking actual observation of activity of the plant by conducting interview with the officials and supervision of the plant and from the records maintained by the plant for the year 2018-19. Data were collected by taking actual observations during processing, conducting time and motion study during processing of Dahi and discussions with the supervisor looking after different activities. The actual observation method used to obtain information on consumption of water in the plant, temperature at various stages of production of Dahi. The time and motion study was conducted to record the time and different activities performed by single person, labour used and time taken in different processes, running time of machinery and equipments, etc. the personal interview and discussion method was used to get information on electricity consumption. Discussions were held with machine operators. The detailed data on various aspects like daily raw milk received with fat and SNF by the plant during reference period, price paid for milk, raw material used for production of Dahi, output were acquired from respective departments. Information regarding manpower and salary and other benefits of staff were retrieved from Human Resource department. Information regarding fuel used for boilers, generators was collected from records maintained in the respective sections. Information about spare parts, electricity bills, telephone bills, chemicals used for testing of samples in quality control section was collected from log book maintained by different sections.

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Analytical procedure

Table 1 Cost components considered while calculating production cost of Dahi

Sr. No.	Particulars	Sr. No.	Particulars
1.	Raw material cost	7.	GST
2.	Wages and salary	8.	Loss in processing
3.	Packaging charges	9.	Miscellaneous
4.	Electricity charges	10.	Depreciation Costs
5.	Repairing and maintenance	11.	License fee
6.	Fuel charges	12.	insurance

Estimation procedure

The total cost of production was calculated by adding total variable cost and total fixed cost. The total fixed cost included depreciation on building, machinery and equipment, well, vehicles, etc, salary, license fee, insurance. Total variable cost included raw material cost, wages, packaging charges, electricity charges, repairing and maintenance, fuel charges, GST, loss in processing and miscellaneous.

It is represented by:

Total cost = Total Fixed Cost + Total Variable Cost

Breakeven level of Dahi

Breakeven level is where there is no loss of money nor profit.

Break even output was worked out by following method:

TR =TR…1

$P \times Q = TFC + (VC \times Q)$…2

$P \times Q – (VC \times Q) = TFC$…3

$(P – VC) \times Q = TFC$…4

$Q = TFC / P – VC$…5

Where,

TR = Total Revenue

TC = Total Cost

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P = Price of output

Q = Breakeven output

TFC = Total Fixed Cost

VC = Variable Cost Per Unit

Profit = Gross Income – Total Cost of Processing

B: C ratio = Gross Income / Total Cost of Processing

Margin of Safety = Total Output – Output at breakeven point

Results and Discussion

Cost and returns of Dahi in Dairy Power Limited

The cost of Dahi production during the study period was worked out. The detailed description of various cost components has been presented in this section.

Table 2: Various Costs involved in Dairy Power Limited(2018-19)

Sr. No.	**Particulars**	**Amount (Rs.)**
1.	Establishment Cost	6,78,74,000
2.	Machinery Cost	2,66,44,000
3.	Equipment Cost	25,07,000
4.	Salary Expenses	59,76,000
5.	Wages Expenses	97,08,000

The establishment cost was calculated by considering the costs such as expenditure on construction of building, vehicles, cost of water structure (well) etc. Machinery and Equipment cost involved the cost of machineries such as milk storage tanks, packaging machines for different products, weighing balance, labeling machines, crates, etc. wages expenses were calculated by considering total labors worked during the period and the daily wages given to them per person. Salary expenses during the study period were calculated by adding up total staff working in the Dairy Power Limited and the monthly salary paid to all staff.

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Table 3: Gross Income of Dairy Power Limited (2018-19)

Sr. No.	Name of the product	Quantity/Year	Rate/Kg or Lit.	Amount/Year (Rs.)	%share of Product
1.	Cow Milk	1,08,00,000	36	38,88,00,000	55.09%
2.	Buffalo Milk	36,00,000	45	16,20,00,000	22.95%
3.	**Dahi**	**10,80,000**	**60**	**6,48,00,000**	**9.18%**
4.	Paneer	1,15,200	240	2,76,48,000	3.91%
5.	Shrikhand	24,000	250	60,00,000	0.85%
6.	Flavoured Milk	48,000	375	1,80,00,000	2.5%
7.	Butter Milk	5,40,000	20	1,08,00,000	1.53%
8.	Ghee	12,000	420	50,40,000	0.71%
9.	Lassi	1,80,000	125	2,25,00,000	3.18%
10.	Khoa	480	150	72,000	0.01%
	Total			**70,56,60,000**	

From above table it was concluded that cow milk has the highest share among the all other products of Dairy Power Limited which was 55.09 % and generated revenue of about Rs.38,88,00,000.

Also, the share of dahi was 9.18% which generated the revenue of Rs.6,48,00,000from the sale of 10,80,000 kg. The following all the values were calculated by considering the share ofdahi i.e. 9.18%

Table 4: Capital Investment of Dahi (2018-19)

Sr. No.	Particulars	Amount(Rs.)
1.	Land	19,27,800
2.	Building	82,620
3.	Water structure	1,51,470
4.	Machinery and Equipment	71,97,969
5.	Electronic Appliances	25,061.4
6.	Vehicles	6,24,240
	Total	**1,02,34,713**

The establishment cost required for Dahi was estimated to be Rs. 1,02,34,713. It was calculated by apportioning all the values by 9.185 share of Dahi.

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Table 5: Machinery and Equipment Cost of Dahi (2018-19)

Sr.No.	Name of Machinery and Equipment	No.	Cost/unit (Rs.0	Total cost (Rs.)	% share	Machinery and Equipment cost for Dahi(Rs.)
1.	Can Conveyor	1	25,000	25,000	9.18	2295
2.	Weighing Balance (RMRD)	1	80,000	80,000	9.18	7344
3.	Dump Tank	1	60,000	60,000	9.18	5508
4.	Milk Storage Tank	9	3,00,000	27,00,000	9.18	2,47,860
5.	Pasteurizer	1	18,00,000	18,00,000	9.18	1,65,240
6.	Homogenizer	1	15,00,000	15,00,000	9.18	1,37,700
7.	Steam Boiler and Generator	1	15,00,000	15,00,000	9.18	1,37,700
8.	Chiller	2	2,00,000	4,00,000	9.18	96,720
9.	Culture preparation tank	1	2,50,000	2,50,000	-	2,50,000
10.	Inoculation tank	1	2,50,000	2,50,000	-	2,50,000
11.	Curd settling tank	1	2,50,000	2,50,000	-	2,50,000
112.	Packing machine	2	25,00,000	50,00,000	91.52	45,76,000
13.	Crates	4000	500	20,00,000	9.18	1,83,600
14.	Labeling machine	1	1,50,000	1,50,000	9.18	13,770
15.	Crates	4000	500	20,00,000	3.91	78,200
16.	Incubation system	1	7,60,000	7,60,000	91.52	6,95,552
17.	Refrigeration system	1	16,00,000	16,00,000	9.18	1,46,880
18.	Effluent plant	1	10,00,000	10,00,000	9.18	91,800
	Total					**71,97,969**

All the Machineries required in production of Dahi were considered and the total Machinery and Equipment cost was found to be Rs.71,97,969.

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Table 6:Raw Material Cost of Dahi (2018-19)

Sr.No.	Raw Material	Total Procurement in Year	Rate/Unit (Rs.)	Total cost in Year(Rs.)
1.	Raw Milk	10,80,000 lit	35	3,78,00,000
2.	Culture	1,08,000 units	2.25	2,43,000
	Total			**3,80,43,000**

Raw material cost required for the Production of Dahi was Rs.3,80,43,000

Table 7: Packaging cost for Dahi (2018-19)

Sr.No.	Particulars	Quantity	Rate/Unit (Rs.)	Total Amount(Rs.)
1.	Cups (80 gm)	5,00,000	1.90	9,50,000
2.	Cups (175 gm)	8,00,000	2.70	21,60,000
3.	Buckets (5 kg)	60,000	41	24,60,000
4.	Cardboard boxes	27,375	8	2,19,000
5.	Tape	930	60	55,800
	Total			**58,44,800**

Packaging cost was estimated to be Rs.58,44,800

Table 8: Fixed cost of Dahi (2018-19)

Sr.No.	Particulars	Amount (Rs.)
1.	Depreciation on Building @ 2% on Rs.8,26,200	16,524
2.	Depreciation on Machinery and Equipment @ 10% on Rs. 71,97,969	7,19,796.9
3.	Depreciation on water structure@ 10% on Rs.1,51,470	15,147
4.	Depreciation on electronics appliances@10% on Rs.25,061.4	2,506.14
5.	Depreciation on vehicles @10% on Rs.6,24,240	62,424
6.	Salary	8,91,194.4

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7.	License	20,000
8.	Insurance	19,839.44
	Fixed cost	17,47,431.88
	Interest on fixed cost @ 12%	2,09,691.82
	Total Fixed Cost	**19,57,123.70**
	Fixed Cost Per kg	**1.81**

Fixed cost was calculated and it was found to be Rs.19,57,123.70 and for per kg it was Rs.1.81

Table 9: Variable cost for Dahi (2018-19)

Sr.No.	Particulars	Amount(Rs.)
1.	Purchase of Raw Material	3,80,43,000
2.	Wages	5,48,596.8
3.	Packaging Charges	58,44,800
4.	Electricity Charges	39,657.6
5.	Repairing of Machinery and equipment	59,670
6.	Fuel charges	91,800
7.	Miscellaneous	48,977.13
8.	Loss in processing @ 0.1%	64,800
9.	GST @ 5%	32,40,000
	Variable cost	4,79,81,301.53
	Interest on variable cost @ 12% on Rs.4,79,63,675.93	57,57,756.184
	Total Variable Cost	**5,37,39,057.71**
	Variable Cost Per Kg	**49.75**

The variable cost for Dahi production was calculated and it was Rs.5,37,39,057.71 and for per kg Dahi Production it was found to be Rs.49.75

Total Cost of Processing

Total Cost of Processing= Total Fixed Cost + Total Variable Cost

Total Cost of Processing= 19,57,123.70 + 5,37,39,057.71

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Total Cost of Processing = Rs. 5,56,96,181.41/-

Per Kg Cost of Processing of Dahi:

Per Kg Cost of Processing= $\frac{\text{Total Cost of Processing}}{\text{Total Quantity}}$

Per Kg Cost of Processing= $\frac{5,56,96,181.41}{10,80,000}$

Per Kg Cost of Processing for Dahi = Rs.51.57/-

Table 10: Profitability of Dahi (2018-19)

Name of Product	Per Unit Cost of Processing (Rs/kg)	Total Cost of Processing (Rs.)	Gross Income (Rs.)	Profit (Rs.)
Dahi	51.55	5,56,96,181.41	6,48,00,000	**91,03,818.59**

Dairy Power gained profit of Rs.91,03,818.59 annually from the production of 10,80,000 kg Dahi.

Break Even Analysis of Dahi (2018-19)

Break – even analysis is of vital importance in determining the practical application of cost functions. It is a function of three factors, i.e. sales volume, cost and profit. Break-even analysis is very important because in the short run, the cost curve and total revenue curve intersect which indicates the level of production at which the producer neither loses money nor make profit.

Break Even Point (BEP)

The points at which total revenue curve and total cost curve are intersect, then it is called as Break-even point.

a) Break Even Point in Terms of Units

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$$\text{BEP} = \frac{\text{Total Fixed Cost}}{\text{Price per kg} - \text{variable cost perkg}}$$

$$\text{BEP} = \frac{19{,}57{,}123.70}{60 - 49.75}$$

$$\text{BEP} = \frac{19{,}57{,}123.70}{10.25}$$

Break Even Point of Dahi (unit) = 1,90,938.89 Kg

1,90,938,89.79 kg of Dahi was required to cover the fixed and variable (Total) expenses.

b) Break Even Point in Monetary Terms

BEP = Total Fixed Cost / 1 - (variable cost per kg/price per kg)

BEP = 19,57,123.70 / 1 – (49.75/60)

BEP = 19,57,123.70 / 0.17

Break Even point of Dahi (Rs.) = Rs. 1,14,56,333.85/-

Rs. 1,14,56,333.85 revenue was must be generated to cover the fixed and variable (Total) expenses

Margin of Safety

The excess of production over the breakeven point is called as margin of safety. A high margin of safety indicates that the enterprise will make profits even if there is a fall in the output.

a) Margin of Safety in Terms of Units

Margin of Safety = Total Production – Output at BEP

Margin of Safety = 10,80,000 – 1,90,938.89

Margin of safety of Dahi (unit) = 8,89,061.11 Kg

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8,89,061.11 kg of Dahi was excess over the Break Even Point which means that this was the additional quantity of Dahi over the breakeven point.

b) Margin of Safety in Monetary Terms

Margin of Safety = Gross income – BEP in rupees

Margin of safety = 6,48,00,000 – 1,14,56,333.85

Margin of safety = Rs. 5,33,43,666.15

Margin of safety of Dahi (Rs.) = Rs. 5,33,43,666.15/-

Rs. 5,33,43,666.15 revenue was the additional revenue generated over the breakeven point of Rs. 1,14,56,333.85.

B: C Ratio

Benefit Cost ratio is an indicator used in cost-benefit analysis to show the relationship between the relative cost and benefits of a particular company or a particular project.

$$\text{B: C Ratio} = \frac{\text{Gross Income}}{\text{Cost of Processing}}$$

$$\text{B: C Ratio} = \frac{6{,}48{,}00{,}000}{5{,}56{,}96{,}181.41}$$

B:C Ratio = 1.16

It indicates that, when entrepreneur invested 1 rupee, he was getting16Paise from that investment.

Conclusion:

From the study it was concluded that, sufficient amount of resources were available in the region of Dairy Power and they were using it in efficient manner with minimum losses. Dairy Power has better layout and capacity design,so, there was efficiency in production activity with proper time and with minimum breakages and losses.Dairy Power has a wide range of scope to expand

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their business not only in Nashik district but also in Maharashtra through their more promotional efforts.

From the study of cost and returns of Dahi production it was revealed that 10,80,000 kg of Dahi was produced during the reference period which generated the revenue of about Rs.6,48,00,000. The share of Dahi was 9.18% among all the products of Dairy Power Limited. The total cost of production of dahi was Rs.5,56,96,181.41 in which the total fixes cost was Rs.19,57,123.70 while variable cost was Rs.5,37,39,057.71. The cost required for the production of 1 kg Dahi was Rs. 51.57. Profit earned during the reference period was Rs.91,03,818.59. also, it was revealed that the Dairy power was producing Dahi above the breakeven level which indicates the production of Dahi was economically feasible. So, from all the observations it can be concluded that production of Dahi was profitable for Dairy Power Limited.

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A Study on Economics of Production of Paneer and Cost and Return Analysis of Paneer in Dairy power Limited, Nashik, Maharashtra.

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ABSTRACT

The study was conducted at Dairy Power Limited, Nashik, Maharashtra. The research was carried out for the study of cost and return analysis of production of paneer. This milk plant having the capacity of 50,000 lit/day. Dairy Power limited engaged in manufacturing of products such as pasteurized milk, Homogenized milk, curd, paneer, shrikhand, flavoured milk, butter milk, ghee, lassi and khoa. Out of them paneer was select for the research. Paneer is indigenous variety of rennet-cogulated, small sized, soft cheese. It is used to prepare various dishes in Indian subcontinent such as sandesh, paneer tikka, rasgulla, paneer bhurji,etc. By conducting the research, it reveals that paneer has maximum share in terms of manufacturing as well as in selling as compared to other products of Dairy Power Limited. The capacity of Paneer manufacturing was found to be 1,15,200 Kg/year. The study also tells that, profit for paneer was Rs. 88,06,632/- and B:C ratio was found to be 1.46. By conducting research it was concluded that, Dairy Power Limited has wide range of scope to expand their business in terms of paneer manufacturing as they follow the principle of cost minimization and profit maximization.

Key Words: Cost and Return, Profit, B:C Ratio, Cost Minimization, Profit Maximization

INTRODUCTION

Dairy industry plays a dynamic role in India's Agro-based economy. India is a largest producer and consumer of milk in the world. India ranks first in the world milk production. Milk production of India during 2017-18 is 176.3

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million tonnes with per capita availability of milk at a level of 375 gram per day in 2017-18. India surpassed the US in 1998 with a production of 92 million tonnes to become the largest milk producing country in the world. The Indian dairy industry contributes to 4% of GDP which leads to astonishing success for dairy industry in India. Dairy activities form an essential part of the rural Indian economy, serving as an important source of employment and income. India also has the largest bovine population in the world. The dairy market in India reached a value of INR 9,168 Billion in 2018.Along with offering profitable business opportunities; the dairy industry in india serves as a tool of socio-economic development. Keeping this in view, the Government of India has introduced various schemes and initiatives aimed at the development of the dairy sector in the country. For instance, the 'National Dairy Programme' (Phase 1) aims to improve cattle productivity and increase the production of milk, strengthening and expanding the rural milk procurement infrastructure and provide greater market access to the farmers. On the other hand, the private participation in the Indian dairy sector has also increased over the past few years. Both national and international players are entering the dairy industry, attracted by the size and potential of the Indian market. The focus is being given to value added products such as paneer, curd, shrikhand, lassi, buttermilk, etc. looking forward, the Indian dairy market is expected to reach a value of INR 21,971 Billion by 2024.

Indian dairy industry of late has become the major growth area and goes for beyond being an important agri-business sector of the national economy. Besides being the largest milk producing country with 5% annual increase in milk production, India has a large market of dairy products due to constantly increasing demand for variety of milk products in the urban as well as rural sectors. But at the same time estimation of cost and break-even level of various milk products is unavoidable part of management to take right decisions for

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product manufacturing, policy and planning purpose to ensure maximum turnout from the plant. Keeping in view the scenario of Indian dairy industry, demand for milk products, and need for value addition, Dairy Power limited company chosen for the research or study. Dairy Power Limited situated at Songaon, Post Saikheda, Dist. Nashik, Maharashtra. Dairy Power Limited was established in year of 2008. The research was carried out by considering the following objectives,

1) To study cost of processing of paneer in dairy power limited
2) To study profitability of paneer in dairy power limited
3) To study break even analysis of paneer in dairy power limited.

METHODOLOGY

For estimation of costs and returns for paneer manufacturing in dairy power limited, required data were collected by taking personal interviews and by observation. The research was carried out during the year 2018-19. The personal interview was takes place with Management staff, supervisors, machine operators, incharge of each section and workers and collects the data regarding various aspects such as Resource use management, Human resource management, Inventory management, financial management, utilization of machineries, utilization of water, steam and electricity. Discussion were held with management staff to know about daily procurement of milk, quality testing, price paid for milk, raw material used by paneer section for its manufacturing. Information about number of labours and employees, their functions and roles, salary, distribution of work, etc. were collected from Human Resource Department. Information regarding number of inventories, their maintenance, purchase procedure, method of ordering was collected from inventory department. Information about method of quality control, methods for checking adulteration of milk, chemicals, etc was collected from quality control

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department. The actual observation method was used to obtain information on factors such as utilization of raw material, various utilities such as water, fuel, steam, method of paneer production, temperature and water requirement at each stage, allocation of workers at each stage of paneer production, storage temperature, required packaging material, daily capacity of paneer production of dairy power limited, etc.

Estimation Procedure

For estimating the cost and returns for paneer production in dairy power limited, various cost component was considered such as cost of raw material, packaging cost, total machinery and equipment cost, their depreciation, repairing and maintenance charges, expenses on manpower, expenditure of utilities such as water, steam, fuel, and miscellaneous expenses.

Total Cost

Total cost was estimated by considering both fixed cost and variable cost required for production of paneer which is represented by:

Total Cost = Fixed Cost + Variable Cost

Fixed Cost

Fixed costs are those costs which do not vary with the level of production. Depreciation on building, machineries, equipment, electronic appliances, water structure, vehicles, cost of salary of employees, insurance, license was considered as a fixed costs while estimating the cost of production of paneer.

Variable Cost

Variable costs are those costs which vary with the level of production. Cost of raw material, packaging charges, wages of workers, repairing of machinaries

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and equipments, fuel charges, electricity charges was considered as a variable cost while estimating the cost of production of paneer.

Break-Even Analysis of Paneer

Break-even analysis is very important because in the short run, the cost curve and total revenue curve intersect which indicates the level of production at which the producer neither losses money nor make profit.Break-even point was worked out by using formula,

BEP = Total Fixed Cost / (Price per Kg – Variable Cost perKg)

Margin of Safety

The excess of production over breakeven point is called as margin of safety. A high margin of safety indicates that the enterprise will make profit even if there is a fall in the output. Margin of safety was worked out by using formula,

Margin of Safety = (Total Production) – (Output at BEP)

B:C Ratio

Benefit Cost ratio is an indicator used in cost-benefit analysis to show the relationship between the relative cost and benefit of a particular company or particular project. B:C ratio was worked out using formula,

B:C Ratio = (Gross Income) / (Cost of Processing)

RESULTS AND DISCUSSION

The cost of production of dairy power paneer and its profitability during the study period was worked out. The detail study about cost of production, break even analysis, and profitability has been presented in this section.

Dairy Power Limited has wide range of products. By taking apportion of all products on the basis of their gross income, paneer acquired 3.91%. The all calculations given below are according to the apportion or percentage (3.91%) of income from paneer in dairy power limited.

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During 2018-19, dairy power limited achieved the 1,15,200 Kg of paneer production. The various cost components required for estimating cost of production of paneer and their detail analysis has been given below,

Table 1: Annual Gross Income of Dairy Power Limited (2018-19)

Sr.No.	Name of the product	Quantity/Year	Rate/Kg or Lit.	Amount/Year (Rs.)	%share of Product
1.	Cow Milk	1,08,00,000	36	38,88,00,000	55.09%
2.	Buffalo Milk	36,00,000	45	16,20,00,000	22.95%
3.	Dahi	10,80,000	60	6,48,00,000	9.18%
4.	**Paneer**	**1,15,200**	**240**	**2,76,48,000**	**3.91%**
5.	Shrikhand	24,000	250	60,00,000	0.85%
6.	Flavoured Milk	48,000	375	1,80,00,000	2.5%
7.	Butter Milk	5,40,000	20	1,08,00,000	1.53%
8.	Ghee	12,000	420	50,40,000	0.71%
9.	Lassi	1,80,000	125	2,25,00,000	3.18%
10.	Khoa	480	150	72,000	0.01%
	Total = 70,56,60,000				

Above table shows that annual gross income of paneer is Rs. 2,76,48,000/- and acquires 3.91% of gross income of dairy power limited.

Initial Capital Investment for paneer

Initial capital investment for paneer includes the factors like land, building, water structure, machineries and equipments, electronic appliances and vehicles for procurement of milk as well as distribution of final product. Initial capital investment is shown in following table,

Table 2: Initial Capital Investment for Paneer (2018-19)

Sr.No.	Particulars	Amount(Rs.)
1.	Land	8,21,100
2.	Building	3,51,900
3.	Water structure	64,515
4.	Machinery and Equipment	18,39,366.5

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5.	Electronic Appliances	10,674.3
6.	Vehicles	2,65,880
	Total	**33,53,435.8**

Total Machinery and Equipment Cost for Paneer

Major machineries and equipments required for paneer production and their costs are shown in following table,

Table 3: Total Machinery and Equipment Cost for Paneer (2018-19)

Sr.No.	**Name of Machinery and Equipment**	**Machinery and Equipment cost for paneer(Rs.)**
1.	Can Conveyor	977.5
2.	Weighing Balance (RMRD)	3,128
3.	Dump Tank	2,346
4.	Milk Storage Tank	1,05,570
5.	Pasteurizer	70,380
6.	Homogenizer	58,650
7.	Steam Boiler and Generator	58,650
8.	Chiller	15,640
9.	Weighing Balance for paneer	10,000
10.	Paneer Press Machine	7,00,000
11.	Movable Tanks	25,000
12.	Paneer Packing Machine	6,00,000
13.	Stirer	1,400
14.	Muslin Cloth	1,600
15.	Crates	78,200
16.	Knife	300
17.	Labeling Machine	5,865
18.	Refrigeration System	62,560
19.	Effluent Plant	39,100
	Total	**18,39,366.5**

Total Salary and Wages Expenses for Paneer

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Total salary and wages expenses required for production of paneer includes the total cost required for manpower worked at administrative level as well as at factory level.

Table 4: Total Salary and Wages Expenses for Paneer (2018-19)

Sr. No.	Particulars	Amount (Rs.)
1.	Wages Expenses	2,33,661,6
2	Salary Expenses	3,79,582.8
	Total	**6,13,244,4**

Raw Material Cost for Paneer

The major raw materials required for preparation of paneer are raw milk and citric acid powder. The detail cost analysis of raw material for preparation of 1,15,200 Kg of paneer is given below,

Table 5: Raw Material Cost for Paneer (2018-19)

Sr.No.	**Raw Material**	**Total Procurement in Year(kg)**	**Rate/lit or kg(Rs.)**	**Total cost in year(Rs.)**
1.	Raw Milk	3,60,000	35	1,26,00,000
2.	Citric Acid Powder	950.4	210	1,99,584
	Total			**1,27,99,584**

Packaging Cost for Paneer

Dairy Power Limited packed their paneer mostly in plastic sachets and cardboard boxes. Total Packaging cost required for packing 1,15,200 Kg of paneer is given below,

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Table 6: Packaging Cost for Paneer (2018-19)

Sr.No.	Particulars	Quantity	Rate/Unit (Rs.)	Total Amount(Rs.)
1.	Plastic Sachets	5,76,000	3	17,28,000
2.	Cardboard Boxes	11,520	8	92,160
3.	Tape	390	60	23,400
	Total			**18,43,560**

Fixed Cost for Paneer

Fixed costs do not vary with the production level. Estimation of total fixed cost required for paneer production (1,15,200 Kg) is given below,

Table 7: Fixed Cost for Paneer (2018-19)

Sr.No.	Particulars	Amount (Rs.)
1.	Depreciation on Building @ 2% on Rs.3,51,900	7,038
2.	Depreciation on Machinery and Equipment @ 10% on Rs. 18,39,366.5/-	1,83,936.65
3.	Depreciation on water strucuture@ 10% on Rs.64,515	6,451.5
4.	Depreciation on electronics appliances@10% on Rs.10,674.3	1,067.43
5.	Depreciation on vehicles @10% on Rs.2,65,880	26,588

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6.	Salary	3,79,582.8
7.	License	20,000
8.	Insurance	8,450.13
	Total	**6,33,114.51**
	Interest on fixed cost @12% on Rs.6,33,114,51	**75,973.74**
	Total Fixed Cost	**7,09,087.98**

Variable Cost for Paneer

Variable cost vary with the level of production, estimation of total variable cost required for production of paneer (1,15,200 Kg) is given below,

Table 8: Variable Cost for Paneer (2018-19)

Sr.No.	**Particulars**	**Amount(Rs.)**
1.	Purchase of Raw Material	1,26,00,000
2.	Wages	2,33,661.6
3.	Packaging Charges	18,43,560
4.	Electricity Charges	16,891.2
5.	Repairing of Machinery and equipment	25,415
6.	Fuel Charges	39,100
7.	Miscellaneous	20,860.63
8.	Loss in processing @ 0.1%	27,648
9.	GST @ 5%	13,82,400

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	Variable cost	1,61,89,536.43
	Interest on variable cost @ 12% on Rs.1,61,82,029.2	19,42,744.37
	Total Variable Cost	**1,81,32,280.8**

Total Cost of Processing of Paneer

Total cost of processing estimated by considering total fixed cost and total variable cost.

Total Cost of processing = (Total Fixed Cost) + (Total Variable Cost)

Total Cost of Processing = 7,09,087.98 + 1,81,32,280.8

Total Cost of processing = Rs. 1,88,41,368.78/-

Per Kg Cost of Processing

Per Kg Cost of Processing $=\frac{\text{Total Cost of Processing}}{\text{Total Quantity}}$

Per Kg Cost of Processing $= \frac{1{,}88{,}41{,}368.78}{1{,}15{,}200}$

Per Kg Cost of Processing = Rs.163.55/-

Profitability of Paneer

Profitability of paneer was calculated by subtracting total cost of processing from gross income of dairy power paneer

Product	Per Unit Cost of Processing (Rs/kg)	Total Cost of Processing (Rs.)	Total Output (Kg/Year)	Rate/ Kg	Gross Income (Rs.)	Profit(Rs.)
Paneer	163.55	1,88,41,368.78	1,15,200	240	2,76,48,000	**88,06,632**

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Profitability of paneer from estimated capital investment is Rs. 88,06,632/-

Break Even Analysis of Paneer

Break even analysis of paneer includes following aspects,

Break Even Point of Paneer in Unit

The point at which total revenue curve and total cost curve are intersect, then it is called as Break-even point.

$$\text{BEP} = \frac{\text{Total Fixed Cost}}{\text{Price per kg} - \text{variable cost perkg}}$$

$$\text{BEP} = \frac{7{,}09{,}087.98}{240 - 157.39}$$

BEP = 8,583.56 Kg

Break Even Point for paneer in terms of unit is 8,583.56 Kg which indicates that, 8,583.56 Kg paneer is required to cover the total fixed and variable expenses to break even.

Break Even Point of Paneer in Monetary Terms

$$\text{BEP} = \frac{F}{1 - (\frac{V}{P})}$$

Where,

F = Total Fixed Cost

V = Variable Cost per Kg

P = Price per Kg

$$\text{BEP} = \frac{7{,}09{,}087.98}{1 - (157.39/240)}$$

BEP = Rs. 20,60,054.4

Therefore break even point of paneer in monetary terms is Rs.20,60,054.4 which indicates that Rs.20,60,054.4 revenue should be generated from production of paneer to cover the total expenses required for it.

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Margin of Safety in Unit

The excess of production over the break even point is called as margin of safety. A high margin of safety indicates that the enterprise will make profits even if there is a fall in the output.

Margin of Safety = (Total Production) – (Output at BEP)

Margin of Safety = 115200 – 8,583.56

Margin of Safety = 1,06,616.44 Kg

Therefore margin of safety for paneer in unit is 1,06,616.44 Kg which means that it is additional quantity of paneer over the break even point.

Margin of Safety in Monetary Terms

Margin of Safety = (Gross income) – (BEP in rupees)

= 2,76,48,000 – 20,60,054.4

= Rs. 2,55,87,945.6/-

In this way margin of safety of paneer in monetary terms is Rs.2,55,87,945.6/- which is additional revenue generated from break even point of Rs. 20,60,054.4/-

B:C Ratio of Paneer

Benefit Cost ratio is an indicator used in cost-benefit analysis to show the relationship between the relative cost and benefits of a particular company or a particular project.

B: C Ratio $= \frac{\text{Gross Income}}{\text{Cost of Processing}}$

B: C Ratio $= \frac{27648000}{1{,}88{,}41{,}368.78}$

B:C Ratio = 1.46

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B:C Ratio for paneer is 1.46 which means that when entrepreneur invest 1 rupee then he get 0.46 paisa from that investment

Conclusions

The study on economics of paneer production in dairy power limited indicated that it is profitable enterprise in terms of paneer production and also occupied second largest production and profit as compared to other by products of dairy power limited. Similarly dairy power paneer has better shock absorbing capacity as compared to other products of dairy power limited because it has a higher margin of safety which is over the break even point of dairy power paneer as well as it has good B:C ratio which is 1.46. At the same time it was observed that dairy power limited follows the principle of optimum utilization of all types of resources for production of paneer which leads to cost minimization and profit maximization.

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A Study on Impact of Climate Change on Food security and Agri business Sector in Maharashtra State

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Abstract:

Food security is very important aspects in agriculture;Agriculture is backbone of our Indian economy and to provide adequate food supply to each and every citizen of India under right to food initiative of the government andin the food security by various laws and act of food security.

In Maharashtra state, and climate change is having direct relation with the production in agriculture and indirect relation with the business of agriculture companies. The state is facing lot of problems due to the draught and sudden change in climatic conditions so around 60% of Maharashtra population who directly and indirectly depend upon agriculture are facing the problems of income through agriculture such as farmers, dealers, distributors and the production units of seeds, fertilizers and pesticides and related products. Due to the draught the farmers are facing water scarcity and because of heavy rainfall the farmers are facing huge loss in production so in both the conditions the cost of production increases and the companies who are in production ofagriculture inputs are also facing huge loss and food security became a big challenge and to deal with this challenge many efforts are needed for ensuring the enough food to the growing Indian population.

In this study we visited agriculture graduates and belonging to farming community of agriculture related business to find out the impact of sudden climate change on the crop production, food production, agribusinessand its allied sectors. The motive behind this study is to find out the reason behind this food scarcity and also to find the different ways of food security. The survey has done along with the questionnaire to find out the socio economic loss of the agribusiness sector due to the global warming and also the ground water depletion and the future difficulties if the same scenario continues for the years and years.

In year 2019 because of heavy rain fall in western Maharashtra and draught in vidharbh and marathwada area the crop production and business of big giants of agribusiness are affected heavily so in this paper the direct and indirect impact of climate change is highlighted with the actual meeting of agriculture people in that area for finding the solutions to this problem in future course of action.

Keywords: Climate change, Food security, Drought, Agribusiness, Crop production, Global warming etc.

Introduction:

Agriculture plays an important role in economic development of India, agriculture accounts around 14% GDP and 11% exports. In last decade many technological changes happened in this sector, many technique adopted by farmers to increase the production and their income. Organic farming also played important role in the development of agriculture. Many foreign companies invested in agriculture of India as this sector is having huge scope in business.

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Agribusiness is the business related to agriculture, in this business thousands of companies are playing important role as far as development is concern. In this business there are some input companies such as seeds, fertilizers, pesticides, micro nutrients etc and some output companies such as exports, food processing, banks and microfinance organizations. Every company is offering the goods and services to the farmers from the sowing to the post harvest for contributing to the farmer’s income along with their business growth.

In this decade many companies are started their business in Maharashtra as Maharashtra is known for agriculture as many crops such as Wheat, Maize, sorghum, soybean, barley, pulses, grapes, pomegranates, vegetables etc are having major production in Maharashtra.

The major challenge that the agriculture sector is facing is climate change, unpredictable rainfall, draught because of global warming, this year Maharashtra state faced lot of challenges due to this climate change, the various parts of the state are affected heavily and occurred huge losses in terms of income and in terms of resource utilization.

In this paper main focus is on the impact of climate change on agribusiness sector and measures to find out the remedial action to minimize this impact as the forecasting of weather is also unpredictable. Around 100 dealers and distributors are visited in this study from various parts of Maharashtra to understand the impact on agriculture sector because of draught, floods, cold and hot temperatures. The company’s business are affected due to this climate change is studies to understand the future courseof action to develop entrepreneurship.

Review of Literature:

Goswami et al. (2006) written in his paper that there is continuous increase in rainfall over the India and it will increase in hazards like increasein surfacetemperature by 2 to 4 degree, changes in rainfall during monsoon and even non monsoon months, increase in rain intensity by 1-4mm per day, GDP will drop by 5% and hence impact on crop yields and related business of agriculture as a whole system.

Brown (2009) focused on the ground water as a major source of utilization of water under irrigation, 15 percent of food is produced by mining of ground water. The groundwater level is decreasing day by day as over extraction is main cause and it will be very critical with huge losses to agriculture sector in next 20 years.

Ahmad et al. (2011) stated in research paper that 46% of Indian geographical area is under agriculture, a large percentage of land falls in rain-fed region and generates 55 percent of Indian agriculture outcome. More than 80% of the farmers are small scale producers of agriculture products and they have very less capacity to deal with the weather and climate change

Sanjay rode (2011) studied in his research that the water demand is increasing in maharashtra state because of population growth and changing cropping pattern. The equal distribution of rainfall is not seen in the state as government is supporting more industrialization than

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agriculture. in order to reduce the scarcity of water the government should allow the farm ponds, rain water harvesting and various other measures.

ParmeshwarUdmale et al. (2014) seen in his research that the draught is a huge challenge to some areas of Maharashtra, the objective of study is to understand the perception of the farmers on the impact of draught on their socio economic environment. The study shows decrease in income level of farmers due to ground water depletion and climate change is big problem in coming future.

Objective of study:

In view of above discussion the research is focus various problems associated with the agriculture business due to climate change with following objectives

1. To understand the impact of climate change on food security in agriculture sector
2. To analyze the feedback of various respondents on climate change and their income level

Research Methodology:

In the methodology of research primary data is collected from 100 respondents of various parts of Maharashtra to understand the impact of climate change on agriculture and agribusiness sector with the help of structured questionnaire. The sampling method used is random sampling and the target respondents are students of agribusiness colleges.

Data Analysis and Results:

Out of 100 respondents more than 70% of the respondents are well aware about the impact of climate change and agree upon the losses in agribusiness incurred are higher as compared to last few years due to which the cost of production is increasing and farmers are becoming poor and poor.

The questionnaire comprises of following questions and on the basis of responses the representation of data is shown in the column chart.

The survey was done and in that survey various results are generated.

1. **How many agriculture companies you know who are giving products and services to agriculture**

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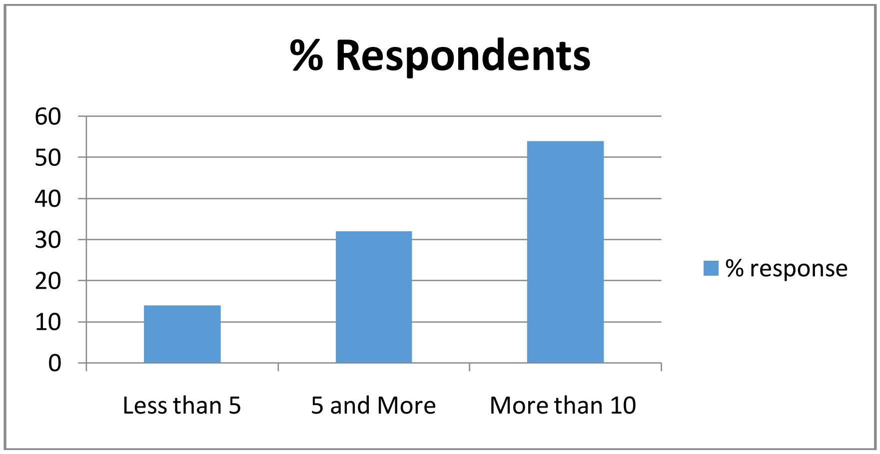
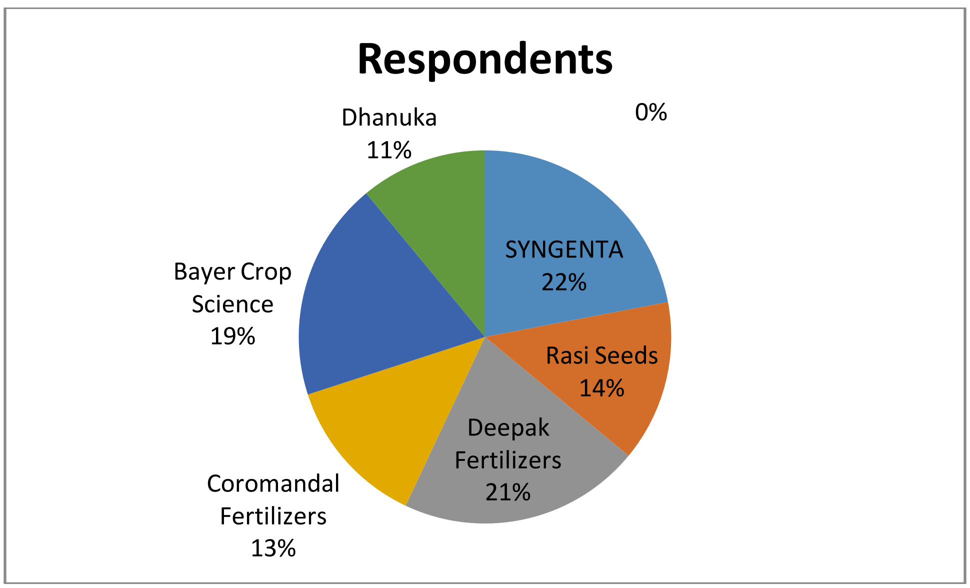


More than 50% of agriculture graduates are aware about more than 10 companies of agribusiness sector which are giving products and services to agriculture.

2. **Which input sector company products you are using in your farm for various purposes right from sowing to post harvest**



Top 6 agriculture companies are asked to the respondents which they are using in their farm so the majorly all company products and services are used by the respondents.

3. **Which output sector company products you are using in your farm for various purposes right from sowing to post harvest**

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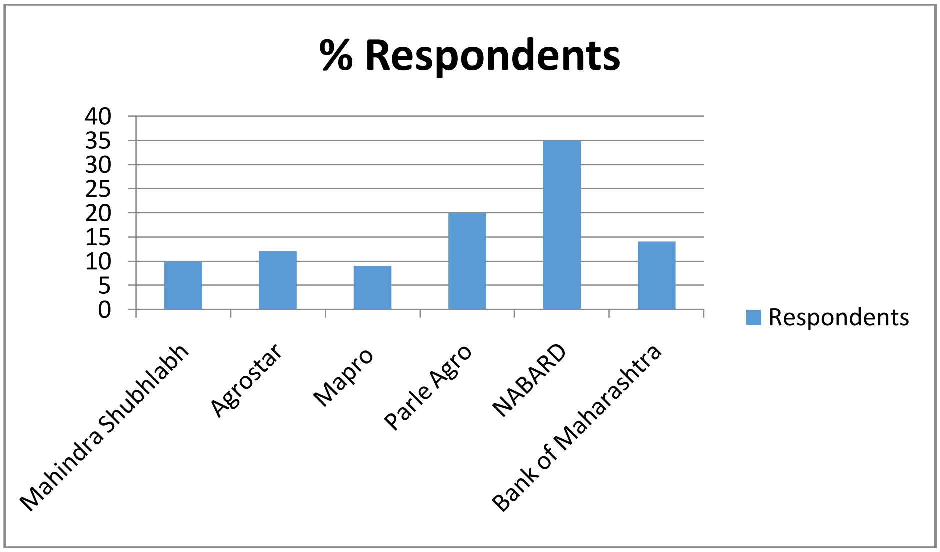
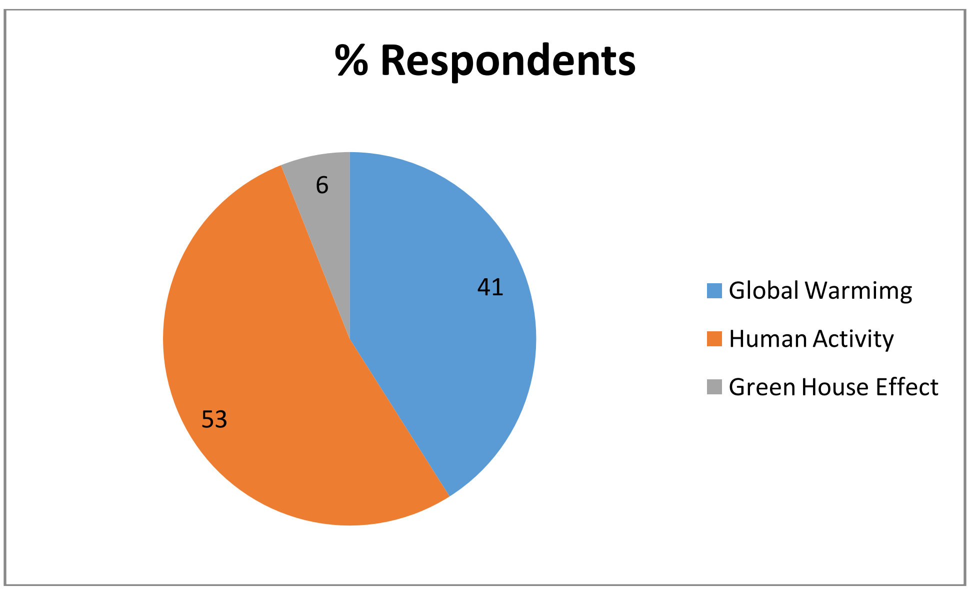


The output companies are majorly exports, food processing and banks which are giving services to the farmers**.**

4. What are the reasons of climate change from your point of view



53% respondents are saying that the human activities like industrialization, urbanization are the reasons of climate change and global warming and green house effect are also factors for climate change.

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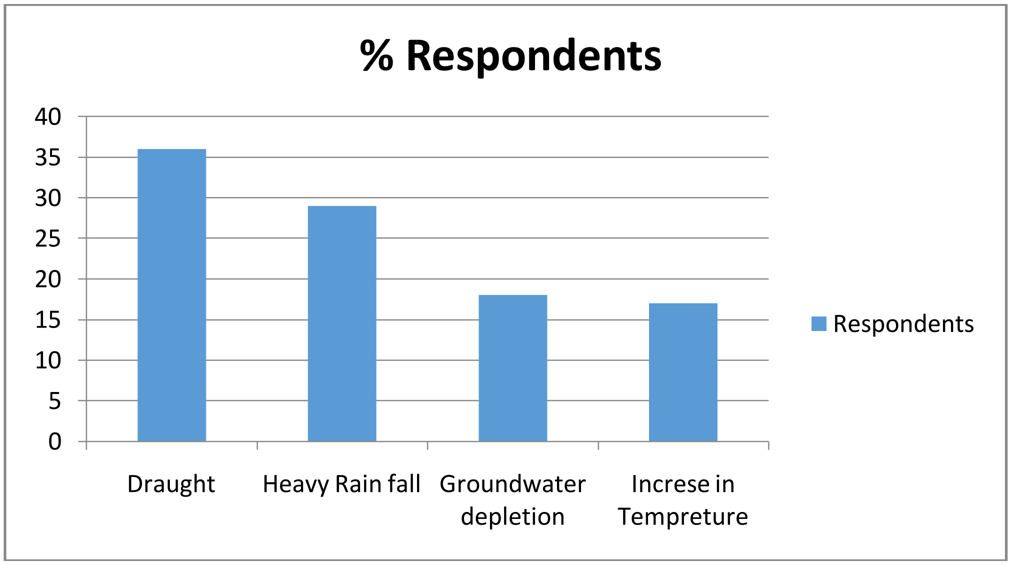
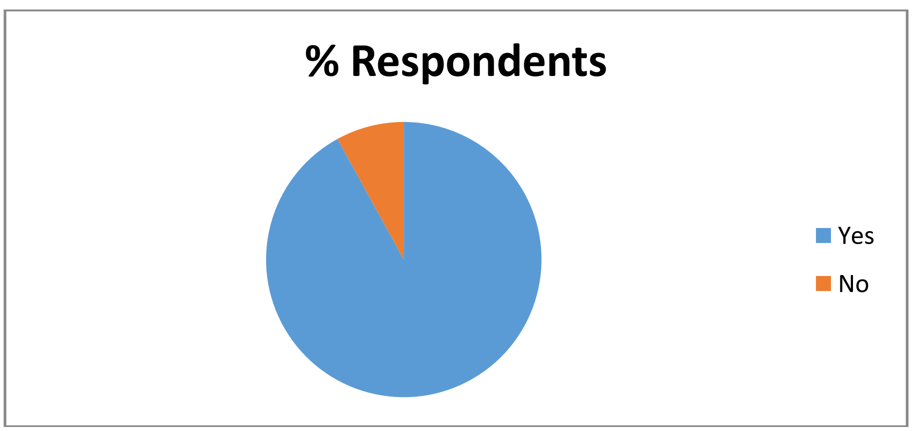
5. **What are the impacts of climate change on food security in agriculture**



36% respondents are saying drought is the major impact of climate change followed by heavy rainfall, ground water depletion and increase in temperature.

6. **Does income level decreases of farmers and cost of production increases due to climate change**



92% of students are saying that because of climate change the cost of production increases and income level decreases.

7. **Does climate change affects the income of agribusiness companies which are stated in above question**

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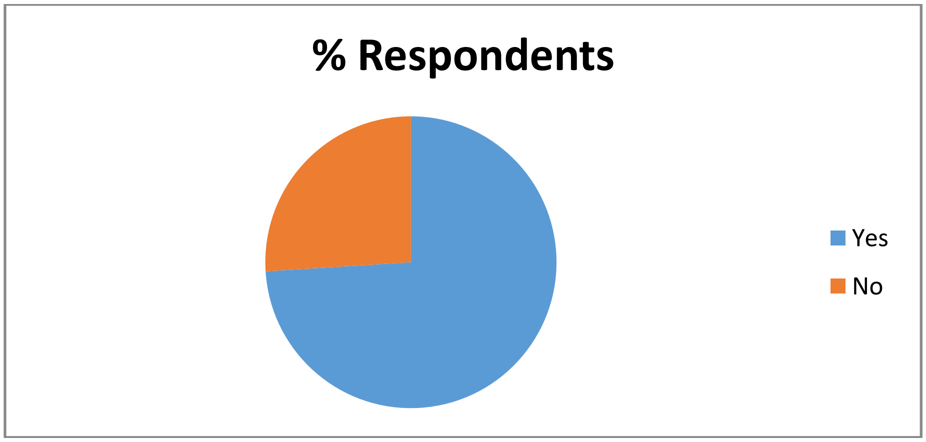
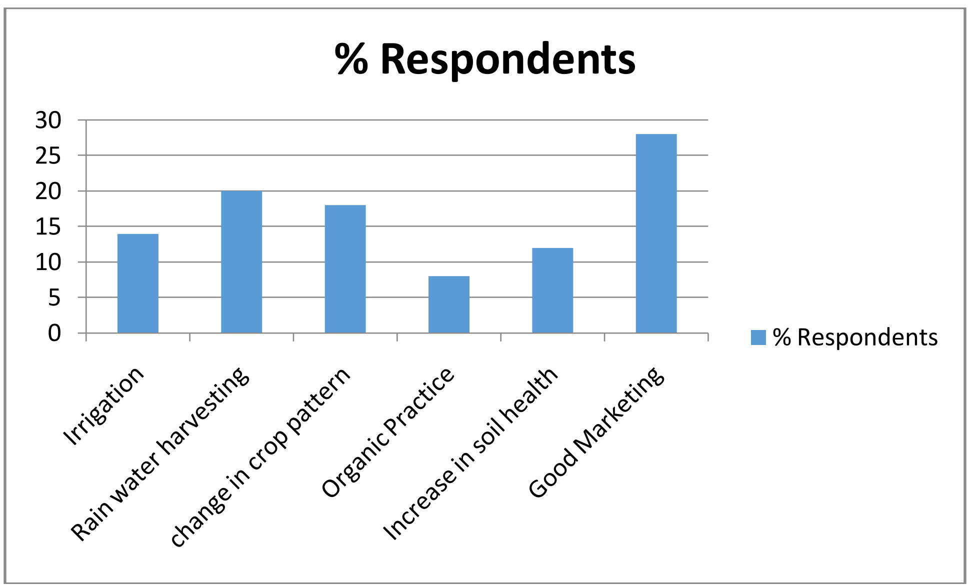


The 74% students who are agriculture graduates who know more than 10 companies of agriculture which are offering products and services are responded that the income level of agribusiness companies affected because of climate change.

8. How to manage the impact of climate change to increase the food security and income of income of agriculture sector



The various measures to reduce the impact of climate change in Maharashtra is discussed and mix response received in this context.

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Conclusion:

In the study of primary responses received from the students of agribusiness colleges who are having farming background and having worked in theirfarms,it is seen that more than 70% of respondents are experienced the impact of climate change on food security and agribusiness sector in their own farms in various parts of Maharashtra state.

Drought, heavy rainfall, ground water depletion and increase in temperature is seen as effect of climate change in Maharashtra state. The farmers and various companies in input as well as output of agriculture which are giving products and services to the agriculture field are also affected with loss in their income level.

The various measures are suggested in this study to minimize the adverse effect of climate change and to increase the food security are effective irrigation management, Rain water harvesting, farm ponds, change in crop pattern, use of organic practice in the farm to get the chemical free farm produce which is good for health of the human being, increase in the soil health by different crops at different climatic conditions, farmers marketing of products both online as well as offline to get the maximize profit by minimizing the middle level people who are incurring many losses to the farmers.

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Analysis of Kisan Mobile Advisory Text Message Sent to Farmers of Latur District, India

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ABSTRACT

Information and communication technology (ICT) is developing very fast it has made its impact on lives of common man. The rapid development of communication technology has become a boon to farmers for getting timely and appropriate message as per the cropping season. In this regard Krishi Vigyan Kendra (KVK) are acting as bridge between farmers and transfer of technology under the aegis of Indian Council of Agriculture Research in dissemination of these message to farmers'. The present study is aimed at to analysis of two year data of text messages sent by KVK Latur to farming community. The study was conducted in Latur district of Marathwada region. Population for the study comprised of respondents who were subscriber of Kisan Mobile Advisory Service (KMAS) in Latur district. From latur district Latur, Ausa and Renapur tahsils were selected purposively because more number of farmers in these tahsils were using KMAS. Proportionate sampling method used in selection of respondents, thus total sample size was one hundred and twenty respondents which who are subscribers of KMAS. One shot case study method of ex-post-facto research design was adopted for this study. Data was coded, tabulated, analysed and interpreted using suitable statistical parameters.
Key words: KMAS, KVK, ICT, SMS

Kisan Mobile Advisory Service scheme in main line extension system of Krishi Vigyan Kendras (KVK) is new ICT initiatives to meet the needs and expectations of the farmers. KMAS is started by ICAR with the aim of passing the agricultural information to maximum number of farmers in local language through SMS free of cost. The Kisan Mobile Advisory Service (KMAS) is started by ICAR with the aim of passing the agricultural information to maximum number of farmers in local language through SMS free of cost. Subject areas of KMAS are Agronomy, Plant protection, Horticulture, Animal science, Home science, Dairy. Advantages of KMAS are farmers can get free information, location specific information delivery, provide information in local language and cost effective. Kisan Mobile Advisory Service (KMAS) delivers real-time agricultural information and customized knowledge to improve farmers decision making ability so that they may enable to increase their production and productivity, better aligning the farm output to market demands; securing better quality and improved price recovery in a globally competitive agrarian economy. The service comprises sending Short Message Service (SMS) alerts from KVK to the farmers.

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MATERIALS AND METHODS

Population for the study comprised of respondents who were subscriber of Kisan Mobile Advisory Service in Latur district. From latur district Latur, Ausa and Renapur tahsils were selected purposively because more number of farmers in these tahsils were using KMAS. Proportionate sampling method used in selection of respondents, thus total sample size was one hundred and twenty respondents which who are subscribers of KMAS. One shot case study method of ex-post-facto research design was adopted for this study.

Among the subject areas, highest number of messages was sent in the area of animal husbandary. Total number of SMS sent related to Animal husbandary was 20, followed by Agronomy and Plant protection was 18 and 17 respectively. With regard to animal husbandary, Dairy: Nutrition and Health (10 SMS), fodder management (6 SMS) and Sheep and goat: Nutrition and Health were sent by KVK .

RESULTS AND DISCUSSION

Table 14: Subject Areas covered under Kisan Mobile Advisory Service in 2017 -2018

Sl. No.	Areas	No. of SMS sent by KVK (2017)	No. of SMS sent by KVK (2018)
1	**Agronomy**		
	Nutrient Management	**3**	**4**
	Seed treatment	**1**	**3**
	Weed Management	**3**	**4**
2	**Soil science**		
	Soil management	**-**	**-**
	Water management	**1**	**1**
3	**Plant protection**		
	Pest management	**4**	**9**
	Disease management	**-**	**1**
4	**Meteorology**		
	Rainfall	**5**	**-**

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5	**Horticulture**		
	Fruit	**-**	**2**
	Floriculture	**-**	**-**
6	**Animal husbandry**		
	Dairy: Nutrition and Health	**5**	**6**
	Sheep and goat: Nutrition and Health	**2**	**1**
	Poultry: Nutrition and Health	**-**	**-**
	Fodder Management	**2**	**4**
7	**Home science**		
	Food and Nutrition	**7**	**6**
8	Post harvest management	**1**	**-**
9	Information on extension activities	**2**	**4**
10	Agriculture products of KVK available for sale	**4**	**2**
Total		**40**	**47**

During 2017 , there are 40 SMS sent by KVK to the farmers and during 2018, there are 47 SMS sent by KVK to the farmers. Among the subject areas, highest number of messages was sent in the area of animal husbandary. Total number of SMS sent related to Animal husbandary was 20, followed by Agronomy and Plant protection was 18 and 17 respectively. With regard to animal husbandary, Dairy: Nutrition and Health (10 SMS), fodder management (6 SMS) and Sheep and goat: Nutrition and Health were sent by KVK .

In Agronomy, about nutrient management and weed management were same (7 SMS) and seed treatment (3 SMS) sent by KVK. SMS sent by KVK related to home science (9 SMS) followed by Information on extension activities (6 SMS) , Agriculture products of KVK available for sale (6 SMS) and Meteorology (5 SMS) sent by KVK. Least number of SMS sent related to Soil science (2 SMS) and Horticulture (2 SMS).

The reason may be in agriculture now a day's marketing of produce is very important. However, the other aspects like nutrient management, seed treatment, weed management, soil management, water management, pest and disease management etc. are also equally important. Other technologies like nursery preparation, floriculture and vegetable are also important technologies

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disseminated through KMAS. In the study area most of the farmers have started taking dairy poultry, sheep and goat rearing as a subsidiary activity. So the technologies disseminated related these were more relevant. Further, government schemes and programmes are helpful in improving livelihood of the farmers.

CONCLUSION

It was concluded that, message related to Animal husbandary were in large number 20 SMS, followed by messages on Agronomy was 18 SMS and Plant protection was 17 SMS. Least number of SMS sent related to Soil science (2 SMS) and Horticulture (2 SMS). The poor network in villages is one of the major constraints in accessing the messages. The conclusion from the messages may be inferred that, KMAS messages were very helpful tips for farmer in need. There may be increased provision for frequency of message per week i.e. least three messages per week will cater to other disciplines which are less covered this issue needs to be addressed through policy intervention by concerned authorities. Another constraint during this study was mobile network which is a barrier for receiving message by farmers.

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Studies and Development of Bioethanol Fuel Production From Rotton Banana

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Abstract:

Bioethanol produced from biomass represents a promising alternative fuel extender. Banana biomass can be used as raw material to produce bioethanol. Banana waste is discarded due to the imperfection during grading process. In this study, fermentation of banana waste was conducted using *Saccharomyces cerevisiae*, under anaerobic condition. Production of bioethanol was determined and the effects of various operating conditions which included different temperatures, pH, rotten and fresh banana fruit and saccharification method were observed. Overall, the fermented banana fruit waste produced 4.5 to 7.7% bioethanol. The bioethanol yield from mixture of rotten banana fruit increased with increase fermentation period with 8 days at pH 5.5 and combination of enzymes (pectinase and cellulase) produced higher bioethanol than enzyme alone. The results showed that, utilization of mixture (skin and pulp) of rotten fruit was more suitable for bioethanol production as renewable energy which could reduce the cost of the initial process. In addition, it did not compete with the consumer food supply and could avoid the overloaded waste for compose, as well as could be used as fuel in the normal petrol engine. In addition to that, energy could be produced from waste banana fruit as environmental recyclingprocess.

Key words: Bioethanol, biomass, fermentation, rotten banana, yeast, enzyme, temperature.

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Introduction

India is 1st in the largest banana producing countries in the world with 27,575,000 tons per year. But according to the Google about 20-30% of overall production gets wasted every year. And on other hand developing countries like India need of fuel is increasing day by day with the increase of development and population rate. As the stock of non-renewable source of energy is getting vanished soon and prices are getting higher to the Everest there should be an another option for full filling the need of increasingpopulation.

Bioethanol production can be the greater way to get out of this problem. Biomass of banana which is thrown out as waste can be used for the production of bioethanol using yeast called *Saccharomyces cerevisiae* providing anaerobic condition, which gives greater result with the application of combination of enzymes (cellulose and pectinase). Banana peel is rich source of starch called cellulose which can be degraded with the application of cellulose enzyme. And hence the banana peel can be the greater source of carbon source forbioconversion.

In developing countries like India garbage management is also a very big problem. This project may be at smaller level but can help as environmental waste management. With the combustion of the fossil fuel release of carbon mono oxides and other harmful elements and gasses occurs and which affects ozone layer. With the use of this biofuel this problem also can be eliminated. This energy could be produced from banana fruit as environmental recycling process.

The objectives of this study were to investigate the influence of different temperature, pH and RPM on bioethanol production by using rotten banana mixture (pulp and peel). In addition, to investigate the proper yeast concentration and enzyme for fermentation for banana mixture (skin and pulp) and to know the standard properties (viscosity, pH, ethanol concentration and glucose estimation) of bioethanol for the use in petrol engine.

Materials Used:

1) RawMaterial
   The banana wastes (rotten) were collected form wholesale market, Cotton Market, Malaviya square, Amravati

2) Enzymes
   - Cellulase
     Starch called Cellulose can get degraded to glucose with the application of cellulase, which can further get fermented using yeast applying anaerobic condition for the production of bioethanol.
   - KMS powder
     Potassium Metabisulphite is used for avoiding other contaminations of microbes.

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3) Yeast
   Yeast called *Saccharomyces cerevisiae* is used for the fermentation of waste collected by providing anaerobic condition.

4) Glasswares

5) Incubator with Temperature Adjustment

Procedure: (whole procedure was carried out 3 different times with 3 different temperature and pH)

Collection of rotten banana waste

↓

Get washed thoroughly with tap water

↓

Slices were done with knife

↓

Slices were mashed with mixer to homogenize the raw material

↓

Collection of mash to the single jar

↓

500gm of mash measured and got distributed in 5 different beakers with 100gm of each

↓

Meanwhile yeast (12.5gm in 125 ml water) get activated by adding some sugar

↓

After proper activation (foaming) of yeast 25 ml of each was added to each beaker

↓

pH measured and maintained at 4.5 , 5 , 5.5 by the addition of 0.1 N NaoH and 0.1 N Hcl (respectively, each at 3 different times)

↓

0.3ml of 0.1 N cellulase was added to each beaker

↓

TSS was measured – 12-13%

↓

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All 5 beakers get sealed with paper and polythene with rubber band and placed in an incubator with 30, 35, 40 ^{0}C (respectively, at 3 different times)

⇩

3 days of incubation was done with respective temperature and pH (at all 3 times)

⇩

After 3 days seal opened and mash get stirred and added 15 ml of water to each

⇩

And again incubated for 1 day at same temperature

⇩

All 5 beakers were removed and mass were collected to the single jar and filtration was carried out and filtrate was then collected to single conical flask
(respective pH was maintained and TSS measured – 5-6%)

⇩

At respective temperature again get incubated for 2 days

⇩

TSS was measured – 4-5%

⇩

Product get centrifuged at 10,000 rpm for 10 mints and crystal clear bioethanol get obtained

⇩

Further tests were done.

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Pictures:

RottenBanana

Banana Slices

Rotten BananaMash

MashbeforeFermentation

Incubator

Mash afterFermentation

Layer ofFermented Banana

FiltrationofBioethanol

Final BioethanolProduct

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Result:

Analytical Assay:

pH, TSS, bioethanol yield, viscosity and glucose amount were analyzed

1) pH
The changes of pH was determined and maintained by using pH meter at each stage of fermentation.

2) Total Soluble Solids(TSS)
Total soluble solids were measured at each stage of fermentation by refractometer ranging from 0 to 30% brix unit. The result was reported as % brix.

3) Viscosity
Viscosity of final product; bioethanol was measured by viscometer.

4) BioethanolConcentration
Ethanol concentration was determined by distillation process. Boiling point of ethanol is 78.1 degree C. In distillation process temperature rises time by time and at particular temperature ethanol starts boiling. And in the product only ethanol and water mixture is there, and boiling point of water is 100 degree Celsius so it can be estimated by separation of evaporated ethanol amount before the temperature get up to boiling point of water.

5) GlucoseEstimation
Glucose estimation was done by the DNS reagent method, in hot water bath. Using 40% Potassium sodium tartarate (Rochelle salt). The absorbance values of the reducing sugar was measured using spectrophotometer at 575 nm, after cooling to room temperature in a cold waterbath.

Table 1: Effect of different pH treatment on the production of concentration of bioethanol.

Parameter (different pH)	Final Bioethanol Concentration
4.5	5.5%
5.0	7.7%
5.5	5.0%

Note: At pH 5.0 we got a maximum ethanol concentration.

Table 2: Effect of different temperature treatment on the concentration of bioethanol.

Parameter (different ^{0}C)	Final Bioethanol Concentration
30 ^{0}C	6.2%
35 ^{0}C	7.7%
40 ^{0}C	6.9%

Note: At 35^{0}C we got a maximum ethanol concentration.

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Table 3: Effect of different shaking days on the production of concentration of bioethanol.

Parameter (different shaking days)	Final Bioethanol Concentration
7 d:ays	5.5%
9 days	7.7%
11 days	7.9%

Note: As the no of days increases ethanol concentration increases up to a certain limit after that ethanol concentration increases very slowly.

Table 4: Effect of rotten and fresh banana on the production of concentration of bioethanol.

Parameter (rotten or Fresh banana)	Final Bioethanol Concentration
Rotten Banana	7.5%
Fresh Banana	5.3%

Note: Rotten banana gives more ethanol Concentration than the fresh banana.

Table 5: Effect of enzyme and combination of enzymes on the production of concentration of bioethanol.

Parameter (enzyme/s)	Final Bioethanol Concentration
Cellulase	6.2%
Pectinase	5.8%
Cellulase & Pectinase	7.8%

Note: Both enzymes combination gives higher yield of ethanol.

Conclusion:

Banana fruit waste could be used to produce bioethanol effectively. It can be concluded that, produced bioethanol from biomass of banana was of good quality and can be use in engine for transportation purpose with producing less emission of harmful green house gases and also don't have harmful element for the engine. In addition to that it can be used as environmental recycling process for waste management.

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Development and Performance Evaluation of Medium Capacity Arecanut Husk Fibre Extraction Machine

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ABSTRACT

Fibre coating is available on Arecanut. The manual method of fibre extraction has low production rate, time consuming, low quality fibre and labourious. The precious biomass is underutilized due to non-availability of fibre extraction machine. Hence the best pre-treatment of chemicals for arecanut studied and machine was developed. Engineering property of arecanut husk and fibre were determined for crop variety: Shreevardhini. The components of the developed machine were beater cylinder, concave, main frame, feed hopper, duct, electric motor 3.5 HP.

Outer fibre length, inner fibre length, and tensile strength were 43.08mm, 58.55mm, and 23.92N respectively. The highest fibre recovery of 78.83% using pressing and soaking in water for 24 hours husk treatment at moisture content of husk 66% at cylinder peripheral speed of 16 m/s. The maximum tensile strength of fibre (38.81 N) was obtained in pressing and soaking in Sodium Hydroxide husk treatment at 66% moisture of husk and at beaters peripheral speed of 16 m/s. The output capacity of developed arecanut husk fibre extraction machine was determined using best operating parameter viz. alkali treatment of husk, husk moisture content of 66% and 16 m/s cylinder peripheral speed, and was found to be 110.58 kg/h.

Key Words: Arecanut, husk

INTRODUCTION

Arecanut is the fruit of Areca palm tree (*Areca catechu* L), also called Betel nut, a species of palm, which is native of Malaysia and widely grown across Asia, Taiwan, and India. India is the largest producer of arecanut in the world contributing to around 51 per cent of world’s arecanut production. India ranks first in both, area4.55 lakh ha and production 7.23 lakh MT. of arecanut during 2016-17 (Anonymous, 2017). Regarding to consumption scenario in India, the country is the largest consumer of arecanut in the world. The current consumption figure has

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mounted around 3,20,000. In Maharashtra, arecanut is grown in Konkan region. The area under arecanut in Konkan region is 2300 ha with production of 3500 to 4000 tons (Anonymous, 2015).

The fully dried arecanut fruit contains 40 per cent husk and 60 per cent kernel by weight. Arecanut husk is a solid residue generated as waste after kernel removal from fruit. The husk is being largely wasted except for being used as an inferior fuel and mulch. In the states of Karnataka and Kerala, majority of the arecanut is processed at ripe stage (fruit of golden yellow colour) (Srinivasa *et al*., 2011). Arecanut husk is useful in preparations of composites, hard boards, paperboards, brown wrapping paper, fluffy cushions, thermal insulators, non-woven fabrics, industrial chemicals like xylose, alcohol and furfural. This potential is not commercially exploited due to the cost factor. Among all the natural fibre reinforcing materials, arecanut husk appears to be one of the promising biomass. It is inexpensive and largely available in coastal and North Eastern India. In India, arecanut cultivation is coming up on a large scale basis highlighting its economic importance to farmers as well as industrial users in sectors like medicine, paint, chocolate and chewable gutka (Deshmukh, 2016).

Natural fibres are used for composites because of their low cost, low density, high toughness, reduced dermal and respiratory irritation, ease of extraction, enhanced energy recovery and biodegradability (Mohanty *et al*., 2002). The presence of the hollow lumen decreases the bulk density of the fibre and acts as an acoustic and thermal insulator. These properties make biofibres preferable for lightweight composites used as noise and thermal insulators in automobiles (Netravali and Chabba, 2003).

In Indian market, not a single efficient technology is available for arecanut fibre extraction. Presently, fibres are extracted manually. The problems associated with manual fibre extraction methods are low production rate, low quality fibre, time consuming, and requirement of skilled labours. Due to lack of the viable technology available in market for the judicial and economic use of the arecanut fibre in various marketable products, there is need to develop human friendly technology for the efficient utilization of arecanut husk.

In order to improve fibre separation method from arecanut husk in Konkan region, a laboratory prototype of arecanut fibre extraction machine has been developed. Considering use of chemicals for husk fibre separation, a study on chemical and mechanical treatment to husk

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before adding into machine for separation along with the performance of developed machine was undertaken in this project.

MATERIALS AND METHODS

Initially engineering properties of arecanut husk fibre were studied. Based on requirement design and development of arecanut husk fibre extraction machine was done. Then performance evaluation of developed arecanut husk fibre extraction machine was carried out. For machine performance, the chemically and mechanically treated husk was used as feed material.

Engineering Properties of Husk

In order to have material characterization engineering properties were determined. Shreevardhini variety of arecanut was used for the study. The engineering properties including physical properties of husk were studied. The size and moisture content (w.b.) of husk was determined. The fibre content of husk was determined by soaking it in water for 24 h. Fibre content of husk was determined by using the methodology followed by Rajan *et al.*, (2005).

$$\text{Fibre Content},\% = \frac{\text{Weight of fibres, g}}{\text{Weight of fibres and shell, g}} \times 100$$

Engineering Properties of Fibre

Engineering properties of fibre viz. length, moisture content, diameter and maximum tensile strength were determined. Tensile strength of arecanut husk fibre was measured with Shimadzu Universal Testing machine with cross-head speed of 1 mm/minute and force application at the rate of 0.5 N/s (Yusriah *et al.*, 2012).

Development of Arecanut Husk Fibre Extraction Machine

The design of Arecanut Husk Fibre Extraction Machine was done suitable for small and medium arecanut growers. Provisions were considered for safety, portability and easy operation. The designed components included beater cylinder and feed hopper, concave, feed hopper, duct and safety arrangements. Initially, the diameter of beater cylinder was determined. Based on the bearing load required to rotate the cylinder, the beater shaft was designed. The feed hopper of the machine was designed for its shape and dimensions on the basis of engineering properties of husk. The power requirement of the machine was determined as 3.5 hp (electric motor). This

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power was further transmitted to the beater shaft by V-belt and pulley arrangement. The diameter of the beater cylinder was calculated as 350 mm. Taking into consideration of factor of safety as 1.2, the diameter of beater cylinder shaft was designed to be 20 mm. The length of cylinder was considered as 1000 mm for helically arranged beaters and conveying action. Hence number of beaters was found as 156. The cylinder was made up of mild steel sheet of 14 SWG in thickness and mild steel shaft of 20 mm in diameter.

The thickness of the arecanut husk was observed in the range of 2.21 to 4.75 mm. Assuming swelling allowance, the concave clearance of 5 mm was considered for the design. The effective inner diameter of the round concave was determined as 360 mm, taking radial clearance of 10 mm. The hopper was designed for capacity of 50 kg/h. The height of husk box was selected as 200 mm and the bottom width of the husk hopper was 270 mm. The slope of hopper was 38.13^o based on the angle of repose of arecanut husk was 38.13^o(Deshmukh, 2016). The hopper volume was determined as 0.06879 m^3. Capacity of hopper considering density of arecanut husk (310.73 kg/m^3) was 21 kg

The developed arecanut husk fibre extraction machine consisted of feed hopper, beater cylinder, upper concave, lower concave with duct, V-belt and pulley power transmission, safety cover and guard, and main frame.

Beater cylinder

The beater cylinder consisted of mounting drum and beater bars helically welded on MS sheet drum. Each beater with 39 bars, spaced at 2.50 cm and helically welded on drum of length 1000 mm was fabricated. The schematic view of the beater cylinder is shown in Fig. 1.

Fig. 1 Helically arranged beaters on drum

Concave

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The concave was made in two parts i.e. upper and lower. The provision is made to lift upper concave for cleaning. The round concave was placed on the main frame. Upper concave was also welded with MS flat support placed exactly over the lower concave support strips. A cover (GI sheet) (1000x 1030 mm) was fixed over the upper concave with MS flat.

Feed hopper

The hopper was made up of galvanized iron sheet of thickness 18 SWG. The galvanized iron sheet was cut manually in different shape by using shear blade and welded to each other as per their designed shape. Final dimension of the feed hopper was 27 x 27x 20 cm.

Duct

The arecanut husk is fed into the hopper and the fibres come out of the duct. The duct is also is made of galvanized iron sheet of thickness 18 SWG. The dimensions of duct were 17 cm length, 10 cm width and 20 cm height respectively.

Main frame

The main frame of the developed arecanut husk fibre extraction machine supported all other developed components. MS angle of 40x 40 x 5 mm was used for fabrication of frame. Electric motor mounting frame was provided 100 mm above ground surface. It was made from MS angle of size 25x25x3 mm. Also, all the four supports of the main frame were welded with MS angle size 25x25x3 mm, 100 mm above ground, to ensure stability of the machine.

Safety guard and covers

Safety cover made from MS sheet was provided over the upper concave, which cover the width and periphery of the upper concave. The cover was placed 100 mm away from the concave, to allow removal of the mixture of shell and fibre from the upper concave. The belt and pulley transmission was covered with safety guard made from 16 SWG MS sheet. The guard was fixed to the main frame at three places using nuts and bolts.

The schematic view of the developed machine is shown in Figure 2. The final prototype developed for arecanut husk fibre extraction is shown in Fig. 3.

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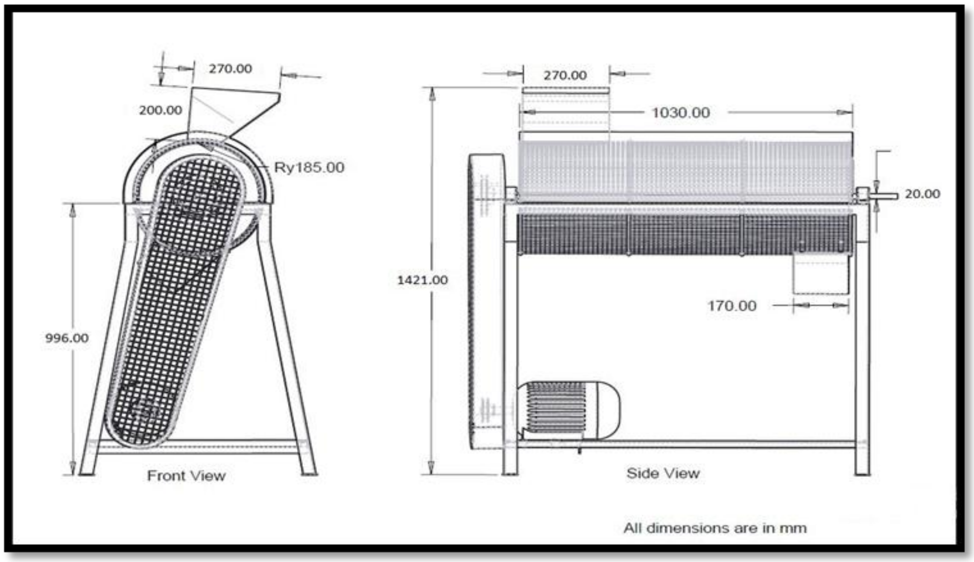

Fig. 2 Schematic view of developed arecanut husk fibre extraction machine

Fig.3 Developed arecanut husk fibre extraction machine

RESULTS AND DISCUSSIONS

Engineering properties of arecanut husk

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The engineering properties of arecanut husk viz. size, moisture content, fibre content, were determined experimentally. The moisture content of dry husk was 12.10 per cent (wb) and that of husk soaked in water for 24 hours was 66 per cent (wb). Size of the husk was determined in terms of length, width and thickness. The engineering properties of husk samples were determined and their average values are furnished in Table 1. The mean values indicate the average of 40 individual samples. The results of this study regarding size of arecanut husk, when compared with values obtained in respect of length and width of arecanut fruit by Balasubramanian (1985) and Aware *et al.,* (2013), of cv. Shreevardhini were higher. Moisture content of dried husk in present case was higher than the moisture content of dried arecanut fruits used in the respective studies of Balasubramanian (1985) and Aware *et al*., (2013). It is seen from Table 1 that the fibre content in the arecanut cv. Shreevardhini varied between 67.39 to 84.11 per cent, with a mean value of 80.20 per cent.

Table 1 Engineering properties of husk

Sr. No.	Property of Husk		Mean Value	Range
1	Size	Length, mm	55.52	44.63 - 68.06
		Width, mm	47.04	34.62- 64.46
		Thickness, mm	3.01	2.210- 4.750
2	Moisture content of husk on wet basis, %		12.10	11.90 - 12.39
3	Moisture content of husk soaking in water on wet basis, %		66.00	58.00 – 74.00
4	Fibre content, %		80.20	67.39 – 84.11

Engineering properties of fibre

Engineering properties of fibre viz., length, diameter, and tensile strength, were determined by following standard procedures. The length of the outer (thin) and inner (thick) fibres was measured and presented in Table 2. The length obtained was in consonance with the reported lengths by Rajan *et al*., (2005) and Naik *et al.* (2014). Diameter of arecanut husk fibre

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found in the present study was more as compared to the diameters reported by Yusriah *et al.*, (2012), Naik *et al.*, (2014) and Dhanlaxmi *et al.*, (2015)

Table 2 Engineering properties of arecanut husk fibre

Sr. No.	Property of Fibre	Mean Value	Range
1	Length	Outer fibre – 43.02. mm Inner fibre – 58.55 mm	27.87 - 61.82 mm 45.95 - 72.46 mm
2	Diameter	0.46 mm	0.271 - 0.653 mm

Performance Evaluation of Developed Arecanut Husk Fibre Extraction Machine

The performance of developed prototype was studied using three different treatment viz. pressed husk soaking in water, pressed husk and soaking in Sodium Hydroxide, 2.5 % Solution and No pressing and only soaking in water in different set of experiments. The machine was operated at the cylinder peripheral speed of 12, 14 and 16 m/s and husk moisture content as 42, 50, 58, and 66 per cent.

Effect of husk treatment, husk moisture content and cylinder peripheral speed on fibre recovery

It was observed that husk treatment, moisture content of husk and peripheral speed of cylinder had significant effect on the fibre recovery at 5 per cent level of significance. The combine effect of husk treatment, moisture content of husk and peripheral speed had non-significant effect on fibre recovery statistically.

The combine effect of husk treatment, cylinder peripheral speed and moisture content of husk on fibre recovery is shown in Table 3. The maximum fibre recovery of 78.83 per cent was observed in husk treatment pressing and soaking in water at 66 per cent moisture content of husk and cylinder peripheral speed 16 m/s. Minimum fibre recovery of 52.00 per cent was obtained in husk treatment pressing and soaking in Sodium Hydroxide (NaOH) at 42 per cent moisture content of husk and peripheral speed of 12 m/s. For all the husk treatment the fibre recovery was increased with husk moisture content as well as peripheral speed of cylinder. The husk moisture content of 66 per cent rotating at highest peripheral speed 16m/s resulted into highest fibre recovery, irrespective of the husk treatments. Thus moisture content of husk and rotating

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peripheral speed are important parameters for fibre extraction. This might be due to the effect of husk treatment (Water or NaOH) on husk which loosened the bonding between shell and fibre and causing disintegration of husk at required moisture content. Also, due to higher peripheral speed the impact of beaters over the husk was more which might have resulted in high fibre recovery. Hence moisture content of husk 66 per cent with husk treatment of NaOH with highest peripheral speed 16 m/s resulted into maximum fibre recovery (78.83 per cent) amongst all other treatments.

Table 3 Combine effect of husk treatment, husk moisture content and cylinder peripheral speed on fibre recovery

Husk Treatment	Moisture Content, %	Peripheral Speed, m/s	Fibre Recovery, %
Pressing and Soaking of Husk in Water	42	12	53.17
		14	56.47
		16	58.13
	50	12	63.53
		14	65.23
		16	72.90
	58	12	66.50
		14	71.13
		16	76.53
	66	12	67.50
		14	71.97
		16	78.83
Pressing and Soaking of Husk in Sodium Hydroxide (NaOH)	42	12	52.00
		14	55.90
		16	57.73
	50	12	63.30
		14	63.97
		16	71.57
	58	12	66.20
		14	70.30
		16	72.03
	66	12	67.20
		14	71.47
		16	73.37

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Unpressed and Soaking of Husk in Water	42	12	51.87
		14	55.77
		16	56.60
	50	12	64.33
		14	63.53
		16	69.37
	58	12	65.80
		14	71.23
		16	73.17
	66	12	67.80
		14	71.07
		16	74.80

Effect of husk treatment, husk moisture content and cylinder peripheral speed on tensile strength

The husk treatment, moisture content of husk and peripheral speed of cylinder had statistically significant effect on the fibre tensile strength at 5 per cent level of significance. Combine effect of husk treatment, moisture content of husk and cylinder peripheral speeds had non-significant effect on fibre tensile strength.

The combine effect of husk treatment and moisture content of husk and peripheral speed of cylinder on tensile strength is shown in Table 4. It is seen that for all the treatment of husk, the tensile strength was increased with respect to husk moisture content as well as peripheral speed of cylinder. The maximum tensile strength of 38.81 N was observed for the husk with pressing and soaking in Sodium Hydroxide (NaOH) using 66 per cent moisture content of husk and peripheral speed 16 m/s. Minimum tensile strength of 18.14 N was obtained in untreated and soaking in water using 42 per cent moisture content of husk and peripheral speed ratio of 12 m/s. The moisture content of husk 66 per cent rotating at highest peripheral speed 16 m/s resulted into highest tensile strength, irrespective of the husk treatment. Thus moisture content of husk, alkali treatment and rotating peripheral speed are important parameters for fibre tensile strength. The alkali treatment played important role in improvement of fibre strength. Similar result are observed by Mohan Kumar, (2008) for soaked arecanut husk fibres in 5, 10, 15, 20 and 25 per cent sodium hydroxide solution for about 12, 24, 36, 48 and 60 hours and confirmed that alkali

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treatment improved the overall mechanical performance of the fibre. Hence moisture content of husk 66 per cent with husk treatment of NaOH and peripheral speed 16 m/s resulted into maximum tensile strength (38.81 N) amongst all other treatments.

Table 4 Combine effect of husk treatment, husk moisture content and cylinder peripheral speed on tensile strength

Husk Treatment	Moisture Content, %	Peripheral Speed, m/s	Tensile Strength, N
Pressing and Soaking of Husk in Water	42	12	22.44
		14	25.08
		16	29.25
	50	12	25.84
		14	31.08
		16	34.70
	58	12	25.68
		14	32.47
		16	36.12
	66	12	25.38
		14	34.20
		16	37.24
Pressing and Soaking of Husk in Sodium Hydroxide (NaOH)	42	12	24.67
		14	24.58
		16	26.14
	50	12	29.06
		14	30.11
		16	33.17
	58	12	31.68
		14	33.55
		16	36.53
	66	12	31.69
		14	34.24
		16	38.81
Unpressed and Soaking of Husk in Water	42	12	18.14
		14	19.46
		16	22.20
	50	12	20.25
		14	21.38
		16	24.73

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	58	12	21.84
		14	26.08
		16	30.94
	66	12	22.13
		14	26.59
		16	31.96

Effect of husk treatment, husk moisture content and cylinder peripheral speed on output capacity

It was observed that the individual effect of husk treatment, husk moisture content and cylinder peripheral speed to be significant at 5 per cent level. The combine effect of husk treatment and husk moisture content, husk treatment and cylinder peripheral speed and husk moisture content and cylinder peripheral speed was also found to be statistically significant at 5 per cent level .Also the combine effect of all variables was found to be statistically significant (Table 5).

For all treatments, moisture content and cylinder peripheral speeds, the output capacity was found to be increased. This might be due to the fact that, by increasing the peripheral speed, the impact force also increased, and due to high impact force, maximum disintegration of husk might have occurred. Also, due to higher moisture content of husk, bonding between husk and shell decreased resulting in higher output capacity of the machine. The maximum output capacity of 100.58 kg/h was observed when husk pressed and soaked in NaOH for 24 h using 66 per cent moisture content and peripheral speed 16 m/s. Minimum output capacity of 77.15 kg/h was obtained in husk untreated and soaked in water using 42 per cent moisture content and peripheral speed ratio of 12 m/s. The moisture content 66 per cent rotating at highest peripheral speed 16 m/s resulted into highest output capacity, hence husk moisture content 66 per cent with husk treatment of pressing and soaking of husk in NaOH with highest peripheral speed 16 m/s resulted into maximum output capacity (110.58 kg/h) amongst all other treatments.

Table 5 Combine effect of husk treatment, husk moisture content and cylinder peripheral speed on output capacity

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Husk Treatment	Moisture Content, %	Peripheral Speed, m/s	Output Capacity, kg/h
Pressing and Soaking of Husk in Water	42	12	80.23
		14	82.23
		16	84.30
	50	12	83.72
		14	86.17
		16	88.52
	58	12	88.08
		14	89.52
		16	99.70
	66	12	93.65
		14	95.86
		16	105.54
Pressing and Soaking of Husk in Sodium Hydroxide (NaOH)	42	12	88.52
		14	89.11
		16	90.76
	50	12	93.92
		14	98.48
		16	97.85
	58	12	100.19
		14	102.21
		16	106.24
	66	12	106.65
		14	108.94
		16	110.58
Unpressed and Soaking of Husk in Water	42	12	77.15
		14	78.25
		16	80.03
	50	12	80.61
		14	85.30
		16	87.57
	58	12	86.40
		14	90.52
		16	95.59
	66	12	87.82
		14	94.32
		16	100.31

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Selection of best operating parameters

It was revealed that higher fibre recovery was obtained using the pressed husk treatment with water of 78.83 per cent, which is 2.3 per cent higher than the husk treated with water under same treatment (76.53 per cent). Pressing and soaking in NaOH of husk reported 73.37 per cent recovery which is ranking third but 5.46 per cent less over the highest recovery achieved at moisture content of 66 per cent and peripheral speed of 16 m/s. The machine performed better for husk with NaOH and highest moisture content and peripheral speed. These treatment combinations of husk moisture content of 66 per cent and peripheral speed of 16 m/s resulted into 4.21 per cent higher fibre tensile strength and 1.50 per cent higher output capacity over second better treatment viz. pressed husk with soaking in NaOH, husk moisture content of 66 per cent and 14 m/s peripheral speed of cylinder. Considering better tensile parameter of the husk fibre and its commercial view, alkali treatment is found to be better. Slightly compromising with fibre recovery (2.3 per cent) and for higher machine output capacity, higher moisture content of husk of 66 per cent and cylinder speed of 16 m/s are found to be best operating parameter within the test range.

CONCLUSIONS

1. The length, width, thickness, moisture content, and fibre content of arecanut were found to be 55.52 mm, 47.04 mm, 3.01 mm, 12.10 per cent (wb), and 80.20 per cent respectively.
2. The outer fibre length, inner fibre length, diameter, and tensile strength of arecanut were found to be 43.02 mm, 58.55 mm, 0.46 mm, and 23.92 N, respectively.
3. The highest fibre recovery of 78.83 per cent was obtained using pressing and soaking in water for 24 hours husk treatment at moisture content of husk 66 per cent and at cylinder peripheral speed of 16 m/s.
4. The maximum tensile strength of fibre (38.81 N) was obtained in pressing and soaking in Sodium Hydroxide (NaOH) husk treatment at 66 per cent moisture content of husk and at peripheral speed of 16 m/s.

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5. The output capacity of developed arecanut husk fibre extraction machine was110.58 kg/h with the husk pressing and soaking in water for 24 hours husk treatment at 66 per cent moisture content of husk and peripheral speed of 16 m/s.
6. The husk soaking in NaOH, moisture content of 66 per cent and cylinder peripheral speed of 16 m/s are found to be best operating parameters within the test range for the developed machine.

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Development of Nutritionally Enriched Khakhra

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ABSTRACT –

Snack foods, being one of the major food categories of the global health and wellness market, are becoming a major focus of new product development in the food industry. Generally, a snack is a smaller portion of food than our regular meal can consume between meals. Snacks are of different varieties can make quickly, satisfy the consumers, less perishable, more durable and more portable than prepared food. Khakhra is a very thin, crispy, crunchy, healthy and flavoured snack product usually served as a breakfast dish and mostly common in the Gujrat and Rajasthan. The present study was conducted to determine the sensory quality and nutrient content of khakhra prepared with the incorporation of rajma flour (Kidney beans) as a protein source and Spinach as it is rich in iron and has many health benefits. This khakhra were prepared by using 700 g wheat flour, 300 g rajma flour and 500 gm spinach leaves paste along with some spices, and veg Manchurian seasoning is also used. This nutritionally enriched khakhra were evaluated organoleptically using nine point scale. It provides (195.9) Kcal energy, (5.2 g) protein, (42.2 g) carbohydrates, (0.7 g) fat, (4.9 mg) iron, (3.0 mg) calcium, and (1.8 %) moisture as compared to control khakhra. Thus, the results of the present study suggest that the incorporation of Rajma flour and Spinach paste improves the nutritional quality of the product.

Key words -*Indian Traditional Snacks, Rajma flour, protein, Iron*

INTRODUCTION

Snack food is a portion of food which is smaller than regular meal and can be consumed between meals. It is convenient because it is quick and easy to eat. Snack food comes into variety such as processed food and traditional foods. Most of the snack foods are intended for immediate consumption and have shelf life of 1-2 days only. Mostly sold in loose, without packaging, or in small polythene or paper packages. The shelf life can be extended by using adequate packaging. Generally, Snack foods is considered unhealthy and should be avoided but same can be made nutritious if enriched with addition of fruits, vegetables, pulses or cereals into it which. It will not only solve health problems but also provide sufficient energy. (2,5) Therefore, an attempt to

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make local snacks item nutritious and if these snack foods are made part of diet it will be beneficial for poorer strata of our society.

Khakhra is a thin cracker common in the Gujarati andRajasthan cuisines of western India, especially among Jain community. It is traditionally made from wheat flour and oil. Khakhra are individually hand-made and roasted to provide a crunchy and healthy snack that can be enjoyed with a selection of spicy pickles and sweet chutneys. Khakhra is made in several varieties, such as *methi*(fenugreek), *jeera* (cumin), *bajri*, *pudina*, garlic and *ajwain*, are among others. There are variations in the method of preparation, but generally the following method is observed. Wheat flour (and/or refined flour), salt and masala are mixed. Oil, water or milk are added and kneaded to make a soft dough. This dough is then rolled into small balls and flattened. These are then roasted over low heat and pressed via wooden press, until crisp and light brown in color. (1) The traditional Khakhra is enriched with protein by adding kidney bean flour. The nutritional and medicinal value of Kidney beans makes it suitable diet for asthma and diabetes patients, boosting their immune system. Such enriched Khakhra are great source of vitamin, minerals, proteins, dietary fibers and iron. It contains antioxidants that are beneficial to our health. Consumption of kidney beans on regular basis is good for hair and skin. These legumes are tasty and nutritious. They provide support for proper functioning of the nervous system and brain (3). Red kidney beans have low sodium content and saturated fatty acids but are rich in unsaturated fatty acids (linoleic acid) (6). They are also a good source of soluble and insoluble dietary fiber and display health benefits, which include reduced risk of heart disease and colon cancer (7). However, red kidney beans' nutraceutical value is yet to gain popularity in the prevention of chronic diseases (8)

Spinach provides good amount of vitamin B6, riboflavin, folate, niacin, soluble dietary fibers and minerals. Spinach is rich in iron which prevents from diseases like osteoporosis, anemia which are result of iron deficiency(4).

Nutri khakhra was prepared by adding wheat flour, kidney bean flour and spinach paste (7,3,7 %) along with oil, water and some spices, green chili paste, lime, salt as per taste. Soft dough was prepared. After resting it for 20 mins it was sheeted into 1mm thick sheet and given circular shape. Khakhra was precooked on low flame and then cooled at room temperature. Baking was done at 160ºC temperature for 3-4 mins from both the sides, again cooled at room temperature and then packed in vacuum package and this change in production process enhanced the shelf life of 90 day

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METHODOLOGY

Selection of ingredients for enrichment

To ensure that the cost of raw material is within limits and also keeping commercial viability in mind the ingredients are selected in such a way that they are available in local market at reasonable cost.

PROCESS FLOW CHART

Sieving of Wheat flour and Rajma flour

↓

Addition of oil, cumin, green chili paste, spinach paste, salt, lime, veg Manchurian spices and water as per recipe.

↓

Kneading properly into soft dough

↓

Covering with muslin cloth and resting for 15 – 20 min

↓

Dividing dough into small balls

↓

Sheeting (1mm thickness)

↓

Cutting into circular shape with molds

↓

Precooking on hot pan

↓

Cooling at room temperature

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↓

Baking at 160ºC temperature for 3-4 min from both sides.

↓

Cooling at room temperature

↓

Weighing of khakhra

↓

Filling

↓

Packaging

↓

Storage

Organoleptic evaluation of nutrikhakhra:

The organoleptic evaluation of prepared khakhra was conducted to find out maximum level of incorporation of selected nutritious ingredients such as red kidney bean flour and spinach.

Sensory evaluation of nutrikhakhra:

Nutri khakhra was prepared with different levels of incorporation of selected nutritious ingredients. All the selected panel members were requested to evaluate the developed nutria khakhra. The judges were requested to score the recipes for different sensory characters namely color and appearance, taste, texture, flavor, mouth feel, overall acceptability by using nine point hedonic scale. Highly accepted variations were selected for nutritional analysis and shelf life study.

Nutrient analysis of nutrikhakhra:

Nutrient analysis of nutria khakhra was done by chemical analysis in the laboratory. Various parameters considered for nutrient analysis were total energy, moisture, protein, carbohydrate, fat, ash, iron and calcium.

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OBSERVATION AND ASSESSMENT:

The results obtained from the present investigation as well ae relevant discussion have been summarized under following heads:

Organoleptic evaluation of nutrients enrichednutrikhakhra:

Nutrients enrichednutrikhakhra was prepared by incorporating wheat flour, red kidney bean flour, spinach paste at different levels such as variation 1 (7, 3, 4); variation 2 (6,4,5); variation 3 (5,5,6); variation 4 (7,3,7) percent. The prepared nutrikhakhra was evaluated for various sensory characteristic. The data which gives clear idea about sensory score of nutrikhakhra is presented in table no. 1

The sensory score for color of nutrikhakhra for studied variation varied from 6 to 8 highest score was observed in variation 4 (8), taste 6.5 to 8.5 and highest score was observed in variation 4 (8.5), texture 7 to 8.5 highest score was observed in variation 4 (8.5), flavor 6.5 to 8.8 highest score was observed in variation 4 (8.8), mouth feel 6.5 to 8.7 and highest score was observed in variation 4 (8.7).

Overall acceptability scores ranged between 6.5 and 8.5 like other sensory parameters the significantly highest score 8.5 was acquire by variation 4. On the whole, it can be said that addition of wheat flour, red kidney bean flour, spinach paste at the rate 7, 3 and 7 percent, respectively this nutrikhakhra exhibited better acceptability than other variation. Hence such combination of ingredients for preparation of value-added nutri khakhra stands better.

Level of incorporation (%)

Variation	Wheat flour	Kidney bean flour	Spinach puree
1	7	3	4
2	6	4	5
3	5	5	6
4	7	3	7

Sensory evaluation-

The sensory evaluation of different organoleptic characteristics i.e., colour and appearance,taste, texture, flavour, mouth feel, and overall acceptability were carried out by semi trained panelists on 9 point hedonic scale with "9 as Like Extremely and 1 as Dislike extremely". The average score was calculated for individual organoleptic properties. Sensory evaluation is carried out by 10 evaluators for various quality attributes on following scale:

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Variation	Colour and appearance	Taste	Texture	Flavor	Mouth feel	Overall acceptability
1	6	6.5	7	6.5	6.5	6.5
2	6.9	7.2	7.5	7.2	7.3	7.2
3	7.5	7.6	6.8	7.9	6.5	7.2
4	8	8.5	8.5	8.8	8.7	8.5

Nutritional content of nutrikhakhra:

As per new norms of FDA and FSSAI, it is mandatory to have nutritional value analysis displayed on food container. Hence same was carried out for nutria khakhra. The result for 100 gm sample is as follows.

The values for basic and value added nutrikhakhra were moisture 2 and 1.8 percent, protein 3 and 5.2 percent, carbohydrate 2 and 4.2 percent, fat 0.5 and 0.8 percent, iron 1.1 mg/100 g and 2.5 mg/ 100g, calcium 10.4mg/100 g and 14mg/100g.

Nutrients	Values for traditional product	Values for enriched product
Moisture	2 %	1.8 %
Protein	3 %	5.2 %
Carbohydrate	2 %	4.2 %
Fat	0.5 %	0.8 %
Iron	1.1 mg/100 g	2.5 mg/ 100g
Calcium	10.4mg/100 g	14mg/100g

Biochemical and Microbial Analysis and Quality Control:

The quality testing is an important aspect of product before releasing into market. The Biochemical and Microbial analysis is established process for snack products testing and same was used for testing this product. The results are acceptable to release the product in market

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CONCLUSION:

Value added Product “Nutri khakhra” can be prepared by incorporating nutritious ingredients. The simple and successful process can be used to improve the essential nutrient content with special reference to protein, carbohydrate, fat, iron, calcium. The developed value added nutrikhakhra can be stored for 90 days.

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Our Heritage

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Effect of Antimicrobial Chitosan Based Films on the Physico chemical properties of Tomato

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Abstract

Edible coating and film is an attractive technology in the packaging of fruits and vegetables to reduce postharvest losses. Different sources are used for the preparation of films and coating materials with the incorporation of antimicrobial agents. In the present research, an antimicrobial assay of the different concentration of chitosan (0.5,1,1.5 & 2%) was carried out to check its efficacy for the prevention of certain microbes. Furthermore, the physicochemical properties of chitosan packed tomato were tested. Physiological loss in weight, total soluble solids, titratable acidity and pH of coated tomatoes have been investigated. Results indicated that chitosan improved the quality attributes in tomatoes significantly. Chitosan (CH) film packed fruits showed reduced weight loss, deferred changes in titratable acidity and total soluble solids. The non-significant difference was found in pH of chitosan-coated tomatoes. From the current research, it can be expressed that chitosan packaging not only acts as antimicrobial packing but also enhance the shelf life of tomato fruits by maintaining their quality attributes.

Keywords: Antimicrobial Packaging, Chitosan, Tomato, Apple, Physicochemical properties

1. Introduction

Postharvest losses in fruits is a severe issue in the world. It is due to poor maintenance in infrastructure, rapid loss occurs due to physicochemical and microbial deterioration during handling, transport, and storage. Tomato (*Lycopersicon esculentum*) is one of the most extensively eaten fresh fruit throughout the world. Nevertheless, its highly perishable nature which reduces its long term use after harvesting. To prevent the losses of this fruits and to preserve its quality attributes after harvesting, employment of appropriate preservative methods

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are necessary. Various kinds of preventive methods have been executed to reduce these losses. Edible coating, packaging with organic and biodegradable materials also have been tried and successfully applied by many researchers. Different materials can be used to make biodegradable packaging viz. polysaccharides, proteins, lipids or their combinations. Biopolymers are attracting in the search for both renewable and biodegradable materials. Among all, polysaccharides are the most commonly used. Particularly, chitin is a polysaccharide which is extracted from marine sources. Chitin is famous for its bioavailability as it ranks second in abundance after cellulose in nature. Besides, it is the compound that not only has the highest production rate but also is biodegradable in nature (Muxika et al., 2017). Chitosan is obtained from chitin after alkaline deacetylation. Being polycationic it has a high molecular weight (MW) and is a linear copolymer composed of β(1,4)- linked with N-acetyl-D-glucosamine units. Chitosan is well known for its film-forming properties. Moreover, is possesses beneficial characteristics such as antioxidant, antifungal, and antimicrobial nature. Also, it is a barrier to gases and water vapors which helps in improving the shelf life food (Yuan et al.,2016). It is believed that chitosan has outstanding resistance against different deteriorative causes such as biotic and abiotic stress (Friedman et al.,2010). Petriccione et al (2015) studied the coating of strawberry fruits with chitosan. They revealed that chitosan coating increased the shelf life of the fruits by lowering the loss of moisture and delayed the changes in titratable acidity and rate of respiration. Chitosan mostly utilized as a food additive and material used for packaging which reduces the microbial count as well as enhances the quality of food (Vasilatos & Savvaidis, 2013). Ansorena et al., (2011) studied the chitosan-coated broccoli and stated that the application of coating reduced the microbial growth significantly on samples. Additionally, it preserved the quality characteristics of food and helped to improve its shelf life. In this research, the desired concentration of chitosan is used to make the films as it is selected from the previous studies. Tomatoes and apples are packed into the films and their physicochemical attributes are checked to examine the efficacy of chitosan in extending the shelf life of said fruits.

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2. Materials and Methods

Chitosan obtained by extraction from shrimp shells waste in the previous studies. Antimicrobial activity of extracted chitosan concentrations (0.5,1, 1.5 and 2 %) was checked.

2.1 Antimicrobial Test

Agar well diffusion method was carried out as reported by Sena et al., (2013).Antimicrobial activity was assayed by the method of agar well diffusion. Nutrient agar plates were swabbed (sterile cotton swabs) with 8 hours of an old - broth culture of *Staphylococcus aureus* and *Pseudomonas aeroginosa*. Wells (10mm diameter and about 2 cm apart) were made in each of these plates using sterile cork borer. The stock solution of chitosan was prepared at a concentration of 0.5, 1, 1.5, and 2mg/ml in 1 % acetic acid. These different concentrations were added into the wells and allowed to diffuse at 4 °C for 10 min. The plates were incubated at 37°C for 24 hours. After incubation, the diameter of the inhibition zone (mm) was measured. Four replications were maintained and the average values were recorded.

2.2 Preparation of films.

For the preparation of films, 2 % chitosan was selected from the previous study as they were possessing good mechanical and barrier properties. Then they were further used to pack the tomatoes. Tomatoes (*Lycopersicon esculentum*) were procured from the local market. Storage study of control samples as well as chitosan film covered tomatoes was carried out up to 8 days at room temperature. PLW, TSS, Titratable acidity, pH of control samples and chitosan film covered samples were carried out on an alternate day.

2.3 Physiological loss in weight (PLW)

The initial and final weight of sample was recorded and physiological loss in weight was calculated according to Restrepo et al (2010).

Formula:

$$\text{PLW}= \frac{\text{Initial weight} - \text{Final weight Initial weight}}{\text{Initial weight}} \text{ X } 100$$

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2.4 pH

The pH of the sample was recorded using a pH meter (AOAC, 1990).

2.5 Total soluble Solid (TSS)

Total soluble solids were measured by a refractometer (AOAC, 1990).

2.6 Titratable Acidity (TA)

Titratable acidity was determined according to the method of AOAC (1990). Each sample was treated with 0.1N NaOH solution using a titration kit, where 3 to 5 drops of phenolphthalein indicator were used. Volume of alkaline solution used for the experiment was recorded and the titratable acidity was calculated.

$$TA= \frac{\text{Titre reading} \ \text{X} \ \text{Eq.weight of acid}}{\text{Wt.of sample} \ \text{X} \ 1000 \ \text{X DR}} \text{X } 100$$

$$D.R. = \frac{\text{Volume of sample}}{\text{Made up volume}}$$

Eq. wt. of citric acid=64

3. Results and Discussions

3.1Antimocrobial activity of chitosan

Experimental studies showed that tested concentrations (0.5, 1, 1.5 & 2 %) of chitosan exhibits good antimicrobial activity against *Staphylococcus aureus* and *Pseudomonas aeruginosa*.The results are in agreement with Rejane et al., (2015) who said that 1% of chitosan has an inhibitory effect against *S. Aureus*. They have shown that the most suitable antimicrobial function of chitosan includes the involvement of the charged group in the polymer backbone and their ionic contacts with bacterial wall constituents. This reaction signals the emergence of peptidoglycan hydrolysis in the membrane of the microorganism, contributing to leakage of intracellular electrolytes, leading to the death of the microorganism. Likewise, chitosan derivatives have

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inhibitory activity against *P.aeruginosa.* This research was illustrated by Liu et al. in their analysis in 2019. The inhibition of bacterial adhesion and biofilm development by anionic chitosan and cationic chitosan was evaluated against *P. aeruginosa*. The study found that chitosan derivatives were effective in inhibiting the biofilm formation of *P. aeruginosa* and proposed chitosan as a potential alternative for the prevention of bacteriological pathogen in the food trade.

The zone of inhibition studies was carried out and diameter measured for the said organisms is reported in Table 1.

Table 1. Antimicrobial activity of different concentrations of chitosan

Test organism	Zone of inhibition in mm			
	0.5%	1%	1.5%	2%
S. aureus	20	21	21	22
P. aeruginosa	18	20	21	21.5

The above table demonstrates that the increasing concentration of chitosan showed the maximum inhibition to mentioned microbes which displayed the antimicrobial activity of chitosan. Van et al (2013) got the similar outcomes who worked on the antimicrobial activity of chitosan methodically. They prepared chitosan solutions at diluted concentrations and in spray form, which applied to apples and bananas. It significantly prolonged the shelf life of the fruits and constrained the microbiological population and their growth. The evaluation informed that chitosan possesses strong antimicrobial behavior against pathogenic and spoilage microorganisms, including fungi, and both Gram-positive and Gram-negative bacteria.

From the previous studies it was proved that chitosan film with 2% concentration had better mechanical properties and high antibacterial activity compared to other films. Hence the concentration of 2% was selected for storage study. For this study tomatoes were selected and packed in chitosan film and stored at room temperature. During the storage study different parameters like weight loss, acidity, pH, TSS were calculated on alternate day and results obtained are given in Table 2.

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3.2 Physico-chemical changes in tomato during storage at room temperature

Table 2. Changes in PLW and TSS during storage study of tomato at room temperature

Storage days	PLW (%)		TSS (%)	
	Control	Chitosan packed	Control	Chitosan packed
0	0	0	4.50±0.17e	4.32±0.23d
2	20.08±0.09d	6.27±0.04d	5.40±0.11d	4.72±0.04c
4	22.45±0.15c	7.51±0.08c	5.89±0.04c	4.82±0.01c
6	50.38±0.14b	8.39±0.08b	6.46±0.04bb	5.11±0.06b
8	54.26±0.28a	10.27±0.18a	6.75±0.22a	5.27±0.04a
LSD	0.24	0.22	0.20	0.16
CV	0.50	1.97	2.31	2.28

The data in table 2 showed significant difference in control and chitosan packed tomato. Greater weight loss was found in control samples on the 8^{th} day of storage with the level of 54.26±0.28 from 20.08±0.08 whereas chitosan coated tomatoes showed the PLW of 10.27±0.18 which suggests that chitosan packaging significantlyreduce the PLW in tomatoes.The results are similar to the outcomes given by Leak et al (2017) who told that Chitosan lessened weight loss in ambient stored tomato fruits. Several experiments have shown that chitosan is more active in preventing weight loss in banana and mangoes (Kittur et al.,2001) and strawberries (Ribeiro et al.,2007) than other polymers such as starch and alternatives.

Moreover, control tomatoes showed more increase i. e. from 4.50±0.17 to 6.75±0.22 in total soluble solids than in chitosan film packed tomatoes in which the change seems from 4.32±0.23 to 5.27±0.04. This means that the chitosan delayed the changes in TSS of tomatoes during the storage. These results are in agreement with Eshetu et al (2019). Although there is significant difference among fruits before application of the coating (at zero day), there is faster increasing trends for control treatments than coated fruits in terms of TSS.

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Fig 1 and fig 2 showed significant decrease in pH and increase in acidity in control samples and chitosan packed tomatoes. The graphical view finds that the chitosan packed tomatoes showeddelay increase in titratable acidity and decrease in pH. These results are more or less similar to Ghaouth et al (1992). They coated tomatoes with chitosan solutions which reduced its respiration rate and ethylene production, with greater effect at 2% than 1% chitosan. Coating increased the internal CO_2, and decreased the internal O_2 levels of the tomatoes. Chitosan-coated tomatoes were firmer, higher in titratable acidity, less decayed, and exhibited less red pigmentation than the control fruit at the end of storage. The same results were observed in the Raffo et al. (2002) study, which shows that acidity decreased with maturation and increased with a high percentage of fruit sugar content in cherry tomatoes. The rise in pH indicates that most of the hydrogen ions in tomatoes are formed by organic acids, which usually decrease with maturation and cause an increase in pH.

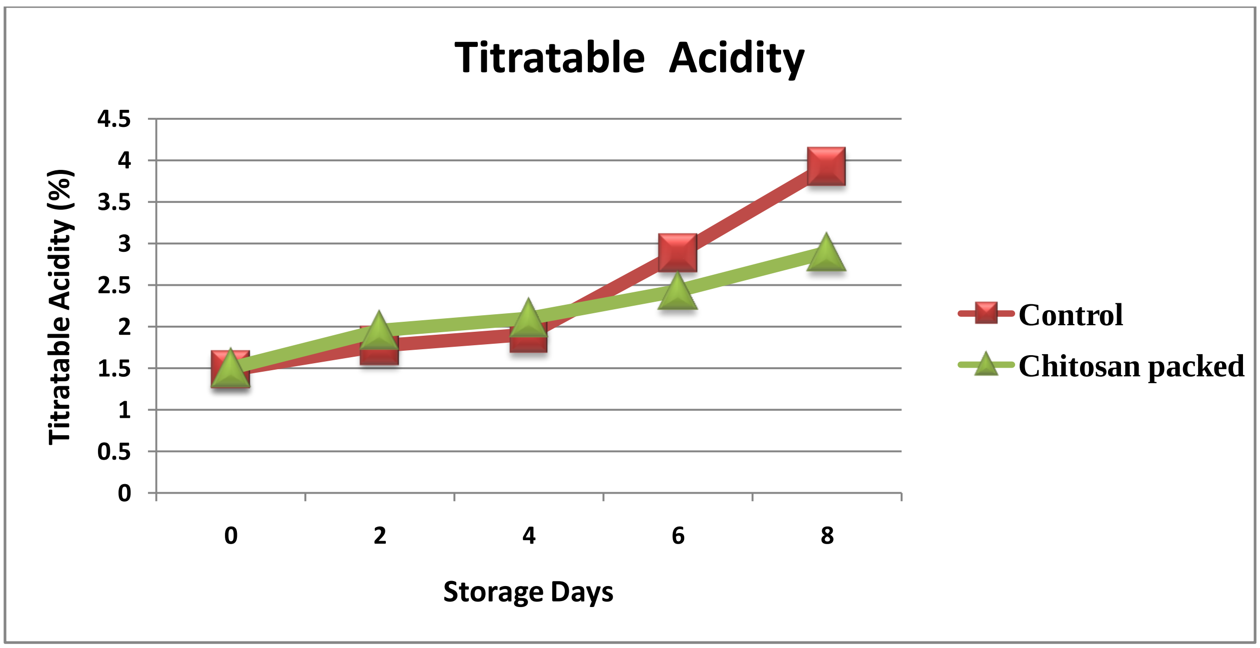

Figure 1. Changes in Titratable Acidity during storage study of tomato at room temperature

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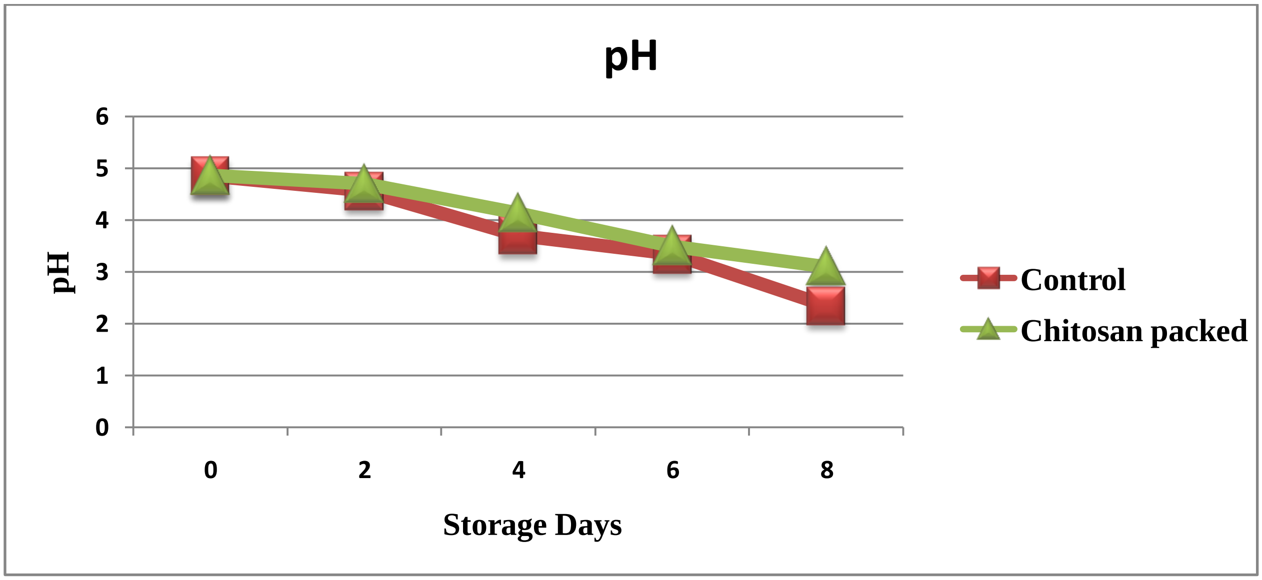

Figure 2. Changes in pH during storage study of tomato at room temperature

In the case of the control sample as the storage, period increased acidity decreased and TSS, and pH increased. But in the case of chitosan packed film, as the storage period, increased acidity decreased slightly and TSS and pH increased slightly. Zhelyazkov et al. (2014) investigated the possible use of chitosan coating on fresh-cut apples in their research. Manually sliced apples were treated with solutions of 1, 2.5, 5 and 10 g.kg-1 chitosan in acetic acid and then stored at 4°C for 17 days. They established parallel results. Coating with chitosan hindered water loss and the fall in sensory quality, increasing the soluble solidcontent and decreasing titratable acidity. They proved that applying a chitosan coating preserved effectively the quality and extended the shelf life of fresh-cut apples. Chitosan packed tomatoes did not show any deterioration in tomatoes while the control sample showed deterioration. Its shelf life extended up to 8 days at room temperature.

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3.3 Visual appearance of tomatoes on the 8th day of storage at room temperature

Control **CH-Coated Tomato**

Fig 4 Visual appearance of tomatoes

From the fig. 4 it can be clearly seen that tomatoes coated with chitosan has shown glossy appearance while control tomato was looking dull, bruised and ripen. Chitosan coating helped to increase the glossiness of tomatoes even after 7 days.

4. Summary and Conclusion

In this study different concentration of chitosan (0.5, 1,1.5& 2%) optimized to check the antimicrobial activity. Antimicrobial activity of chitosan proved that concentration at 2% inhibits the development of microbes such as *Pseudomonas aeruginosa and Staphylococcus aureus*. Physiological loss in weight, Total Soluble Solid, acidity and pH of control and chitosan packed tomatoes were checked. It was found that chitosan packed tomatoes showed a slight increase in physiological loss in weight, Total soluble solids and Titratable acidity while a slight decrease in pH as compared to the control sample. It shows that it extends the shelf life of tomatoes up to 8 days at room temperature. It has convincingly been proved that chitosan films exhibit good antimicrobial activity which can help to extend the shelf life of tomatoes. At 2% chitosan concentration the films showed the best results in not only in terms of physico-chemical

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attributes but also in terms of glossiness. Hence, it is going to be no surprise if we witness the widespread use of chitosan films in tomorrow's food packaging.

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Effect of Growth Regulators and Methods of Application on Growth, Flowering and Corm Yield of Gladiolus

Ashwini Patil[1], G. B. Phuke[2] And S. A. Udalkar

ABSTRACT

A field study on the effect of GA_3 @ 100 & 200 ppm, BA @ 50 & 100 ppm and control with three methods of application *viz.* soaking, spraying and soaking + spraying on growth and quality of gladiolus Cv. American Beauty was carried out at Satpuda Botanic Garden, College of Agriculture, Nagpur (M.S.), India during 2011-2012. Uniform sized corms of gladiolus cv. American Beauty were soaked in different concentration of growth regulators for 24 hours before planting and spraying also carried out with different concentrations of growth regulators at 30 and 45 days after planting.Results revealed that, significantly minimum days to sprouting of corms, emergence of first spike and maximum shoots plant^{-1}, eaves plant^{-1},length of spike, length of rachis, longevity of flower on plant were seen with GA_3 at the rate 200 ppm however, methods of application of growth regulators had non-significant influence on all these characters.Significantly maximum spikes plant^{-1}, corms and cormels plant^{-1} were seen with BA @ 100 ppm with soaking treatment.Days to first spike emergence showed significant results with interaction of growth regulators and methods of application.

Key words : Flowering, growth, GA_3, BA, quality

INTRODUCTION

Gladiolus is the leading cut flower grown worldwide for flower trade and garden display owing to it's magnificent inflorescence and attractive colour. It is herbaceous plant which belongs to the family *Iridaceae*. An increase in flower production and improvement of spikes quality can be achieved by application of growth regulators such asgibberellic acid which has been reported to increase the plant height,leaves and shoots plant^{-1} and improve the spike quality, stimulating flowering and increase the yield of gladiolus spike. Similarly, benzyl adenine is a growth regulator reported to be useful for enhancing sprouting, increasing sprout plant^{-1} and yield of better quality corms. Therefore, the present investigation is proposed on effect of growth regulators and methods of application on growth and quality of gladiolus Cv. American Beauty.

MATERIAL AND METHODS

The experiment was laid out in Factorial Randomized Block Design at Satpuda Botanic Garden, College of Agriculture, Nagpur during *rabi* season of

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the year 2011-2012 with three replications and fifteen treatment combinations. The treatments comprised of five growth regulators *viz*. GA_3 100 ppm, GA_3 200 ppm, BA 50 ppm, BA100 ppm and control as main factor and three methods of application *viz*. soaking, spraying and soaking + spraying as sub factor.After preparing the land, the field was laid out with the beds of 45 cm spaced ridges and furrows and the beds were prepared of the dimension 2.25 m × 1.40 m.The rested, cold stored, best quality, de-husked and uniform sized corms of gladiolus variety American Beauty treated with aqueous solution of $GA_3$100 and 200 ppm and BA 50 and 100 ppm for 24 hours as per the treatment. Then all the corms were treated with copper fungicide solution for 20 minutes as a preventive measure for *Fusarium wilt* disease before planting. The treated corms were then planted at a spacing of 45 x 20 cm on the ridges at a depth of 5-6 cm. Light irrigation was given immediately after planting.Foliar sprays of GA_3 and BA in the prescribed concentration of the treatments were undertaken twice after 30th and 45th day after planting. Observations on various vegetative and quality parameters were recorded and analyzed statistically.

RESULTS AND DISCUSSION

Growth study

Effect of growth regulators: The data presented in Table 1 revealed that, significantlyearly sprouting was observed under the treatment of GA_3 at the rate 200 ppm (3.89 days) which was found to be at par with the treatments 100 ppm GA_3 and BA 50 ppm (4.00 and 4.66 days, respecctively), whereas, the control treatment took the maximum days to sprouting (6.33 days) which was found to be at par with the treatment BA 100 ppm(5.89 days). This might be due to the promotory action of gibberellic acid on dormancy of corms.In respect of number of shoots, significantly maximum shoots plant^{-1} was found under the treatment of GA_3 200 ppm (4.11) and it was found to be at par with GA_3 100 ppm treatment (3.95). However, the minimum number of shoots was recorded in the control treatment (3.50) which was found to be at par with the treatments of BA at the rate 100 and 50 ppm (3.53 and 3.63, respectively).An increase in the number of shoots plant^{-1} due to the treatment of gibberellic acid, it is might be due to it's promotory action on sprout production in gladiolus corms.The results can be correlated with the findings of in gladiolus.Quyoom (2011) in gladiolus observed decrease in the days to sprouting of gladiolus corms (11.89 days at 125 ppm), however, increase in number of shoots plant^{-1} (1.44 at 125 ppm) with the increase in concentration of GA_3.

The treatment of GA_3 200 ppm produced significantly maximum leaves plant^{-1} (21.93) which was found to be at par with the treatment GA_3 100 ppm(21.55). The increase in number of leaves plant^{-1} with GA_3 may be

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attributed to enhanced cell division in shoot tip and cell elongation. However, minimum number of leaves plant^{-1} were observed in the control treatment(17.58) and it was found at par with the treatments BA 100 ppm and 50 ppm (18.39 and 18.5, respectively). These findings are correlated with the findings of Kirad *et al*. (2001) who registered maximum leaves plant^{-1} (6.87)with the treatment of GA_3 150 ppm.

Effect of methods of application: The data presented in Table 1 revealed that, significantly maximum vegetative growth in respect of earlysprouting of gladiolus corms and shoots plant^{-1} were recorded with the treatment ofsoaking and soaking + spraying, respectively (4.46 days and 3.97 shoots, respectively) of gladiolus corms with growth regulators. Earliness in corm sprouting (4.67) and maximum shoots plant^{-1} (2.07) with the treatment of corm dipping was also observed by Baskaran and Misra (2007) in gladiolus.This might be due to the optimum absorption of chemicals by corms due to soaking compared to spraying, which might have been further utilized for physiological processes to influence favourably the character under study.Whereas, late sprouting and minimum number of shoots plant^{-1} were found with spraying treatment (5.40 days and 3.61 shoots, respectively).However, number of leaves plant^{-1} was influenced non-significantly by methods of application.

Interaction effect: An interaction effect due to the growth regulators and methods of application on the days to sprouting of gladiolus corms, shoots and leaves plant^{-1}during the experiment were found to be non-significant.

Flowering and quality study

Effect of growth regulators: According to the Table 1,significantly early emergence of first spike (49.33 days) was registered with the treatment of GA_3 200 ppm and it was found to be at par with treatment 100 ppm GA_3 (49.36 days), whereas, control treatment reported late spike emergence (61.09 days). It might be due to further gibberellin is quite effective in reducing juvenile period of plant and induced reproductive phase. Baskaran and Misra (2007) in gladiolus reported that, earliness in sprouting was maximum (4.67 days) under the treatment of GA_3 500 ppm. The treatment GA_3 200 ppm produced significantly maximum length of spike (94.19 cm) which was found to be at par with the treatment GA_3 100 ppm (92.39 cm), whereas, the control treatment produced minimum length of spike (69.04 cm) and it was at par with the treatment of BA 100 ppm (73.38 cm).Baskaran and Misra (2007) in gladiolus noticed maximum spike length (63.00 cm) at higher concentration of GA_3 i.e.1000 ppm. The maximum rachis length (34.97 cm) and longevity of spike (13.53 days) were found under the treatment $GA_3$200 ppm which found to be at par with GA_3 100 ppm (34.43 cm and 13.16 days, respectively) and treatment of BA 50 ppm (32.55 cm and 12.51 days, respectively).The similar results were reported byBaskaran and Misra (2007) in gladiolus, it resulted that, maximum longevity of

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spike (21.44 days) and rachis length (51.33 cm) were observed under the treatment of GA_3 500 ppm. It is might be due to GA_3enhanced the cell elongation and produced photosynthats whichmight have been produced good quality spikes in respect of rachis length and which helps to last longer on plant in the field. Probably, this might be due to the fact that, an increase in length of spike and rachis and longevity of spike due to promotory effects of gibberellins on cell division, cell elongation and vigour of gladiolus plant.

Effect of methods of application: Significantly minimum days to spike emergence (50.21 days) observeddue tosoaking treatment which was followed by the treatment of soaking + spraying (55.72 days), whereas, late spike emergence noted under spraying treatment. Similar results were found by Baskaran and Misra (2007) in gladiolus reported that, earliness in flowering was maximum (53.87 days) under the treatment of soaking of gladiolus corm. This is might be due to the optimum absorption of chemicals by corms due to soaking compared to spraying. Whereas, length of spike and rachis andlongevity of spike on plant were resulted non-significantly due to effect of methods of application of growth regulator during entitled experiment (Table 1).

Interaction effect: The data pertaining to the length of spike and rachis and longevity of spike on plant were non-significantly influenced due to interaction of the growth regulator treatments with methods of application during experimentation. However, the data presented in Table 1 revealed that, an interaction effect due to the growth regulator treatments with methods of application in respect of days to emergence of first spike significantly resulting early spike emergence (48.20 days) under the treatment ofGA_3 200 ppm and soaking,however, the treatment combination of control and spraying took the maximum days for the emergence of first spike (69.00 days).

Yield study

Effect of growth regulators: The yield parameter such as spikes plant^{-1}, corms and cormels plant^{-1} were found to be significant with application of growth regulators.The application of GA_3 at the rate of 200 ppm had noticed significantly maximum number of spikes plant^{-1} (2.88) and it was found to be at par with the treatment of GA_3 at the rate 100 ppm (2.69). However, the minimum number of spikes plant^{-1}were recorded in the control treatment (1.60) which was at par with the treatment of BA at the rate of 100 ppm (1.69). It might be due to the fact that, gibberellic acid promotes vegetative growth and then accumulation of enough photosynthates required for reproductive phase which resulted into more spikes yield in gladiolus. These results are in close conformity with the results of Kumar and Singh (2005) in gladiolus who reperted maximum spikes plant^{-1} (1.90) with the treatment of GA_3 50 ppm. Significantly maximum number of corms plant^{-1} (3.37) and cormels plant^{-1} (31.55) was recorded with the treatment BA at the

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rate 100 ppm and which found to be at par with 50 ppm BA (3.28 and 28.11, respectively) and GA_3 200 ppm (3.26 and 24.77, respectively). However, minimum number of corms and cormels plant^{-1} was noticed under control treatment (2.65 and 24.48, respectively) and it was found to be at par with the treatments of GA_3 at the rate 100 ppm (2.88 and 24.48, respectively). Benzyl adenine promotes cell division and anabolism which resulted into increase of more number of good sized daughter corms which resulted into maximum number of corms and cormels plant^{-1}. The similar results were reported by earlier research worker like and Baskaran *et al.*, 2009 that, number of corms plant^{-1}(2.52) andcormels plant^{-1} (34.17) in gladiolus.

Effect of methods of application: The data recorded in Table 1 regarding spikes, corms and cormels plant^{-1} as influenced by methods of application had showed non-significant differences.

Interaction effect: The data furnished in Table 1 regarding spikes, corms and cormels plant^{-1}as influenced by interaction due to growth regulators and methods of application had showed non-significant differences.

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Studies on biochemical Changes in kiwi-guava-mint lemonade During Storage

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Abstract:

A pulp of Kiwi (*Actinidia deliciosa),* Guava (*Psidium*guajava) and Lemon (*Citrusaurantifolia)* was optimised and blended into lemonade by addition of water and mint extractfor flavouring purposed. Which was stored and studied for 90 days in glass bottles at refrigerated and ambient temperature. Kiwi pulp was blended with lemon and guava pulp for increasing nutritional and functional value of lemonade beverage. The optimum levels ofkiwi pulp, guava pulp, lemon juice, mint extract, sugar, preservative and water were selected. Based on sensory evaluation by a panel of trained judges, the optimum level of kiwi pulp, guava pulp, lemon juice, mint extract, sugar, preservative and water were reported to be 75 ml, 25 ml, 2.30 ml, 9.55 g, 17 g, 0.15% and 71 ml respectively for 200 ml beverage. The final beverage was then pasteurized at 92^0C for 15 sec. and filled in clean, sterilized dried glass bottles and sealed air tight with the help of a crown corking machine. After sealing the bottles were again pasteurized at 72^0C for 25 min. and the bottles were stored at refrigerated temperature (4^oC) and ambient temperature (24^oC). The storage studies were conducted by drawing representative samples periodically at 15 days interval upto 90 days to evaluate changes in biochemical parameters such as acidity, pH, TSS, vitamin C, reducing sugars and total sugars of the kiwi-guava-mint lemonade beverage.

Key Words - Lemonade, Beverage, Sensory evaluation, vitamin C, Storage studies

I. INTRODUCTION

Fruits are important constituents of the diet and provide significant quantities of nutrients, especially vitamins, sugars, minerals and fibers (Sindumathi *et al.,* 2013). Daily consumption of fruits reduce the risk of cancer, heart disease, premature aging, stress and fatigue primarily due to the integrated action of oxygen radical scavengers such as β- carotene and ascorbic acid plus calcium and dietary fibers (Sindumathi *et al.,* 2013). It has been reported that the organoleptic quality of beverage prepared from juice could be increased by the addition of spice extracts of ginger, black pepper, mint, cardamom and cumin etc. (Sindumathi *et al.*, 2013). Lemonade is a sweetened beverage found throughout the world, characterized bya lemon flavour. It is a drink made from lemon juice, citrus fruit and water sweetened with sugar. The advantage of lemonade beverage is that there is no need to dilute it whereassquash, syrup, cordial, crush are diluted with water before use.

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Increasing preference of consumers for natural and natural like ingredients in various food products, the technology of blending various juices to obtain desired combination of nutrients and quality characteristics offers great promise for the fruit juice industry. Citrus fruits are the rich source of vitamin C. About 80% of vitamin C in our diet comes from citrus fruits (Tariq *et al.,* 2015). Which have numerous health-promoting properties. For this reason, lemonjuice, citrus fruit is an interesting food matrix for developing new beverages and a suitable source for value-added products.

Kiwi fruit (*Actinidia deliciosa)*belongs to a family*Actinidiaceae*. It is a small fruitapproximately 3 inches long and has a brown hairy peel with a green flesh and white pulp in center with many tiny black edible seeds (Ram, 2017). Kiwi is an excellent source of vitaminC (ascorbic acid). A 100 gram serving of kiwi fruit has around 61 calories and 15 grams of carbohydrates. It also contains lots of glucose and fructose and small amount of sucrose. It contains anti-oxidants such as β-carotene, lutein and xanthin. It also has a strong anti-mutagenesis effect and also contains a number of valuable anti-cancer bioactive materials that are prooxidant (at higher concentrations) and antioxidant (at lower concentrations), as well as having tumour selective, cytotoxic and antimicrobial activity. It also increases immune function (Sachin, 2015).

Guava fruit (*Psidium*guajava) belongs to the *Myrtaceae* family. It is originated in central tropical America widely distributed in the tropical and subtropical areas. Guava is consumed fresh or made into processed products such as juice, nectar, puree, jam and jelly (Sirichote *etal.,* 2007). Guava fruit has exotic flavor. Itis a small tropical tree that grows up to 35 feet tall(Baby, 2011). It is a sweet and delicious fruit. Guava fruit is a powerhouse of nutrients. It is a good source of energy, dietary fiber, vitamins, and minerals. The guava fruit contains vitamin C, A, E, B-vitamins, as well as potassium, phosphorus, magnesium, calcium, sodium, and zinc (Meenakshi, 2019). Guava contains broad spectrum of phytochemicals including polysaccharides, vitamins, essential oils, tannins. It is a rich source of ascorbic acid than citrus (80 mg of vitamin C in 100 gm of fruit) and a good source of pectin – a dietary fiber (Baby, 2011).

Peppermint or mint (*Mentha piperita* L.) belongs to the *Lamiaceae* family. It is a medicinal plant that has received more attention from both food and pharmaceutical industries because of its health benefits for human society. Mint herbs are used for flavoring foods, culinary preparation, perfumery, cosmetics, beauty and body care. The simple aroma of peppermint enhances memory and increases alertness in human subjects (Loolaie *et al.,* 2017).

Lemon (*Citrus aurantifolia)* is an important medicinal plant of the family *Rutaceae*. It is cultivated mainly for its alkaloids, which are having anticancer, antioxidant, antibacterial, antifungal, antidiabetic, anticancer and antiviral activities. Lemon can be used for culinary and non-culinary purposes. Citrus flavonoids can function as direct antioxidants and free radical scavengers and have the capacity to modulate enzymatic activities (Mohanapriya *etal., 2013).*

In this project lemonade made up of combination of fruits. In the modern era people are very aware about health; they select products having health benefits. For this reason this study aims to prepare blended new beverage using kiwi pulp, guava pulp and mint extract, having high nutritional value and rich in vitamin C and will be preferred by consumers for their sensory properties. The blended beverage containing kiwi and guava fruit will be a good option for the health conscious consumer. To avoid health problems consumption of healthy and nutritious food is necessary. The present research work will be done to prepare kiwi-guava-mint lemonade beverage.

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II. RESEARCH MATERIAL ANDMETHODOLOGY

2.1. Materials

The present research work was undertaken in the Department of Food Safety and Quality Nutrition in MIT College of Food Technology, during the year 2018-2019, entitled ‘Studies on formulation and standardization of kiwi-guava mint lemonade beverage. The material used and methods adopted during the tenure of study are presented in this paper.

2.1.1. Fruits

Kiwi fruit, guava fruit, lemon, mint leaves were purchased from local market of Hadpsar, Pune. The fruits were thoroughly washed prior to processing to remove dust and dirt adhered to fruits, to prevent contamination.

2.1.2. Chemicals and Packaging material

Ingredients like sugar used in the experiment was obtained from grocery shop. Other chemicals and equipment required for experiment are acquired from MIT-ADT laboratory. Glass bottles used as packaging material for blended juice, were obtained from Pune.

2.2. Methodology

2.2.1 Preparation of kiwi-guava-mint lemonade

Kiwi Fruits	Guava Fruits
(Selection of mature, fresh and ripe)	(Selection of mature, fresh and ripe)
↓	↓
Washing	Washing
↓	↓
Cutting	Cutting
↓	↓
Pulp extraction	Pulp extraction

↓
Mixing with the strained syrup solution
(Sugar+water)
↓
Addition of mint extract
(4.78g/100g water, kept it for 10 min)
↓
Mixing of lemon juice (1.15g/100g)
↓
Filtration (muslin cloth)
↓
Addition of potassium meta-bisulfite
↓
Pasteurization (95°C for 15 sec)
↓
Bottling and Corking

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↓
Pasteurization (72°C for 25 min)
↓
Cooling and Labeling
↓
Storage
(At both ambient and refrigeration temperatures)
↓
Quality monitoring of blended kiwi-guava-mint lemonade
(Sensory, microbial and physicochemical analysis)

Fig. 2.2.1 Flow chart for the preparation of kiwi-guava-mint lemonade.

2.2.2 Formulation of kiwi-guava-mint lemonade beverage preparation

Different samples like KGML(control), KGML1, KGML2 and KGML3 were prepared by blending kiwi and guava pulp proportions with variations 100ml. The formulation is presented as below in table.

Ingredients	KGML(control)	KGML1	KGML2	KGML3
Kiwi pulp (ml)	50.00	37.50	37.50	25.00
Guava pulp, white guava (ml)	-	12.50	-	25.00
Guava pulp, pink guava (ml)	-	-	12.50	-
Sugar (g)	8.50	8.50	8.50	8.50
Mint extract (g)	4.78	4.78	4.78	4.78
Water (ml)	35.50	35.50	35.50	35.50
Lemon juice (g)	1.15	1.15	1.15	1.15
Potassium Meta bisulfite (g)	0.075	0.075	0.075	0.075

Table No. 2.2.2. Formulation for kiwi-guava-mint lemonade

KGML: kiwi-guava-mint lemonade, KGML(control)- 1:0(kiwi pulp:guava pulp), KGML1- 3:1(kiwi pulp:white guava pulp), KGML2- 3:1(kiwi pulp:pink guava pulp), KGML3- 1:1(kiwi pulp:white guava pulp)

2.2.3 Sensory evaluation of kiwi-guava-mint lemonade

Sensory evaluation of kiwi-guava-mint lemonade for color, taste, flavor, texture, appearance and overall acceptability were carried out using 9-point hedonic scale with semi-trained panelists. Sensory attributes were rated on a scale of 1 (dislike extremely) – 9 (like extremely) Amerine et. al., (2013).

2.2.4 Statistical analysis of data

The data obtained were analysed for statistical significance according to the procedure given by Panse and Sukhatme (1967). However, due to spoilage of some samples before the completion of storage period, simple mean values have been reported.

2.2.5 Biochemical parameters studied during storage of kiwi-guava-mint lemonade

2.2.5.1 Acidity - Titrable acidity was determined in percentage as described (Ranganna,1986) and measured volume of sample was taken in a conical flask. Water was added to it and mixed thoroughly. Titrate with 0.1N sodium hydroxide using few drops of phenolphthalein solution as indicator. The titre value was noted.

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2.2.5.2 pH - The pH was determined using digital pH meter (Ranganna, 1986).

2.2.5.3 TSS – TSS was determined by using hand refractometer. One drop of the sample wasadded on previously cleaned prism and observed through the eye piece of refractometer. The number given parallel to separating line of light and dark areas of image on the screen was noted as the TSS of the sample (Ranganna, 1986).

2.2.5.4 Vitamin C - The vitamin C content was determined by Assay method given byRanganna (1986).

2.2.5.5 Total sugar - Total sugars were determined by method of Thimmaiah (2016).

2.2.5.6 Reducing sugar - The reducing sugars were estimated by the DNS Method. In thismethod, several reagents have been employed which assay sugars by their reducing properties.

One such compound is 3, 5 dinitrosalicylic acid (DNS) which in alkaline solution is reduced to 3-amino-5 nitrosalicylic acid Thimmaiah (2016)

2.2.5.7 Microbial Analysis- (Total plate count and Yeast and mold count) - The NutrientAgar media was prepared by weighing required quantity of nutrients and agar in 100 ml distilled water was added to it. The media was autoclaved at 121°C at 15 psi pressure for 20 min. Then, after sterilization of media, it was used for plating. The 0.1 ml sample (each treatment) was poured on a separate sterile petri plates under the Laminar Air Flow. The nutrient media was poured in the plate containing sample and mixed by swirling slowly and properly and the plates were incubated at 37°C for 48 hr. After incubation, bacterial count was checked and kept for 5-6 days at room temperature for fungal count. The total microbial plate count was expressed in CFU/g. Similar procedure was followed for yeast and mold count by using Potato dextrose Agar (PDA) medium. The result was expressed as Total Plate count and the number of yeast and mold count per ml of the sample using formula (Aneja K. R., 2007).

Yeast and mold counts per ml of sample = Colonies count x Dilution factor

III. RESULTS AND DISCUSSION

3.1. Formulation and Standardization of kiwi-guava-mint lemonade

Several trials (Table 3.1) were conducted to select optimum level of kiwi pulp, guava pulp, mint extract, lemon juice, sugar, preservative and water for the blended beverage. Based on sensory evaluation by a panel of trained judges, the optimum level of kiwi fruit pulp, guava pulp, mint extract, lemon juice, sugar, water and preservatives were reported to be 37.50 ml, 12.50 ml, 4.78 g, 1.15 g, 8.50 g, 35.5 ml and 0.075 g respectively for 100 ml beverage.

Table 3.1. Standardization table for kiwi-guava-mint lemonade

Ingredients	KGML(control)	KGML1	KGML2	KGML3
Kiwi pulp (ml)	50.00	**37.50**	37.50	25.00
Guava pulp, white guava (ml)	-	**12.50**	-	25.00
Guava pulp, pink guava (ml)	-	**-**	12.50	-
Sugar (g)	8.50	**8.50**	8.50	8.50
Mint extract (g)	4.78	**4.78**	4.78	4.78
Water (ml)	35.50	**35.50**	35.50	35.50
Lemon juice (g)	1.15	**1.15**	1.15	1.15
Potassium Meta bisulfite (g)	0.075	**0.075**	0.075	0.075

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KGML: kiwi-guava-mint lemonade, KGML(control)- 1:0(kiwi pulp:guava pulp), KGML1- 3:1(kiwi pulp:white guava pulp), KGML2- 3:1(kiwi pulp:pink guava pulp), KGML3- 1:1(kiwi pulp:white guava pulp)

3.2. Sensory evaluation of kiwi-guava-mint lemonade

Based on the sensory evaluation by a panel of trained judges the sample KGML1 got highest score i.e. 8.0 (Table 3.2).

Table 3.2. Sensory evaluation of kiwi-guava-mint lemonade

Sample	Color and Appearance	Taste	Flavor	Mouth Feel	Overall acceptability
KGML(control)	7.8	8.1	8.0	8.2	8.1
KGML1	7.7	8.0	7.7	7.8	8.0
KGML2	7.1	7.4	7.5	7.3	7.5
KGML3	7.0	7.2	7.4	7.2	7.5
Mean	7.40	7.68	7.65	7.63	7.78

KGML: kiwi-guava-mint lemonade, KGML(control)- 1:0(kiwi pulp:guava pulp), KGML1- 3:1(kiwi pulp:white guava pulp), KGML2- 3:1(kiwi pulp:pink guava pulp), KGML3- 1:1(kiwi pulp:white guava pulp)

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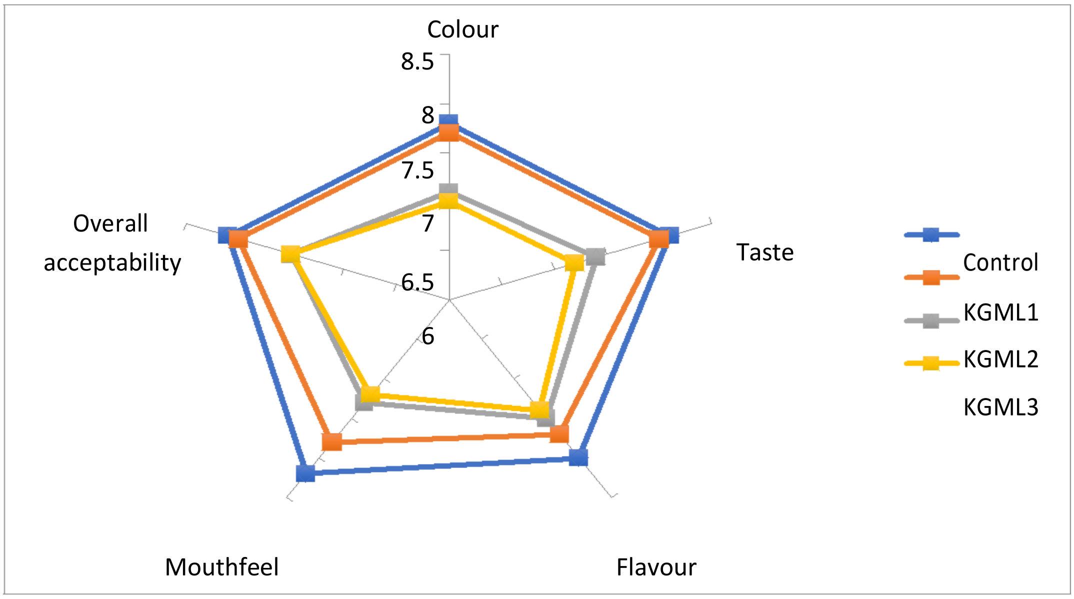

Figure 3.2. Sensory evaluation of kiwi-guava-mint lemonade

3.3 Proximate analysis of selected kiwi-guava-mint lemonade

The data of proximate analysis of kiwi-guava mint lemonade is presented in Table 3.3. Among the chemical composition of kiwi fruit and guava blended beverage, the values for protein content were 0.80 %, carbohydrates were 12.10%, fat were 0.30%, ash content were 0.22 %, moisture were 81.30 %, vitamin C were 14.20 mg/ml, where as energy were 54.30 Kcal.

Table 3.3. Proximate analysis of selected kiwi-guava-mint lemonade

Sr. no.	Properties	Result (Per 100ml)
1	Protein (%)	0.80
2	Carbohydrates (%)	12.10
3	Fat (%)	0.30
4	Ash (%)	0.22
5	Moisture	81.30
6	Vitamin C (mg)	14.20
7	TSS (^{0}Brix)	14.00
8	Titrable acidity (%)	0.40
9	Ph	4.00
10	Energy value (Kcal)	54.30

3.4 Biochemical parameters studied during storage of kiwi-guava-mint lemonade

The product was analyzed for its shelf life and stability by keeping it at two different temperatures.

1.Refrigerated Condition - Two samples were kept at refrigerated temperature (RT) (4±1^{o}C) one is with preservative and another one is without preservative.

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RT_1 - lemonade + preservative
RT_2 - lemonade + without preservative

2.Ambient Condition - Two samples were kept at ambient temperature (AT) (24±5°C) one is with preservative and another one is without preservative.

AT_1 - lemonade + preservative
AT_2 - lemonade + without preservative

3.4.1. Acidity

Acidity of various samples was determined by titrating against 0.1 N NaOH. It was observed that maximum increase in acidity (0.49) was recorded in sample RT_1 while, minimum increase in acidity (0.40) was recorded in sample RT_2 and AT_2. During passage of storage (0 to 90 days) there was significant increase in acidity ranging from (0.41 to 0.49%, 0.40 to 0.45%, 0.41 to 0.47%, 0.40 to 0.44%) it is due to release of acid from the juice constituents. (Byanna et al., 2013)

Table 3.4.1 Chemical parameters of acidity content of KGML during 90 days storage period

Treatments	Storage Period (Days)						
	0	**15**	**30**	**45**	**60**	**75**	**90**
RT_1	0.41	0.41	0.43	0.44	0.46	0.48	0.49
RT_2	0.40	0.42	0.44	0.45	*	*	*
AT_1	0.41	0.42	0.45	0.47	*	*	*
AT_2	0.40	0.44	*	*	*	*	*
Mean	0.41	0.42	0.44	0.45	0.46	0.48	0.49
SE ±	0.001	0.002	0.001	0.002	0	0	0
CD@5%	0.004	0.007	0.005	0.007	0	0	0

***Spoiled sample**

RT_1 - lemonade + preservative, RT_2 - lemonade + without preservative, AT_1 - lemonade + preservative, AT_2- lemonade + without preservative

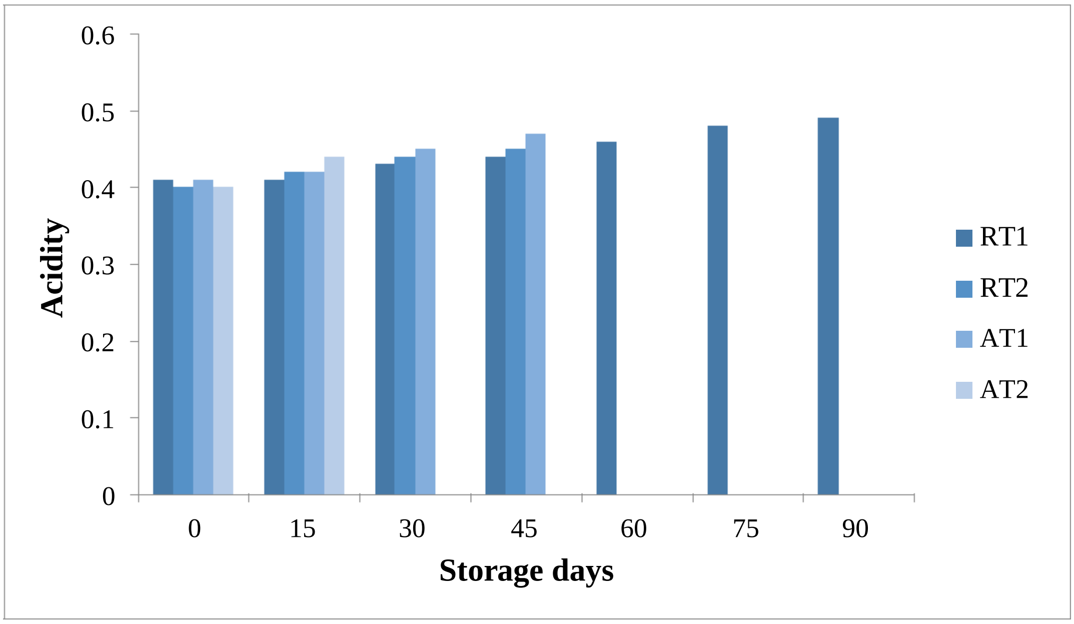

Figure 3.4.1 Effect of storage intervals and treatments on acidity of KGML

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3.4.2. pH

Initially the pH values of the samples (RT_1 to AT_2) were 4.00, 3.88, 4.00 and 3.88 which gradually decreased to 3.70, 3.72, 3.89, 3.81 respectively during 90 days of storage. As the pH decreased there was a proportional increase in acidity during storage of KGM lemonade. The decrease in pH is due to increase in acidity during storage period. This decrease may be due to the formation of free acids and pectin hydrolysis. Highest pH value were observed in sample RT_1 and AT_1 were lower pH value were observe in sample RT_1. (Tariq *et al.*, 2015)

Table 3.4.2 Chemical parameters of pH of KGML during storage period

Treatments	**Storage Period (Days)**						
	0	**15**	**30**	**45**	**60**	**75**	**90**
RT_1	4.00	4.00	3.96	3.94	3.91	3.85	3.70
RT_2	3.88	3.84	3.79	3.72	*	*	*
AT_1	4.00	3.97	3.93	3.89	*	*	*
AT_2	3.88	3.81	*	*	*	*	*
Mean	3.94	3.91	3.89	3.85	3.91	3.85	3.70
SE ±	0.015	0.017	0.015	0.019	0	0	0
CD@5%	0.046	0.053	0.046	0.057	0	0	0

*** Spoiled sample**

RT_1 - lemonade + preservative, RT_2 - lemonade + without preservative, AT_1 - lemonade + preservative, AT_2- lemonade + without preservative

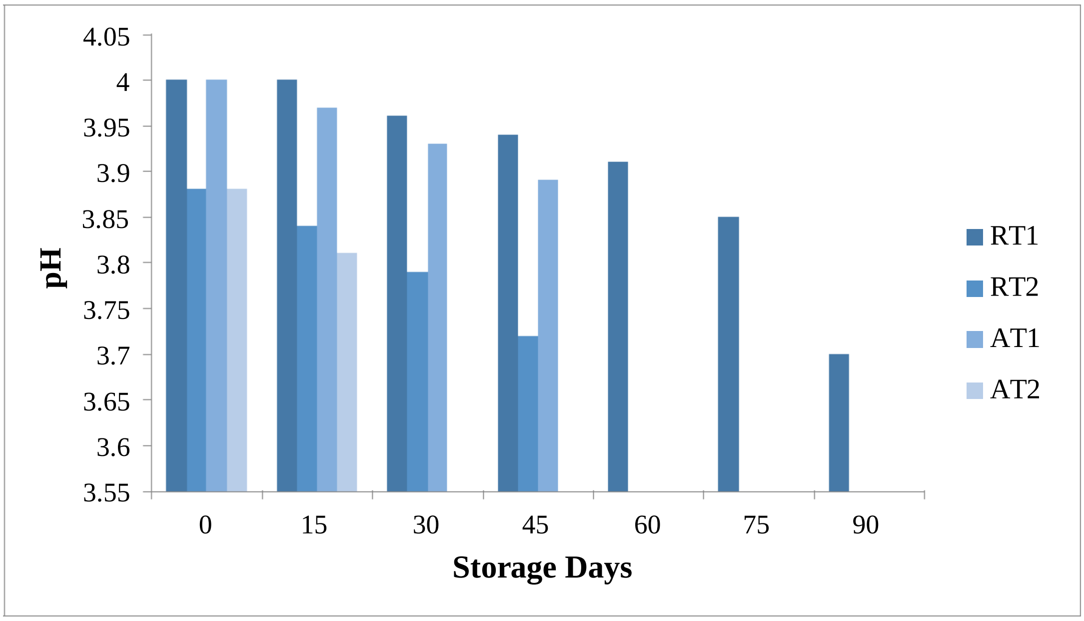

Figure 3.4.2 Effect of storage intervals and treatments on pH of KGML

3.4.3. TSS

The TSS values of samples (RT_1 to AT_2) on day first were 14.0 ^{0}brix which were similar in all the samples. Then it is gradually increased to 15.1, 14.7, 14.5, and 14.4 ^{0}brix respectively during 90 days storage. During storage maximum increase was observed in sample RT_1 (15.1), while minimum increase was recorded in all fresh samples (14.0) respectively. Increase in soluble content of the product due to the solubilization of fruit constituents during storage. (Byanna et al., 2013)

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Table 3.4.3. Chemical parameters of TSS of KGML during 90 days storage period

Treatments	**Storage period (Days)**						
	0	**15**	**30**	**45**	**60**	**75**	**90**
RT_1	14.0	14.1	14.3	14.5	14.6	14.8	15.1
RT_2	14.0	14.2	14.5	14.7	*	*	*
AT_1	14.0	14.2	14.3	14.5	*	*	*
AT_2	14.0	14.4	*	*	*	*	*
Mean	14.00	14.23	14.37	14.57	14.60	14.80	15.10
SE ±	0.022	0.049	0.031	0.056	0	0	0
CD@5%	0.068	0.148	0.096	0.171	0	0	0

***Spoiled sample**

RT_1 - lemonade + preservative, RT_2 - lemonade + without preservative, AT_1 – lemonade + preservative, AT_2- lemonade + without preservativ

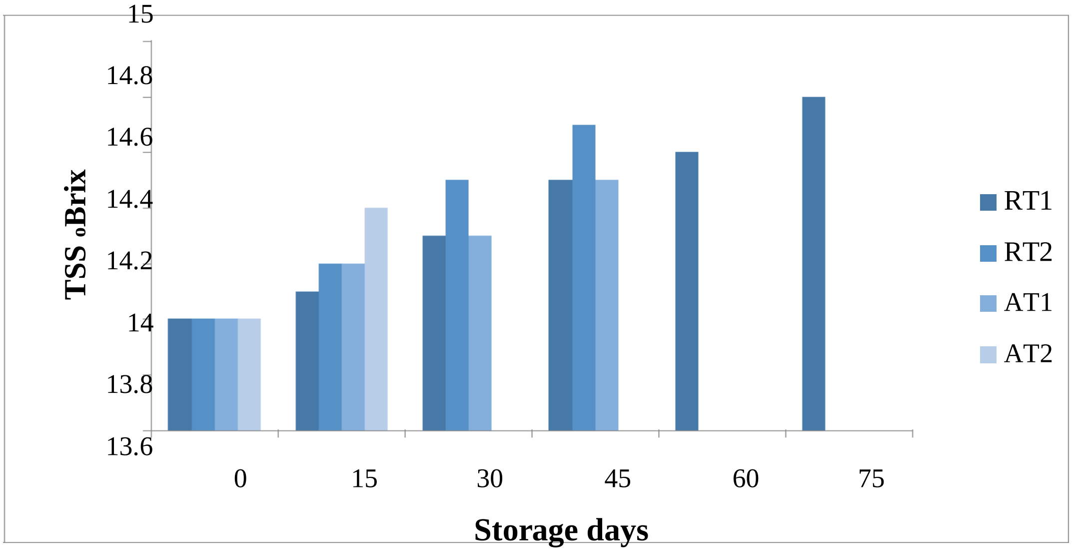

Figure 3.4.3. Effect of storage intervals and treatments on TSS of KGML

3.4.4. Ascorbic acid

The experimental data on changes in ascorbic acid content of blended lemonade during storage are presented in Table and figure 4.6.4. Initially the ascorbic content of samples (RT_1 to AT_2) was 22.7, 23.0, 22.7 and 23.0 mg/100 g, which was gradually decreased to 16.4, 14.7, 13.4 and 14.8 mg/100 g respectively during 90 days of storage period. For treatment maximum ascorbic acid content were observed in sample RT_2 and AT_2 (23.0) were minimum ascorbic acid content were observed in sample RT_1 and AT_1 (22.7) during storage. Vitamin C was found decreasing trend in all storage period due to oxidation caused by entrapped oxygen in glass bottles resulted in the formation of dehydro-ascorbic acid (Byanna *et al.*, 2013). Also it is due to the fact that ascorbic acid being sensitive to oxygen, light and heat was easily oxidized in presence of oxygen by both enzymatic and non-enzymatic catalyst (Mapson, 1970).

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Table 3.4.4. Chemical parameters of ascorbic acid content of KGML during 90 days storage period

Treatments	Storage Period (Days)						
	0	15	30	45	60	75	90
RT_1	22.7	21.9	21.2	20.5	18.8	17.9	16.4
RT_2	23.0	19.5	17.4	14.7	*	*	*
AT_1	22.7	19.5	16.6	13.4	*	*	*
AT_2	23.0	14.8	*	*	*	*	*
Mean	22.85	18.92	18.40	16.20	13.81	11.13	9.80
SE±	0.018	0.033	0.016	0.017	0	0	0
CD@5%	0.051	0.099	0.048	0.045	0	0	0

*** Spoiled sample**

RT_1 - lemonade + preservative, RT_2 - lemonade + without preservative, AT_1 - lemonade + preservative, AT_2- lemonade + without preservative

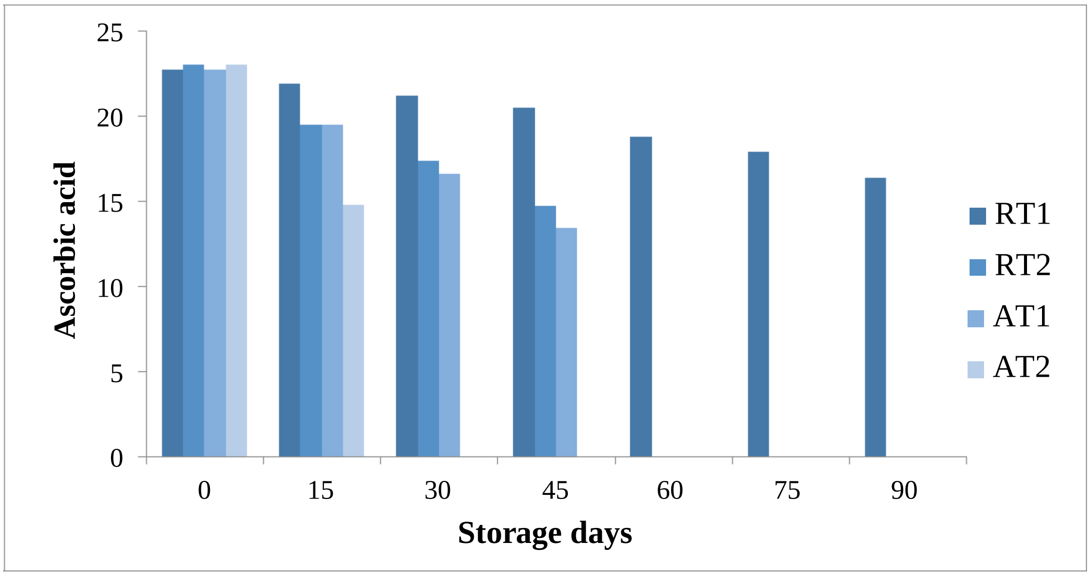

Figure 3.4.4 Effect of storage intervals and treatments on ascorbic acid content of KGML

3.4.5. Reducing sugars

Reducing sugars, non reducing sugars, total sugars were detected. During passage of storage (0 to 90 days) there was slightly increased in reducing sugars of samples (RT_1 to AT_2) ranging from (6.50 to 6.74%, 6.50 to 6.63%, 6.50 to 6.60%, 6.50 to 6.53%) during storage in all treatments due to hydrolysis of non reducing sugars into reducing sugars. At first day (fresh samples) it was same in all the samples, while it was changed during storage period. Muskmelon RTS stored for six months at room temperature had exhibited an increase in reducing sugars content. (Teotia *et al.*, 1997)

Table 3.4.5. Reducing sugars of KGML during 90 days of storage period

Treatments	Storage Period (Days)						
	0	15	30	45	60	75	90
RT_1	6.50	6.57	6.63	6.68	6.70	6.72	6.74
RT_2	6.50	6.56	6.59	6.63	*	*	*

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AT_1	6.50	6.54	6.56	6.60	*	*	*
AT_2	6.50	6.53	*	*	*	*	*
Mean	6.50	6.55	6.59	6.64	6.70	6.72	6.74
SE ±	0.002	0.003	0.005	0.006	0	0	0
CD@5%	0.007	0.010	0.017	0.020	0	0	0

***Spoiled sample**

RT_1 - lemonade + preservative, RT_2 - lemonade + without preservative, AT_1 - lemonade + preservative, AT_2- lemonade + without preservative

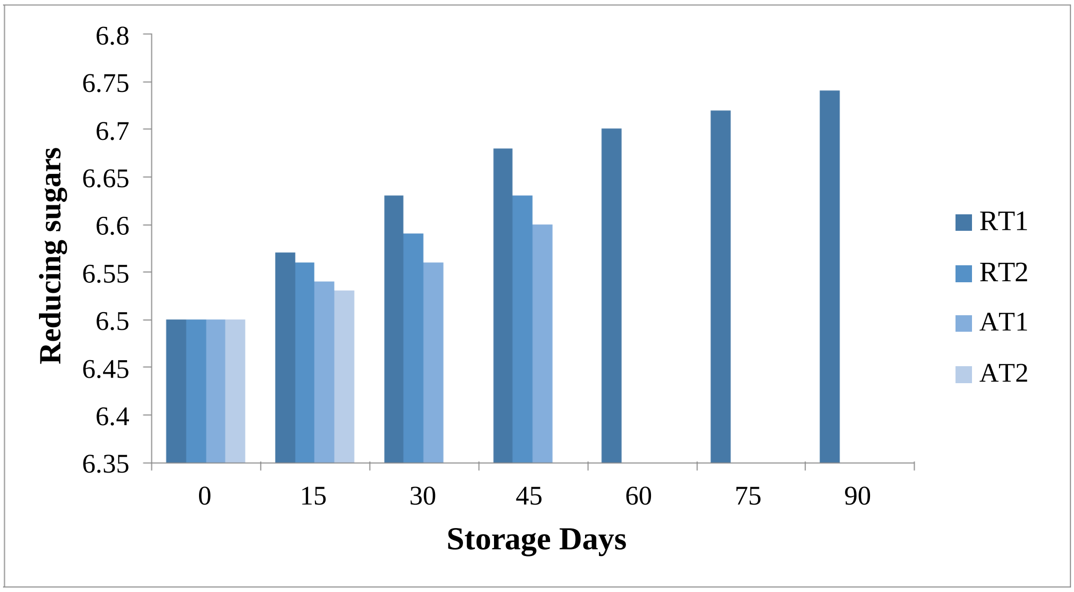

Figure 3.4.5. Effect of storage intervals and treatments on reducing sugars of KGML

3.4.6. Total sugars

Sugar acid ratio also decreased during storage of kiwi-guava mint lemonade. There was decreased in total sugars of samples (RT_1 to AT_2) ranging from (13.6 to 13.15%, 13.6 to 13.19%, 13.6 to 13.18%, 13.6 to 13.35%) respectively due to reaction of sugars with amino acids. (Byanna et al., 2013)

Table 3.4.6. Total sugars of KGML during 90 days of storage period

Treatments	Storage Period (Days)						
	0	15	30	45	60	75	90
RT_1	13.6	13.42	13.22	13.19	13.16	13.16	13.15
RT_2	13.6	13.40	13.20	13.19	*	*	*
AT_1	13.6	13.38	13.19	13.18	*	*	*
AT_2	13.6	13.35	*	*	*	*	*
Mean	13.60	13.39	13.20	13.19	13.16	13.16	13.15
SE ±	0.017	0.005	0.002	0.001	0	0	0
CD@5%	0.053	0.016	0.007	0.004	0	0	0

***Spoiled sample**

RT_1 - lemonade + preservative, RT_2 - lemonade + without preservative, AT_1 - lemonade + preservative, AT_2- lemonade + without preservative

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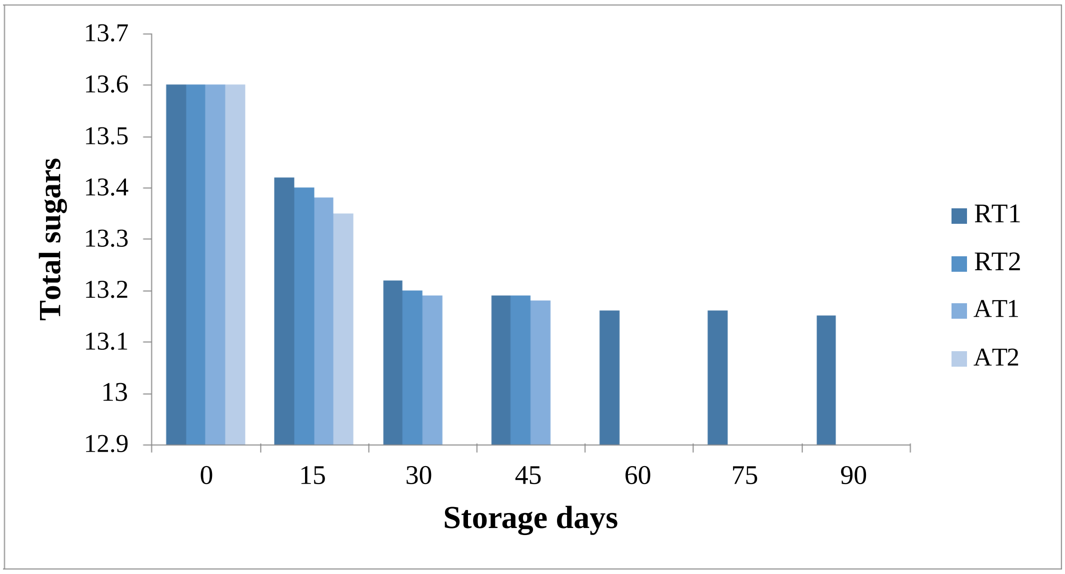

Figure 3.4.6. Effect of storage intervals and treatments on total sugars of KGML

3.4.7 Effect on microbial parameters (Total plate count and Yeast and mold) in kiwi-guava-mint lemonade beverage during storage

From Table 3.4.7. it is concluded that TPC count of fresh lemonade was 1 x 10^1 CFU/g and after 15 days of interval it slightly increases. Refrigerated samples had more shelf life then ambient samples. And also the sample RT_1 have shelf life upto three months. No yeast & mold count was found in fresh lemonade and after words also, if good manufacturing practices (GMP) are adhered to strictly (Davenport, 1995). It was found that product have shelf life upto three months.

Table 3.4.7. Total plate Count, yeast and mold count of KGML during 90 days storage period

Treat ments	Storage period (Days), TPC count							Y & M (CFU/g)
	0	15	30	45	60	75	90	
RT_1	1 x 10^1	3 x10^1	7 x10^1	11 x10^1	15 x10^1	19x10^1	26 x10^1	0
RT_2	2 x10^1	9 x10^1	20 x10^1	31 x10^1	*	*	*	0
AT_1	5 x10^1	15 x10^1	30 x10^1	50 x10^1	*	*	*	0
AT_2	8 x10^1	28x10^1	*	*	*	*	*	0

***Spoiled sample**

RT_1 - lemonade + preservative, RT_2 - lemonade + without preservative, AT_1 - lemonade + preservative, AT_2- lemonade + without preservative

II. CONCLUSION

In this present investigation, research has been made to prepare and standardize the method of kiwi-guava-mint lemonade drink. The nutritious drink with good storage life was developed by taking different proportion of kiwi and guava. After preparation the quality of product was evaluated with help of various properties like acidity, TSS, pH, ascorbic acid, reducing sugars, total sugars. The quality of product was found good for a period of 90 days. The TSS, reducing sugars, total sugars of kiwi-guava-mint lemonade was increased from 14.0 to 15.1 ^{o}Bx, from 6.50 to 6.74%, from 13.6 to 13.15% respectively, while the pH and vitamin C of beverage was also decreased from 4.00 to 3.70 and from 22.7

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to 16.4 mg/100 ml. The population of bacteria was 26 x10^{1} at the end of storage of 90 days. The overall result showed that sample RT_1(Lemonade+ potassium meta-bisulfite) have shelf life upto three months during storage at refrigerated condition (4±1°C).
It is obvious from the findings of this research wok that certainly it can improve the nutritional status of the population because it is rich source of vitamin C similar research work should be carried out with different citrus fruits individually as well as with combination.

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Studies on Biochemical Changes in Passion Fruit and Pineapple Blended Beverage During Storage

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Abstract:

The formulation and standardization of passion fruit and pineapple blended juice was conducted in order to develop innovative formulation of beverage and study the changes in beverage quality during storage. The extraction of juice from passion fruit and pineapple was done and preliminary trials were conducted to standardize optimum level of ingredients for the blended beverage. The optimum levels of passion fruit juice, pineapple pulp, sugar, stabilizer, preservative and water were selected. Based on sensory evaluation by a panel of trained judges, the optimum level of passion fruit juice, pineapple juice, sugar, stabilizer, preservative and water were reported to be 12 ml, 15 ml, 15 g, 0.10%, 0.10% and 57.80 ml respectively for 100 ml beverage. The final beverage was then pasteurized at 80^0C for 10 min. and filled in clean, sterilized dried glass bottles and sealed air tight with the help of a crown corking machine. After sealing the juice bottles were again pasteurized at 80^0C for 10 min. and the bottles were stored at refrigerated temperature (4^oC) and ambient temperature (24^oC). The storage studies were conducted by drawing representative samples periodically at 15 days interval up 90 days to evaluate changes in biochemical parameters such as acidity, pH, TSS, Vitamin C, reducing sugar and total sugar of the passion fruit and pineapple blended beverage.

Key Words -Passion Fruit, Pineapple, Preservative, Beverage, Vitamin C

I. Introduction

India is evolving as a huge market for juice industry and trade in past few decades. The increase in consumer demands and changing lifestyle fosters the juice industry. In the world of technological development and fast pace, the consumers have moved towards more easy options of lifestyle. This has given easy way for the industries to manufacture and capitalize in the development of products that are ready to serve and possess health benefits as well. Also, the fact that manufacturers have invested in fruit processing to increase the value of product in order to meet the requirements of consumers. Whereas, the soft drink market grows per year, the juices and nectars market are also increasing due to changing lifestyle of population. Same is the observation in developed countries like China and United States.

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The beverages are generally classified as alcoholic and non-alcoholic whereas non-alcoholic beverages can further be categorized as carbonated and non-carbonated beverages. Also packaged fruit juices; non-carbonated drinks have added water that are packages with bottles, energy drinks, flavored milk and so on. The packaged drinks have been accepted in India widely and reasonably, also has captured the market very well due to the growing demands. The Compound Annual Growth Rate of juice market in India is growing constantly and is predicted to increase in forthcoming decade. The blending of different fruit juices increases taste and flavor of fruit juices. The rightful blending of juice can enhance taste and nutrients of the beverages leading to the production of delightful and delicious beverages with advancement in organoleptic properties and nutritional value. (Singh S. et al., 2012).

Passion fruit (*Passiflora edulis*) belongs to the family Passifloraceae is an important fruit crop having economic values, indigenous to the tropical and subtropical regions of South America, especially in Brazil. It is natively called as yellow passion fruit, granadilla, purple granadilla, apricot vine, Jamaican honeysuckle, etc. (Deshmukh N. et al., 2017). It originates in India, as wild in several parts of Kodaikanal Western Ghats Nilgiris and some North Eastern states like Manipur, Nagaland and Mizoram. Fruits are nearly round to oval in shape with tough rind which is smooth and waxy and weighing about 35 to 40g in yellow species (*P. edulis flavicarpa*) and about 60g in purple species (*P. edulis Sims*) and bears on woody perennial vines. An aromatic mass of double-walled, membranous sacs containing orange color pulpy juice are the edible portion and roughly 250 small, dark brown to black pitted seeds are present inside the fruit. It is a rich source of Vitamin A and C and contains good amounts of iron, potassium, sodium, magnesium, chlorides and has dietary fiber and protein. Fruits are eaten fresh or usually processed into products like jams, squash, ice-cream, cakes, pies and juice. Vines are productive at higher elevations. Fruits are 4-5 cm in diameter, deep purple when ripe each weigh around 35-45 g (juice content differs from 31-35%) (Thokchom et al., 2017).

Pineapple (*Ananas comosus*) is found in all the tropical and subtropical zones of the world. Most of pineapple produced are consumed as raw fruit and addition to that most of it are tropical fruits. Pineapples are processed in several products such as dried pineapple, pulp, concentrate and juice. The fresh pineapple juice as a product has got popularity due to its flavor, pleasant aroma and many functional properties. The types of juices provided include clear juice, juice from concentrate, blended juice with other fruits and also juice that is obtained from pineapple parts by squeezing in mills, called as single strength juice (Paull et al., 2011). Pineapple juice is a rich source of manganese, as well as amino acids, various sugars, vitamins, and polyphenols. It is considered as a functional drink due to its health-promoting feature and has anti-inflammatory, anti-atherosclerotic, antiaging, and many other healing properties. This fruit has been extensively used as a traditional remedy for several health ailments such as digestive problems. Recent research has indicated that pineapple fruit, peel, and juice exhibit robust effects of anti-oxidant capacity, phenolic content, and polysaccharide. Pineapple juice has the capacity to relieve suffering from heart conditions mainly because it reduces blood clots in the blood stream (Khalid et al., 2016).

The fruit juices are very delicious, refreshing, soothing (Roger et al., 2002) and rich source of antioxidant, anti-inflammatory, anti-tumor, anti-fungal and blood clot inhibition activity (Abeysinghe et al., 2007). Different types of bioactive compounds like ferrulic acid, hydro cinnamic acid, cyanidin glucoside, hisperidine, vitamin-C, carotenoid and naringin in citrus fruit juice (Xu et al., 2008). Generally, the commercialized fruit beverages contain 12% minimum of fruit juice and rest as sugar, citric acid and other ingredients. (European Commission, 2008). However, processed juice affected by a wide range of biochemical

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changes during storage so required to be processed properly, preserved under appropriate conditions with suitable additives. The food industries apply some common processes such as thermal treatments because of their ability to kill microorganisms and inactivate enzymes, like pasteurization and sterilization, use of chemical preservatives to ensure safety and quality for preservation of functional beverage. The most common preservatives which are being used in fruit processing industries are salts releasing sulphur dioxide and salts of benzoic acid. The great potential for commercialization of RTS beverages as natural health drinks in domestic and the export market. The studies confirm the formulation of the blended passion fruit and pineapple beverage portrayed good sensory properties. Thus, in this present work, the biochemical changes taking place during preservation of fruit juice and their regulation to improve the storage quality of beverage.

II. RESEARCH MATERIAL AND METHODOLOGY

2.1. Materials

The present research work was undertaken in the Department of Ethical Science and Food Technology at MIT College of Food Technology, MIT ADT University, Pune.

2.1.1. Fruits

Passion fruits were obtained from the APMC Market, Navi Mumbai and Pineapples were purchased from Local Market: Loni-Kalbhor, Pune. The fully matured, healthy, flawless and uniform sized passion fruits and pineapple were carefully selected and brought to the laboratory for further experimentation. The fruits were thoroughly washed prior to processing to remove dust and dirt adhered to fruits, to prevent contamination.

2.1.2. Chemicals and Packaging material

Ingredients like sugar used in the experimentation was obtained from Local Market: Loni-Kalbhor, Pune. Other chemicals and equipment required for experimentation are acquired from MIT-ADT laboratory. Glass bottles used as packaging material for blended juice, were obtained from Ravivar Peth, Pune.

2.2. Methodology

2.2.1 Preparation of passion fruit and pineapple blended beverage

Passion Fruits	Pineapple Fruits
(Mature, sound, fresh, ripe and firm)	(Mature, sound, fresh, ripe and firm)
↓	↓
Remove scaly portions	Remove outer layer
↓	↓
Extracting juice	Extracting juice
↓	↓
Filtering juice (muslin cloth)	Filtering juice (muslin cloth)

↓

Addition of sugar, water, preservative and stabilizer

↓

Mixing with fruit juice thoroughly

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↓
Pasteurization (80°C for 10 minutes)
↓
Filling in bottles (head space 2 cm)
↓
Crown corking
↓
Pasteurization (80°C for 10 minutes)
↓
Cooling and Labeling
↓
Storage
(At both ambient and refrigeration temperatures)
↓
Quality monitoring of blended Passion Fruit and pineapple Beverage
(Sensory, microbial and physicochemical)

Fig. 2.2.1 Flow chart for the preparation of passion fruit and pineapple blended beverage.

2.2.2 Formulation of passion fruit and pineapple blended beverage preparation

Different samples like S_0, S_1, S_2, S_3 and S_4 were prepared by blending Passion fruit and Pineapple juice proportions. The formulation is presented as below in table.

Table No. 2.2.2. Formulation for Passion Fruit and Pineapple Blended Beverage

Sample code	Passion Fruit juice (ml/100ml)	Pineapple fruit juice (ml/100ml)	Sugar (g/100 ml)	Water (ml/100ml)	Stabilizer (g/100ml)	Preservative (g/100ml)
S_0	12.00	-	15.00	72.80	0.10	0.10
S_1	12.00	10.00	15.00	62.80	0.10	0.10
S_2	12.00	15.00	15.00	57.80	0.10	0.10
S_3	12.00	20.00	15.00	52.80	0.10	0.10
S_4	12.00	25.00	15.00	47.80	0.10	0.10

S_0-Controle sample, S_1-Blend with 10% pineapple juice, S_2-Blend with 15% pineapple juice, S_3-Blend with 20% pineapple juice, S_4-Blend with 25% pineapple juice

2.2.3 Sensory evaluation of passion fruit and pineapple blended beverage

The sensory evaluation of passion fruit and pineapple blended beverage was done by a panel of 5 semi-trained judges as described by Amerine *et. al.*, (2013) on 9-point hedonic scale. The mean value of sensory score was calculated and reported for each sensory parameter.

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2.2.4 Statistical analysis of data

The data obtained were analysed for statistical significance according to the procedure given by Panse and Sukhatme (1967). However, due to spoilage of some samples before the completion of storage period, simple mean values have been reported.

2.2.5 Biochemical parameters studied during storage of Passion fruit and pineapple blended beverage

2.2.5.1 Acidity - The titratable acidity was determined individually by simple acid / alkaline titration method.The percentage acidity was calculated by the following formula:

$$\text{Acidity (\%)} = \frac{\text{Titre value} \times \text{Normality (NaOH)} \times \text{Eq. wt. of acid}}{\text{Volume of sample taken for estimation } \times 1000} \times 100$$

2.2.5.2 pH - The pH was determined using digital pH meter, with prior calibration with standardized buffer solution of pH 4, 10 and 7 respectively. The results were recorded.

2.2.5.3 TSS - The total soluble solids were determined by Hand refractometer with three replications. The drop extracted pulp was placed on the prism and the glass slit was closed. The refractometer reading was noted and the average of reading was calculated (°Brix). Wipe the prism with wet and clean cloth after use.

2.2.5.4 Vitamin C - The Vitamin C content was determined by Assay method given by Ranganna (1986)

$$\text{Vitamin C (mg/100 g)} = \frac{\text{Titre value} \times \text{Dye factor} \times \text{Volume made up}}{\text{Aliquot of sample taken for estimation} \times \text{Weight of sample taken for estimation}} \times 100$$

2.2.5.5 Total sugar - Total sugars were determined by method of Thimmaiah (2016)

$$\text{Total sugars (\%)} = \frac{\text{Factor } \times \text{Volume made up}}{\text{Titre value } \times \text{Weight of sample taken}} \times 100$$

2.2.5.6 Reducing sugar - The reducing sugars were estimated by the DNS Method. In this method, several reagents have been employed which assay sugars by their reducing properties. One such compound is 3, 5 dinitrosalicylic acid (DNS) which in alkaline solution is reduced to 3-amino-5 nitrosalicylic acid. Thimmaiah (2016).

$$\text{Reducing sugar (\%)} = \frac{\text{Sugar value(graph)} \times \left(\text{Total vol. of alcohol} - \text{free extract(10 ml)}\right)}{\left(\text{Aliquot of alcohol} - \text{free extract used (ml)}\right) \times \text{Weight of sample (100mg)}} \times \frac{1}{1000}$$

2.2.5.7 Microbial Analysis- (Total plate count and Yeast and mold count) - The Nutrient Agar media was prepared by weighing required quantity of nutrients and agar in 100 ml distilled water was added to it. The media was autoclaved at 121°C at 15 psi pressure for 20 min. Then, after sterilization of media, it was used for plating. The 0.1 ml sample (each treatment) was poured on a separate sterile petri plates under the Laminar Air Flow. The

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nutrient media was poured in the plate containing sample and mixed by swirling slowly and properly and the plates were incubated at 37°C for 48 hr. After incubation, bacterial count was checked and kept for 5-6 days at room temperature for fungal count. The total microbial plate count was expressed in CFU/g. Similar procedure was followed for yeast and mold count by using Potato dextrose Agar (PDA) medium. The result was expressed as Total Plate count and the number of yeast and mold count per ml of the sample using formula (Aneja K. R., 2007).

Yeast and mold counts per ml of sample = Colonies count x Dilution factor

III. RESULTS AND DISCUSSION

3.1. Formulation and Standardization of passion fruit and Pineapple blended beverage

Several trials (Table 3.1) were conducted to select optimum level of passion fruit juice, pineapple juice, sugar, stabilizer, preservative and water for the blended beverage. Based on sensory evaluation by a panel of trained judges, the optimum level of passion fruit pulp, pineapple pulp, sugar, water, stabilizer and preservatives were reported to be 12 ml, 15 ml, 15 g, 57.80 ml, 0.10 g and 0.10 g respectively for 100 ml beverage.

Table 3.1. Standardization table for Blended Passion Fruit and Pineapple Beverage

Sample code	Passion Fruit (ml/100ml)	Pineapple (ml/100ml)	Sugar (g/100 ml)	Water (ml/100ml)	Stabilizer (g/100ml)	Preservative (g/100ml)
S_0	12.00	-	15.00	72.80	0.10	0.10
S_1	12.00	10.00	15.00	62.80	0.10	0.10
S_2	**12.00**	**15.00**	**15.00**	**57.80**	**0.10**	**0.10**
S_3	12.00	20.00	15.00	52.80	0.10	0.10
S_4	12.00	25.00	15.00	47.80	0.10	0.10

S_0-Controle sample, S_1-Blend with 10% pineapple juice, S_2-Blend with 15% pineapple juice, S_3-Blend with 20% pineapple juice, S_4-Blend with 25% pineapple juice

3.2. Sensory evaluation of passion fruit and pineapple blended beverage

Based on the sensory evaluation by a panel of trained judges the sample S2 got highest score i.e. 8 which was having, the optimum level of passion fruit pulp, pineapple pulp, sugar, water, stabilizer and preservatives were reported to be 12 ml, 15 ml, 15 g, 57.80 ml, 0.10 g and 0.10 g respectively for 100 ml beverage (Table 3.2).

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Table 3.2. Sensory evaluation of passion fruit and pineapple blended beverage

Sample code	Color and Appearance	Taste	Flavor	Mouth feel	Overall acceptability
S_0	7.2	7.3	7.3	7.3	7.2
S_1	7.4	7.5	7.5	7.4	7.3
S_2	**7.9**	**8.0**	**7.9**	**8.1**	**8.0**
S_3	7.5	7.6	7.5	7.7	7.6
S_4	7.4	7.5	7.5	7.3	7.4
Mean	7.48	7.58	7.54	7.56	7.5
SE (m)	0.018	0.022	0.018	0.024	0.023
CD@5%	0.054	0.066	0.054	0.070	0.067

S_0 –Control sample, S_1 –Blended with 10% pineapple juice, S_2 - Blended with 15% pineapple juice, S_3 - Blended with 20% pineapple juice, S_4- Blended with 25 % pineapple juice

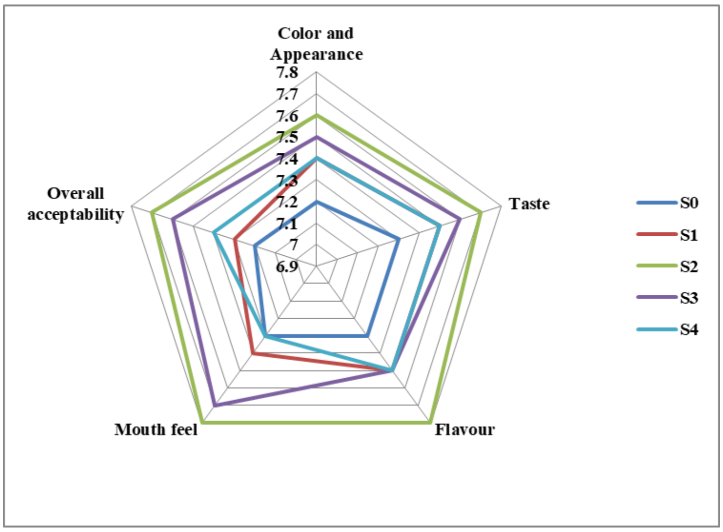

Figure 3.2. Sensory evaluation of Passion fruit and Pineapple blended beverage

3.3 Proximate analysis of selected Passion fruit and Pineapple blended beverage

The experimental data of proximate analysis of final beverage is presented in Table 4.4.1. Among the chemical composition of passion fruit and pineapple blended beverage, the values for moisture were 80.16 %, fat were 0.16 %, protein content were 2.42 %, fiber were 0.11 %, ash content were 0.12 %, carbohydrates were 16.14 % and vitamin C were 11.54 mg/100 ml.

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Table 3.3 Proximate analysis of selected Passion fruit and Pineapple blended beverage

Sr. no.	Properties	Result (Per 100ml)
1	Energy (Kcal)	79.68
2	Protein (%)	2.42
3	Carbohydrates (%)	17.14
4	Fat (%)	0.16
5	Ash (%)	0.12
6	Moisture (%)	80.16
7	Fiber (%)	0.11
8	Vitamin C (mg/100 ml)	11.54

3.4 Biochemical parameters studied during storage of Passion fruit and pineapple blended beverage

3.4.1. Effect on acidity variation in passion fruit and pineapple blended beverage during storage

The experimental data on effect of storage acidity of blended beverages are presented in Table and figure 4.6.1.The data indicated that at Refrigerated temperature (4°C), the acidity increased from 0.59 to 0.70% in S_2 sample, from 0.54 to 0.63% in C sample, from 0.60 to 0.67% in S_2P sample and from 0.54 to 0.64% in CP sample. While at ambient temperature (24°C), the acidity increased from 0.59 to 0.73% in S_2 sample, from 0.54 to 0.70% in C sample, from 0.60 to 0.72% in S_2P sample and from 0.54 to 0.69% in CP sample. The increase in acidity was more in case of ambient temperature storage as compared to cold temperature storage. The increase in acidity of blended beverage could be attributed to the chemical interaction between the organic constituents of the beverage induced by temperature and the action of enzymes. It is reported that similar results were observed by Kumar D. *et al.,* (2016)

Table 3.4.1 Effect on acidity variation in passion fruit and pineapple blended beverage during storage

Days	Refrigerated temperature (4°C)				Ambient temperature (24°C)			
	S_2	C	S_2P	CP	S_2	C	S_2P	CP
0	0.59	0.54	0.60	0.54	0.59	0.54	0.60	0.54
15	0.59	0.55	0.60	0.54	0.60	0.56	0.61	0.55
30	0.60	0.55	0.60	0.55	0.61	0.58	0.63	0.57
45	0.62	0.57	0.61	0.57	0.63	0.60	0.67	0.60
60	0.64	0.59	0.62	0.58	0.66	0.62	0.69	0.62
75	0.67	0.61	0.65	0.60	0.69	0.65	0.70	0.65
90	0.70	0.63	0.67	0.64	0.73	0.70	0.72	0.69

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Mean	**0.63**	**0.57**	**0.62**	**0.57**	**0.64**	**0.60**	**0.66**	**0.60**
SE (M)	**0.004**	**0.003**	**0.003**	**0.002**	**0.003**	**0.002**	**0.005**	**0.004**
CD@5%	**0.011**	**0.010**	**0.010**	**0.006**	**0.008**	**0.007**	**0.014**	**0.013**

S_2: Selected blend; C: Control; S_2P: Selected blend with preservative; CP: Control with preservative

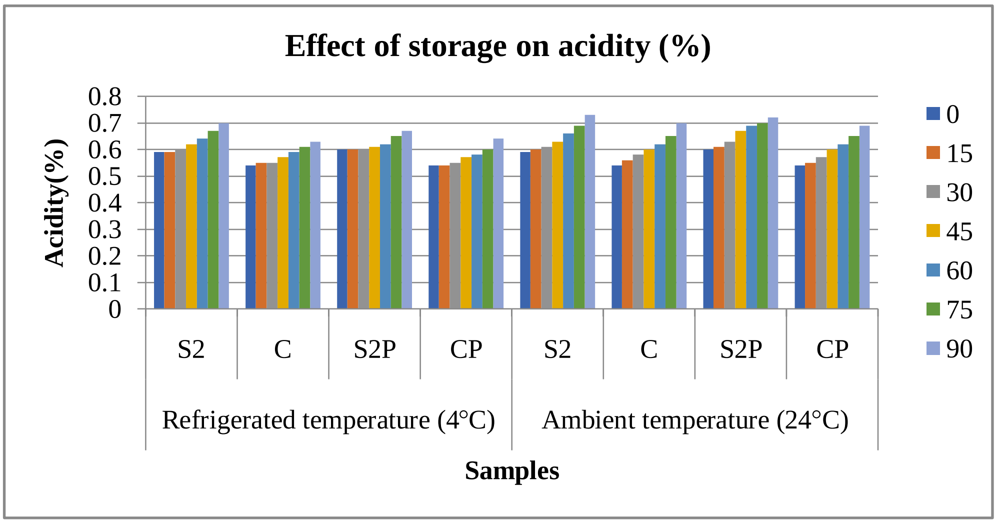

Figure 3.4.1 Effect on acidity variation in passion fruit and pineapple blended beverage during storage

3.4.2. Effect on pH variation in passion fruit and pineapple blended beverage during storage

The experimental data on effect of storage on acidity of blended beverages are presented in Table and figure 4.6.2.The data indicated that at refrigerated temperature (4°C), the pH decreased from 3.57 to 3.47 of S_2 sample, from 3.68 to 3.56 of C sample, from 3.58 to 3.45 of S_2P sample and from 3.68 to 3.52 of CP sample. While at ambient temperature (24°C), the pH decreased from 3.57 to 3.37 of S_2 sample, from 3.68 to 3.44 of C sample, from 3.58 to 3.35 of S_2P sample and from 3.68 to 3.44 of CP sample. The decrease in pH was more in case of ambient temperature storage as compared to refrigerated temperature storage. This decrease in pH was attributed to formation of acidic compounds by degradation of reducing sugars, as discussed by Zia (1987), Kumar *et al.*, (2016) reported that, decline in pH towards acidic region was noticed as the storage of the lemon drink increased. Similar trend of decrease in pH was also reported by Saleem (1980).

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Table 3.4.2 Effect on pH variation in passion fruit and pineapple blended beverage during storage

Days	Refrigerated temperature (4°C)				Ambient temperature (24°C)			
	S_2	**C**	**S_2P**	**CP**	**S_2**	**C**	**S_2P**	**CP**
0	3.57	3.68	3.58	3.68	3.57	3.68	3.58	3.68
15	3.55	3.66	3.57	3.66	3.53	3.65	3.53	3.65
30	3.54	3.64	3.56	3.63	3.50	3.61	3.50	3.62
45	3.52	3.63	3.54	3.60	3.48	3.58	3.48	3.59
60	3.50	3.61	3.52	3.58	3.44	3.54	3.46	3.55
75	3.48	3.59	3.50	3.55	3.40	3.50	3.41	3.51
90	3.47	3.56	3.45	3.52	3.37	3.44	3.35	3.44
Mean	**3.51**	**3.62**	**3.53**	**3.60**	**3.60**	**3.47**	**3.57**	**3.47**
SE (M)	**0.003**	**0.002**	**0.003**	**0.003**	**0.002**	**0.024**	**0.004**	**0.005**
CD@5%	**0.008**	**0.007**	**0.007**	**0.008**	**0.007**	**0.007**	**0.011**	**0.014**

S_2: Selected blend; C: Control; S_2P: Selected blend with preservatives; CP: Control with preservatives

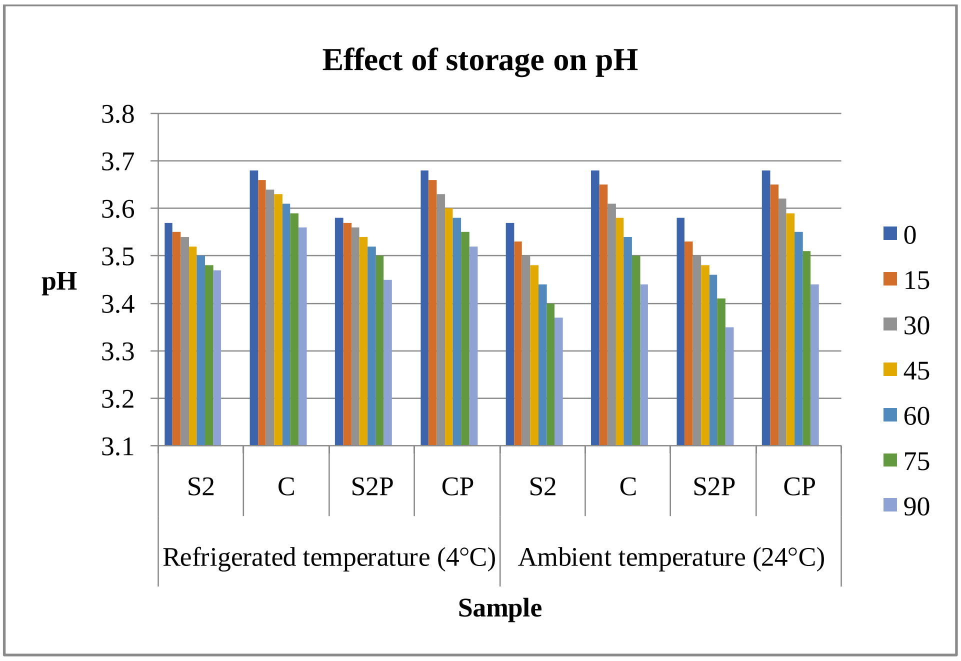

Figure 3.4.2 Effect on pH variation in passion fruit and pineapple blended beverage during storage

3.4.3. Effect on TSS variation in passion fruit and pineapple blended beverage during storage

The experimental data on changes in TSS of blended beverages during storage are presented in Table and figure 4.6.3.The data indicated that at refrigerated temperature (4°C),

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the TSS increased from 19.00 to 19.60°Bx in S_2 sample, 18.00 to 19.50°Bx in C sample, 19.10 to 19.30°Bx in S_2P sample and 18.10 to 18.80°Bx in CP sample.While at ambient temperature (24°C), the TSS increased in 19.00 to 20.70°Bx in S_2 sample, 18.00 to 19.90°Bx in C sample, 19.00 to 20.30°Bx in S_2P sample and 18.10 to 19.25°Bx in CP sample. The increase in TSS value of blended beverage might be due to formation or degradation of sucrose into glucose and fructose (Kumar D. *et al.*,(2016). Similar results have been reported by Sarolia and Mukherjee (2002).

Table 3.4.3. Effect on TSS variation in passion fruit and pineapple blended beverage during storage

Days	Refrigerated temperature (4°C)				Ambient temperature (24°C)			
	S_2	C	S_2P	CP	S_2	C	S_2P	CP
0	19.00	18.00	19.00	18.10	19.00	18.00	19.00	18.10
15	19.10	18.20	19.05	18.10	19.20	18.30	19.20	18.30
30	19.15	18.40	19.10	18.10	19.45	18.60	19.40	18.50
45	19.20	18.70	19.15	18.15	19.60	18.80	19.60	18.65
60	19.20	18.90	19.17	18.20	19.90	19.00	19.70	18.75
75	19.40	19.20	19.20	18.50	20.30	19.40	19.95	18.90
90	19.60	19.50	19.30	18.80	20.70	19.90	20.30	19.25
Mean	**19.23**	**18.70**	**19.13**	**18.27**	**19.73**	**18.86**	**19.59**	**18.64**
SE (M)	**0.034**	**0.045**	**0.182**	**0.023**	**0.174**	**0.019**	**0.019**	**0.035**
CD@5%	**0.100**	**0.132**	**0.534**	**0.068**	**0.509**	**0.055**	**0.058**	**0.104**

S2: Selected blend; C: Control; S2P: Selected blend with preservatives; CP: Control with preservatives

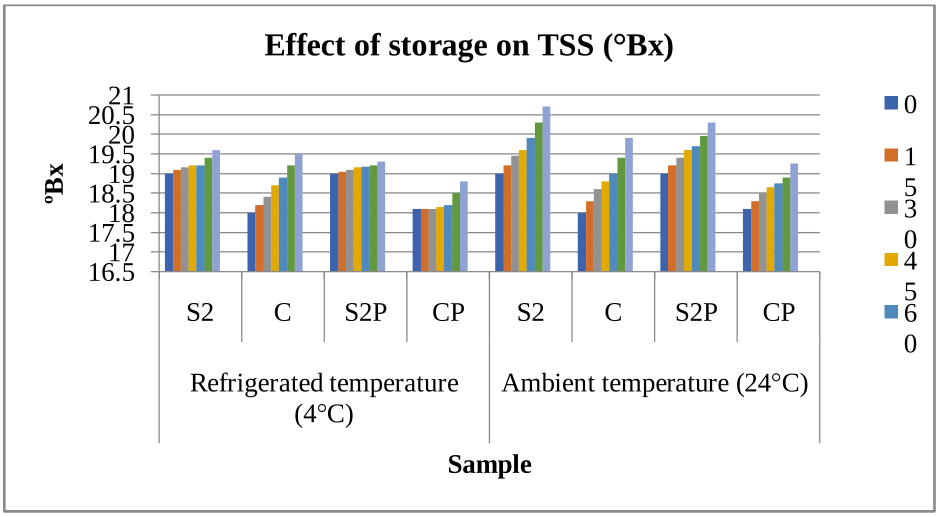

Figure 3.4.3. Effect on TSS variation in passion fruit and pineapple blended beverage during storage

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3.4.4. Effect on vitamin C variation in passion fruit and pineapple blended beverage during storage

The experimental data on changes in vitamin C content of blended beverage during storage are presented in Table and figure 4.6.4.The data indicated that at refrigerated temperature (4°C), vitamin C content decreased from 11.54 to 10.11 mg/100 ml of S_2 sample, from 5.21 to 3.58 mg/100 ml of C sample, from 11.54 to 10.50 mg/100 ml of S_2P sample and from 5.21 to 3.60 mg/100 ml of CP sample. While at ambient temperature (24°C), the vitamin C content decreased from 11.54 to 5.90 mg/100 ml of S_2 sample, from 5.21 to 2.92 mg/100 ml of C sample, from 11.54 to 6.00 mg/100 ml of S_2P sample and from 5.21 to 3.01 mg/100 ml of CP sample. Degradation of ascorbic acid can occur aerobically as well as anaerobically. However, rate of aerobic degradation is 100 to 1000 times faster than anaerobic degradation. Vitamin C is light sensitive as well as heat sensitive, the concentration of Vitamin C follows first order kinetics and thus storage time affects Vitamin C content Heldman and Singh (1981). Similar trend was also reported in cashew apple juice by Maia *et al*., (2001) and Costa *et al*., (2003). Majumdar *et al*., (2009) reported 74% loss in ascorbic acid in cucumber, litchi and lemon blended juice stored for 6 months.

Table 3.4.4. Effect on vitamin C variation in passion fruit and pineapple blended beverage during storage

Days	**Refrigerated temperature (4°C)**				**Ambient temperature (24°C)**			
	S_2	**C**	**S_2P**	**CP**	**S_2**	**C**	**S_2P**	**CP**
0	11.54	5.21	11.54	5.21	11.54	5.21	11.54	5.21
15	11.40	4.98	11.47	5.08	10.89	4.83	11.03	4.98
30	11.27	4.61	11.33	4.89	10.17	4.49	10.41	4.78
45	11.00	4.27	11.15	4.57	9.50	4.16	9.82	4.17
60	10.80	4.04	11.02	4.11	7.92	3.88	8.17	3.88
75	10.47	3.79	10.79	3.87	6.35	3.30	7.45	3.47
90	10.11	3.58	10.50	3.60	5.90	2.92	6.00	3.01
Mean	**10.94**	**4.35**	**11.11**	**4.48**	**8.89**	**4.11**	**9.20**	**4.21**
SE (M)	**0.017**	**0.003**	**0.003**	**0.003**	**0.002**	**0.003**	**0.018**	**0.004**
CD@5%	**0.051**	**0.007**	**0.008**	**0.009**	**0.007**	**0.010**	**0.052**	**0.011**

S_2: Selected blend; C: Control; S_2P: Selected blend with preservatives; CP: Control with preservatives

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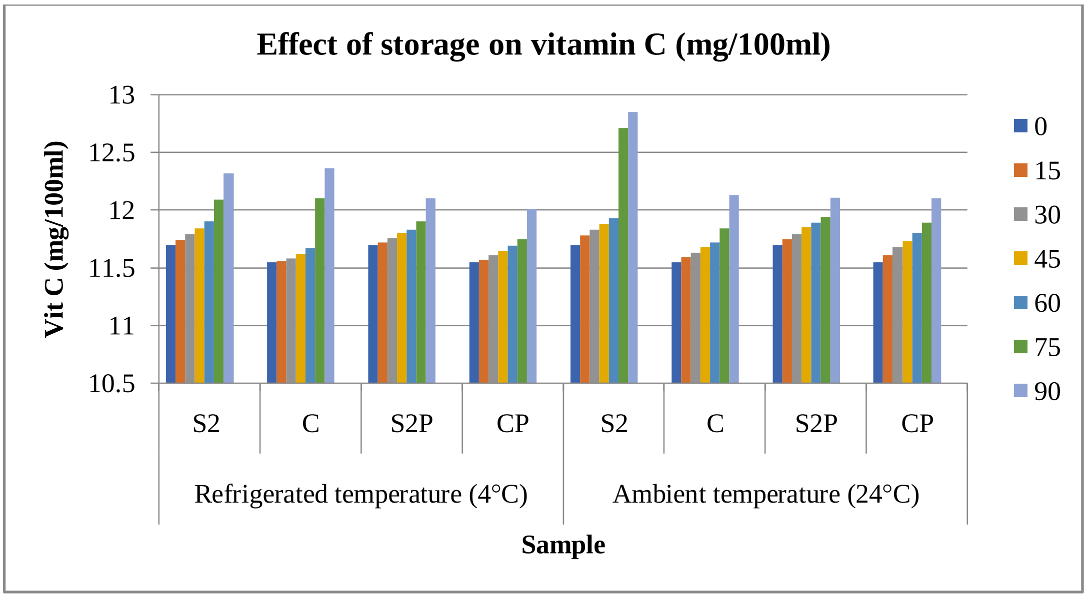

Figure 3.4.4 Effect on vitamin C variation in passion fruit and pineapple blended beverage during storage

3.4.5. Effect on reducing sugar variation in passion fruit and pineapple blended beverage during storage

The experimental data on effect of storage on reducing sugar of blended beverages are presented in Table and figure 4.6.5. The data indicated that at refrigerated temperature (4°C), the reducing sugar increased from 7.50 to 7.87 g/100 ml in S_2 sample, from 7.15 to 7.49 g/100 ml in C sample, from 7.50 to 7.88 g/100 ml in S_2P sample and from 7.15 to 7.80 g/100 ml in CP sample. While at ambient temperature (24°C), the reducing sugar increased from 7.50 to 8.25 g/100 ml in S_2 sample, from 7.15 to 7.69 g/100 ml in C sample, from 7.50 to 8.19 g/100 ml in S_2P sample and from 7.15 to 7.98 g/100 ml in CP sample.The increase in total sugars could be result of hydrolysis of polysaccharides like pectin, cellulose and starch into simple sugars as reported by Singh and Mathur (1983). Similar observations were also reported by Babsky *et al*., (1986) and Pruthi *et al*., (1984).

Table 3.4.5. Effect on reducing sugar variation in passion fruit and pineapple blended beverage during storage

Days	Refrigerated temperature (4°C)				Ambient temperature (24°C)			
	S_2	C	S_2P	CP	S_2	C	S_2P	CP
0	7.50	7.15	7.50	7.15	7.50	7.15	7.50	7.15
15	7.50	7.15	7.55	7.18	7.58	7.20	7.58	7.23
30	7.55	7.20	7.63	7.22	7.65	7.28	7.64	7.29
45	7.63	7.27	7.70	7.27	7.72	7.35	7.71	7.36
60	7.70	7.30	7.75	7.32	7.80	7.43	7.80	7.47
75	7.78	7.38	7.79	7.45	7.91	7.52	7.92	7.58
90	7.87	7.49	7.88	7.80	8.25	7.69	8.19	7.98

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Mean	**7.64**	**7.28**	**7.68**	**7.34**	**7.78**	**7.38**	**7.77**	**7.43**
SE (M)	**0.004**	**0.002**	**0.003**	**0.002**	**0.004**	**0.005**	**0.005**	**0.006**
CD@5%	**0.011**	**0.007**	**0.008**	**0.005**	**0.011**	**0.014**	**0.014**	**0.018**

S2: Selected blend; C: Control; S2P: Selected blend with preservatives; CP: Control with preservatives

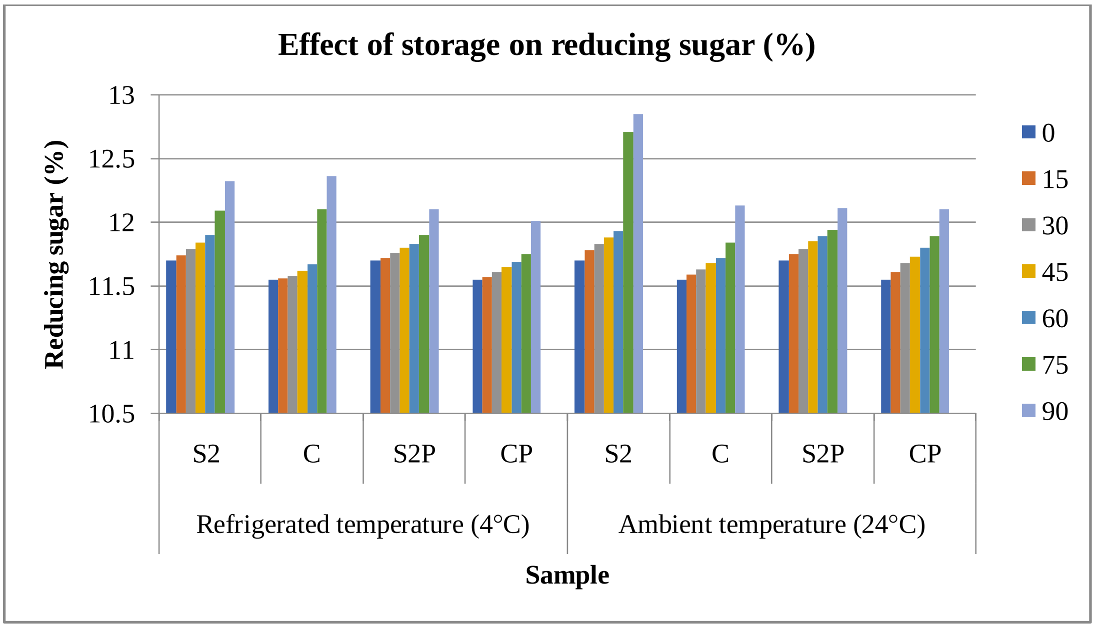

Figure 3.4.5. Effect on reducing sugar variation in passion fruit and pineapple blended beverage during storage

3.4.6. Effect on total sugar variation in passion fruit and pineapple blended beverage during storage

The data on effect of storage on total sugar of blended beverages are presented in Table and figure 4.6.6 The data indicated that at refrigerated temperature (4°C), the total sugars increased from 11.70 to 12.32 g/100 ml in S_2 sample, from 11.55 to 12.36 g/100 ml in C sample, from 11.70 to 12.10 g/100 ml in S_2P sample and from 11.55 to 12.01 g/100 ml in CP sample. While at ambient temperature (24°C), the total sugar increased from 11.70 to 12.85 g/100 ml in S_2 sample, from 11.55 to 12.13 g/100 ml in C sample, from 11.70 to 12.11 g/100 ml in S_2P sample and from 11.55 to 12.10 g/100 ml in CP sample. A significant increase in reducing sugar during storage of citrus juice which may be due to acid hydrolysis of sucrose (non-reducing sugar) to glucose and fructose (Ahmed *et al*., 2008). Similarly, Garget *et al*., (2008) had also reported increase in total sugar content during storage in blended Indian gooseberry juice.

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Table 3.4.6 Effect on total sugar variation in passion fruit and pineapple blended beverage during storage

Days	Refrigerated temperature (4°C)				Ambient temperature (24°C)			
	S_2	C	S_2P	CP	S_2	C	S_2P	CP
0	11.70	11.55	11.70	11.55	11.70	11.55	11.70	11.55
15	11.74	11.56	11.72	11.57	11.78	11.59	11.75	11.61
30	11.79	11.58	11.76	11.61	11.83	11.63	11.79	11.68
45	11.84	11.62	11.80	11.65	11.88	11.68	11.85	11.73
60	11.90	11.67	11.83	11.69	11.93	11.72	11.89	11.80
75	12.09	12.10	11.90	11.75	12.71	11.84	11.94	11.89
90	12.32	12.36	12.10	12.01	12.85	12.13	12.11	12.10
Mean	**11.91**	**11.77**	**11.83**	**11.69**	**12.09**	**11.73**	**11.86**	**11.76**
SE (M)	**0.002**	**0.003**	**0.004**	**0.002**	**0.02**	**0.004**	**0.002**	**0.003**
CD@5%	**0.005**	**0.008**	**0.011**	**0.007**	**0.053**	**0.011**	**0.007**	**0.008**

S_2: Selected blend; C: Control; S_2P: Selected blend with preservatives; CP: Control with preservatives

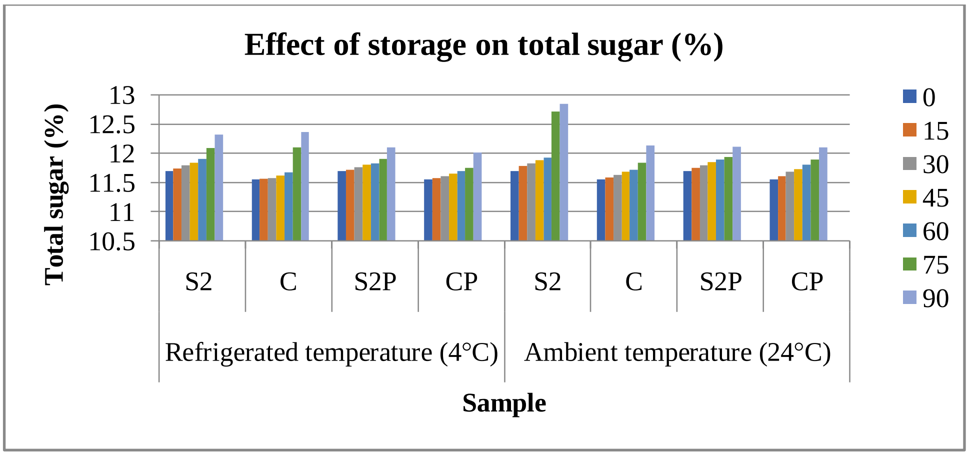

Figure 3.4.6. Effect on total sugar variation in passion fruit and pineapple blended beverage during storage

3.4.7. Effect on microbial parameters (Total plate count and Yeast and mold) in passion fruit and pineapple blended beverage during storage

3.4.7.1 Effect on total plate count

Sample was subjected to shelf life analysis by keeping it for storage, the data recorded in table 4.6.9.1. It indicated that at refrigerated temperature (4°C) had less total plate count than ambient temperature (24°C). Up to the 60 days, there was no microbial growth was found in

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beverage which was stored at refrigerated temperature (4°C), whereas a very small growth of microbes was observed in the beverage which was stored at ambient temperature (24°C).

Table 3.4.7.1 Effect on total plate count in passion fruit and pineapple blended beverage during storage

Days	Refrigerated temperature (4°C)				Ambient temperature (24°C)			
	S_2	C	S_2P	CP	S_2	C	S_2P	CP
0	ND	ND	ND	ND	ND	ND	ND	ND
15	ND	ND	ND	ND	ND	ND	ND	ND
30	ND	ND	ND	ND	ND	ND	ND	ND
45	ND	ND	ND	ND	ND	ND	ND	ND
60	ND	ND	ND	ND	4×10^1	7×10^1	2×10^1	5×10^1
75	8×10^1	10×10^1	2×10^1	4×10^1	15×10^1	17×10^1	4×10^1	9×10^1
90	11×10^1	14×10^1	5×10^1	5×10^1	20×10^1	22×10^1	7×10^1	11×10^1

S_2: Selected blend; C: Control; S_2P: Selected blend with preservatives; CP: Control with preservatives; ND: Not Detected

3.4.7.2 Effect on yeast and mold count

The experimental data was also indicated that there was no any substantial growth trend of yeast and mold at both the refrigerated temperature (4^{o}C), as well as ambient temperature (24°C).

Table 3.4.7.2 Effect on yeast and mold count in passion fruit and Pineapple blended beverage

Days	Refrigerated temperature (4°C)				Ambient temperature (24°C)			
	S_2	C	S_2P	CP	S_2	C	S_2P	CP
0	ND	ND	ND	ND	ND	ND	ND	ND
15	ND	ND	ND	ND	ND	ND	ND	ND
30	ND	ND	ND	ND	ND	ND	ND	ND
45	ND	ND	ND	ND	ND	ND	ND	ND
60	ND	ND	ND	ND	2×10^1	2×10^1	ND	ND
75	2×10^1	2×10^1	ND	ND	5×10^1	3×10^1	2×10^1	2×10^1
90	5×10^1	4×10^1	1×10^1	2×10^1	8×10^1	7×10^1	5×10^1	5×10^1

S_2: Selected blend; C: Control; S_2P: Selected blend with preservatives; CP: Control with preservatives; ND: Not Detected

IV. CONCLUSION

Present research work was undertaken to develop a technology for Passion fruit and pineapple blended beverage making and to study the changes in beverage quality during

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storage.The beverage was packed in glass bottles and the bottles were stored at refrigerated temperature (4°C) and ambient temperature (24°C). The representative samples were drawn periodically at 15 days interval to evaluate changes in biochemical parameters of the blended passion fruit and pineapple beverage. The results obtained during this investigation are summarized below.

1. The acidity, TSS, reducing sugar, total sugar density and specific gravity of passion fruit and pineapple blended beverage was increased from 0.60 to 0.67%, from 19.10 to 19.30^{o}Bx, from 7.50 to 7.88 g/100 ml, from 11.70 to 12.10 g/100 ml from 1.10 to 1.16 g/100 ml and 1.11 to 1.17 g/100 ml respectively, while the pH and Vitamin C of beverage was also decreased from 3.58 to 3.45 and from 11.54 to 10.50 mg/100 ml during storage up to 90 days.
2. The ambient temperature (24°C) was highly affected the quality of blended beverage as compared to refrigeration temperature (4°C) during storage.
3. After considering the quality of all blended beverage samples, S_2P (15 % blended pineapple fruit juice with 0.1 % Sodium benzoate) sample stored at refrigeration temperature was found to be better up to 90 days. The above conclusions were however based on the laboratory scale study and hence pilot plant studies are required further before the passion fruit-pineapple blended beverage is commercialized.

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Low Calorie Multi Fruit Whey Beverage

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Abstract:- Consumption of fruits and vegetables has strongly been associated with reduced risk of cardiovascular diseases, cancer, diabetes, Alzheimer disease, cataracts and age related macular degeneration. Among many fruits, guava and jamun are reported to contain various phytochemicals which possess hypoglycemic properties and control Type-II diabetes. Blending of various fruit juices/pulp with herbal fortification could be an effective tool which can supplement the product with vitamins, minerals and improve their overall organoleptic qualities. Further, Amla which is also known as miracle plant, possess wide range of medicinal and therapeutic properties such as anticarcinogenic, easing intestinal problems, etc. Due to its blood purifying and fat burning nature possibility of developing Amla fortified beverage can be explored. Further, the beverages are generally found to be concentrated source of sugar which provide quick burst of energy and large amount of calories. Unfortunately, excess calorie intake has been reported partially responsible for hypertension, cardiovascular diseases, diabetes and obesity. Alternative sweeteners or non-nutritive sweetener can offer consumers a way to enjoy the sweet taste with little or no calorie intake.

Keywords: - Low calorie, Anti diabetic, cholesterol lowering properties

Introduction:- The use of food for promoting health and the practice of phyto-medicine for treating or preventing various types of illness has been well documented in Hippocratic. Recently, increased health awareness around the globe has increased the demand for certain foods which provide necessary nutrients, prevent nutrition-related diseases and improve physical and mental well-being of consumers. Such foods and food products are popularly known as functional foods, nutraceutical and/or health foods drinks / health drinks are the drinks which are altered in such a way to provide specific taste profile and disease preventing properties

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beyond general nutrition Further, several epidemiological studies have shown that adequate intake of fruits and vegetables can considerably reduce the risk of occurrence of chronic diseases such as cancer, coronary heart diseases, stroke, hypertension, diabetes etc.

Among many fruits, **guava (Psidium guajava L.) and jamun (Syzygium cumini L.)** are reported to contain several bioactive compounds and have been widely used to treat diabetes by the traditional practitioners over many centuries .Guava is the fourth most widely grown fruit in India, accounting for 268.20 thousand hectare area and producing about 3667.90 thousand metric tonnes of fruit annually, Guava is often included among super fruits, being rich in dietary fibres, vitamin A and C, folic acid and dietary minerals. It has been reported to possess several pharmacological activities such as anti-diarrheal, hypoglycemic, antioxidant, ant mutagenic and anti-microbial activities Guava generally provides less energy (38-57 Kcal/100g) as compared to other fruits like mango, banana etc. and hence suitable for diabetics and weight management.

Similarly, jamun commonly called as Indian blackberry or black plum is reported to contain vitamins, amino acids, minerals and other phyto-chemicals It has antioxidant, anti-inflammatory,anti-microbial, antibacterial, antifungal, free radical scavenging, gastro-protective and anti-diabetic properties.

Blending of various fruit juices/pulp with herbal fortification could be an effective tool which can supplement the product with vitamins, minerals and improve their overall organoleptic qualities. Further, Amla (Phyllanthus emblica) which is also known as miracle plant, possess wide range of medicinal and therapeutic properties such as anticarcinogenic,, easing intestinal problems, etc. Due to its blood purifying and fat burning nature possibility of developing Amla fortified beverage can be explored.

Beverages are generally found to be concentrated source of sugar which provide quick burst of energy and large amount of calories. Incorporation of sucralose will simultaneously impart enough sweetness with lesser calories.

Whey as a major by product from dairy industry with its wide nutritional aspects, possibility of whey based beverage can be explored.

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Ingredients with their formulations:

Sr.No	Ingredients	Formulations per 100ml
1.	Jamun Juice	45
2.	Guava Juice	35
3.	Whey	30
4.	Amla Juice	10
5.	Nonnutritive sugar(Sucralose)	15ºB TSS,
6.	citric acid	0.05-0.84%

B. Procedure:-

1. Trial one: 35ml jamun, 35 ml guava, 20 ml whey & 10 ml amla juice, TSS 15 brix

2. Trial two:. By using equal proportion of guava and jamun, the beverage was lacking in jamun taste and other ingredients as guava is having its own dominating flavor.

3. Trial three: Hence this time we have used 45ml of jamun juice and 20 ml of guava with 20 ml whey and 15ml of amla juice. And the final beverage was having extraordinary taste of all ingredients with suitable sweetness.

Process flow chart:-

Jamun and amla | Guava | Sugar+ Water

Boiling whole fruit for 5min | sorting and grading | Addition of sugar

Passing through pulp | Heating guava slices in water | boiling and straining

Homogenization of pulp | Pulping and homogenization | Sugar syrup

Blending

Mixing upto required TSS

Addition of citric acid and permitted preservatives

Filling in pre sterilized PET bottles

Capping

Labelling and Storage

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Nutritional Composition:-

Sr. No	Nutritional parameters	Composition per 100ml
1.	Energy Value	6.56-52.56kcal
2.	Carbohydrates	2.6-17
3.	Fat	0-0.5
4.	Protein	0.5-1.5
5.	Ascorbic acid	33.91mg
6.	Sodium	4mg
7.	Fibers	15gm
8.	Potassium	3mg
9.	Calcium	10mg
10.	Iron	2mg
11.	Total phenolic	36.12mg
12.	Antioxidant Potential	13.40%

Costing:-

Cost incurred in preparation of low-calorie guava-jamun blended health drink was calculated by taking into consideration the cost of all the inputs and the cost involved during processing.

Sr.No	Raw Material	Total cost/kg
1.	Matured guavas	40Rs.
2.	Matured Jamuns	50Rs
3.	Matured amla	40Rs
4.	Whey	35Rs/lit
5.	Sucralose+ Sucrose	400+40Rs
6.	PET bottles(200ml)	5Rs/piece
7.	Citric acid	50Rs

The cost was calculated on the basis of current market prices of ingredients and adding reasonable production charges. The cost production of low-calorie Amla fortified guava-jamun blended drink was found Rs.16.29/200ml bottle, when prepared with 85 per cent sucralose, Rs. 17.09/200ml bottle,thus, the sucralose sweetened drink (85 % sucralose and 25 % sucrose) wasfound to be quite more appreciable and cost effective.

Packaging material:-

We have used material such as polyethylene terephthalate that

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is plastic bottles which is having several advantages, including toughness, energy savings along with low WVTR, OTR and ease of production.Plastic bottles are economical to make, safe to use and recyclable.

Conclusion:-

From the present information, it emerges that blending of guava& jamun pulp along with fortified amla juicehad improved both sensory and nutritional characteristics of the blended drink. Whey had incorporated from the concerns of its nutritional composition and waste utilization, as it is a major byproduct from dairy industry. And product intend to nourish the consumer with nutritional aspect along with taste.

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Demand Planning Process and Demand Forecasting of the Fertilizer Industry in India

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Abstract

Demand forecasting and planning is a process is to predict the future demand of the product and to achieve a higher accuracy level by analyzing the past year sales data. Demand forecasting helps in resolving the gaps in the supply of the fertilizers and it also helps in to fulfil the market demand of the fertilizers. This research study aims to document the demand planning process followed by various fertilizers companies in India and also to predict the demand for the fertilizers (Urea, DAP, MOP, and NPKs) individually by using the regression analysis method and contribution analysis method. Result shows the accuracy for Urea is 92 percent, for DAP is 89 percent, for MOP is 83 percent and for NPKs is 89 percent. This research study will help the fertilizer industry and organizations to maximize the profit by resolving the gaps related to supply and production of the fertilizers.

Key words: Demand Planning, Demand Forecasting, Fertilizer Industry, Agri Input industry etc.

1. Introduction

The fertilizer industry in India is very versatile in nature. In the year 2017-18, 1.3 percent growth has been recorded. Globally fertilizer consumption is seen as dropping by 1.0 percent in year 2018/19 i.e. became 190 Mt. It affected the combination of low international prices for most of the crops and also due to unfavorable weather conditions, currency depreciation in many fertilizer importing countries like; Turkey and Pakistan, Trade tension between China and US, global consumption is anticipated to contract for N (-0.4 percent), for P (-2.3 percent) and for K (-1.0 percent). Global fertilizer demand is expected to rebound in the year 2019-20, assuming that to average weather conditions and the increasing cereal cultivated area. Demand is predicted to increase by 2.6% i.e. 195 Mt. in the absence of unexpected geopolitical and economic shocks. Demand is predicted to recover for all three nutrients, for P it rebounds of 3.1 percent, for K, it rebounds 2.7 percent and 2.4 percent for N (World fertilizer trends and Outlook to 2018, FAO-2015). As the above data says that the growth is expected to be rebound in the year 2020, Indian fertilizer companies may use this forecast to plan their production. But, the issue is that the long term predictions are not much accurate to forecast the demand for fertilizers because of a various number of factors to affect the demand of the fertilizers. So, this paper is based on the short-term forecasting by quantitative analysis of the demand of the fertilizers (Urea, DAP, MOP and NPKs) which is more accurate as compared to the long-term predictions and also the mapping of

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the demand planning process of the fertilizers in the companies in India. Currently, the number of organizations and people is providing the fertilizer consumption forecasts on an aggregate basis but there are many other factors involved in the demand forecast process of fertilizers. Developing the demand forecast which is crop-based and also including the various factors involving in the process of demand forecast. There are many other issues and challenges faced by the companies to forecast the demand for fertilizers in this sector. Demand forecasting termed as a process in which historical data of sales are used to predict the future demand of the product and services. It is also useful to develop a forecast for the consumer's demand.

Demand forecasting helps in increasing the customer service level, management of product life cycle, to improve the distribution planning and logistics management and to increase the organizational efficiency and effectiveness to achieve the goals. Demand forecasting also helps in risk assessment and mitigation, budgeting, expansion planning, cash flow, capital expenditure and also helps in supply chain processes like inbound-outbound logistics, production management, manufacturing, inventory optimization, and capacity utilization. Agriculture and allied sectors are the backbones of the Indian society. Around 60% of the country's population is dependent on agriculture for their livelihood. Various external and internal factors like; unpredictable weather conditions, unavailability of market information, competitor's pricing, etc. are causes of concern. Decisions taken by the companies in the agriculture sector are very much affected by external and internal factors. There should be a need to develop a proper framework to achieve the goals of the organization.

Production planning is done in the agri-input sector is dependent on factors like; Acreage of land cultivated by farmer, season (Kharif, Rabi, and Zaid), suitable soil conditions, etc. All plans for the manufacturing of fertilizers and companies in the market must be derived from the demand forecast of the fertilizers. To analyze the fertilizer market potential in future at national level will also help the companies to manage the yearly or monthly production plan like; which fertilizer to produce, how much to produce etc. With the help of detailed sales prediction on monthly basis of a region, it is possible to know the potential locations so that transportation cost can be optimized, minimization in storage duration. Based on the duration of demand forecast generally, there are two types of planning can be done: Short term demand planning and long term demand planning. Short term demand planning is different for different businesses. For FMCG company it might be for a season or for a week or for maybe for days and for the pharmaceutical company it might be for 12 months. In the short-run forecast, patterns of seasonality are given much importance. Long term forecasting is expert-based planning in which generally strategic decisions are taken for suitable capital planning. It helps in saving time and manpower in operations planning. Planning for starting a new unit must start with long term planning.

2. Types of demand forecasting

Demand forecasting can be classified on various factors Details of various types of demand forecasting is given in figure 1.

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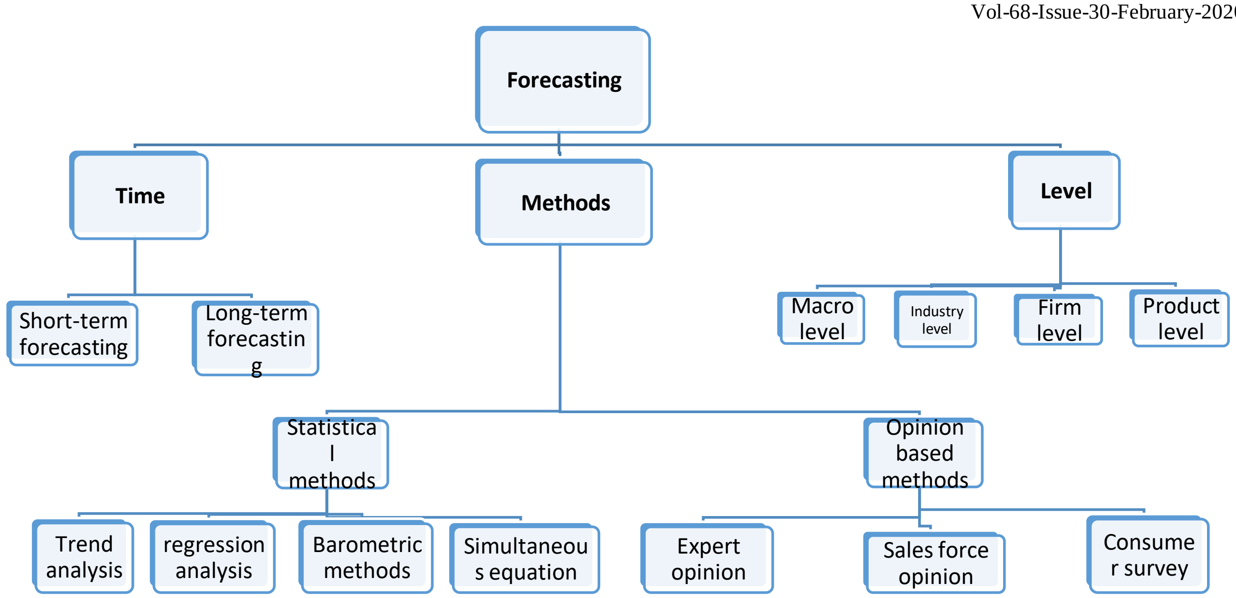

Figure 1: Types of Demand Forecasting

Source: Prepared by authors

3. Literature review

Demand forecasting and planning is a major challenge faced by Agri input industries. Any shortfall, as well as excess production, will lead to heavy losses to these companies. Proper demand planning and forecasting will help these industries to plan their production more efficiently. Various studies are conducted on various aspects of demand planning and forecasting. In a study by Buchinsky (1987), the Partial equilibrium model (PEM) was developed for the demand forecasting of NPK fertilizers in which forecasting has been done for 24 regions in which 16 were the separate countries and others were divided into 6 regions. The paper concluded the structure of the model and estimated equations and also provided the statistical measures to solve the equations (Buchinsky, 1987). Projection of the demand for global requirements of fertilizers from 2015 to 2030 by using the estimation of previous production forecasts and application rates in the crops. Based on that study suggested the three methodologies to forecast the demand, which are: a) Simple Econometric Models (SEM) based on past fertilizer trend. b) Time series analysis with Vector Autoregression (VAR) and by using the production economic approach (Food and Agriculture Organization, 2000).

A study was conducted by Food and Agriculture Organization (2004) with the objectives of proposing the improved methodologies for forecasting fertilizer demand. The conclusions of the study were to categorize the countries according to their position on the adoption curve of techniques and to suggest the best methodologies to predict the demand of the fertilizers. Demand forecasting model for the seasonal and annual demand of three major fertilizers; Urea, TSP, and MOP has also been developed for the duration of six years of production area under rice and vegetable cultivation (Mohammad M.J. & Kayenat K., 2008). The econometric model has been used by considering the demand as a dependent variable, and crop production and other variables as independent variables in relation to soil nutrients (N, P, and K). The study concluded

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that Asia is expected to account for around 40% of global forecasts of 187.7 Mt. in 2015 and in 2030 it will be 223.1 Mt (Tenkorang &Deborer, 2008). Overview of the fertilizer industry, consumption trends and identified the important factors involve in the fertilizer demand and developed the demand scenario for fertilizers in India in 2020-21. This paper concluded that non-price factors such as irrigation, high yielding varieties, were most important than the price factors in demand forecasting for fertilizers (Sharma & Thaker., 2011). The development of the population in the future is the basic factor to encourage the demand for food and agricultural products. The highest growth in the population is projected to occur in the region of sub-Saharan Africa. The global NPK demand was predicted from 223.1 Mt. in the year 2030 to about 324 Mt. in the year 2050 (Drescher et.al. 2011). Tactical demand forecasting of the fertilizers by using the Auto Regressive Moving Average (ARIMA) methods have been developed in which they have considered the seasonality and trend using the data of rainfall conditions. The analysis showed that demand consumption is not only dependent on seasonal behavior but also on the consumption pattern of fertilizers over the previous period (Ganesan. &Raut, 2012). Analysis of demand forecasting of fertilizers has been done on the growth rate of fertilizer consumption in 1915-16 to 2020-21. Paper described that to ensure self-sufficiency in production in agriculture in the country. According to this paper, by 2020 the demand for fertilizer in the country is projected to increase to about 41.6 million tones (Singh, 2013). Discussion on the characteristics of the community agricultural products logistics and the challenges in the demand forecasting of the agricultural products has been done by using the Grey Prediction Model to conduct the demand predictions. The study also provided valuable contributions to solve community problems of matching supply and demand of the agricultural produce (Xu et al., 2015).

3.1 Gaps in the literature

After looking at the available literature on the demand forecasting of the fertilizer industry it has been realized that no research study has documented the process of demand forecasting methods followed in the organizations. Further, demand forecasting is usually done based on the major nutrient. No attempts are made to forecast the demand based on the major fertilizer used. Forecasting of the fertilizers for the year 2030 and 2050 will not be much accurate because of various factors are affecting the demand of the fertilizers like; Rainfall, price of the agricultural produce, irrigation, cultivable land, etc. and they can change over the time, so demand forecasting should be done for a short period i.e. for next season, which will be more effective for an organization to achieve its goals. Hence, the purpose of this paper is to present the analysis of demand forecast of the fertilizers (Urea, DAP, MOP and NPKs) and also to map the process of demand planning at each level of hierarchy in organizations and also enlist the ground level challenges faced by the sales representatives in this sector.

4. Objectives:

In view of the literature gaps, the objectives of the paper are

1. To forecast the demand for fertilizers (Urea, DAP, MOP & NPKs) considering the various factors with the help of past sales data using the trend analysis.

2. To map the demand planning process at each level of hierarchy in the companies in this sector.

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5. Research Methodology

With the objectives of the proposed research, primary information is being collected by doing the extensive phone call interviews with the sales representative of the companies and secondary data is being collected extensively for the study. Data and information were collected from government sites, articles & annual reports, etc. By using the monthly contribution analysis method, forecasted the demand of the fertilizers of any state for any month based on its past consumption of the fertilizers in that particular month.

The guideline for forecasting the demand of fertilizers at the National level, the following process can be followed (Figure 2):

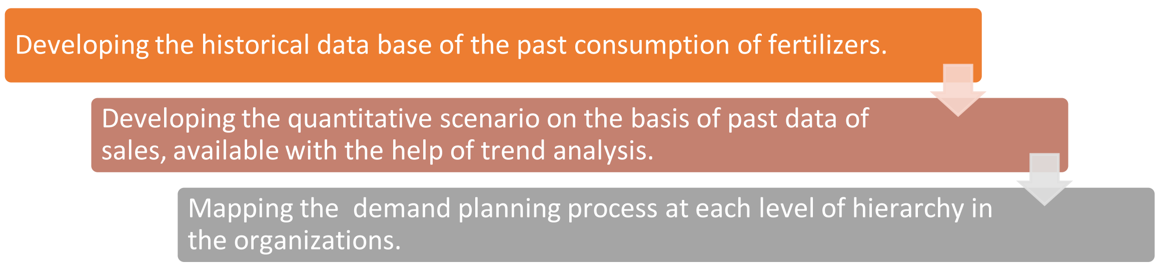

Figure 2: Steps for demand forecasting

6. Results and Analysis

6.1. Demand forecasting of the fertilizers

It is based on the past consumption data of fertilizers collected from the government sites from April 2016 to September 2019 and by using the regression equation

Data has been collected for each fertilizer (Urea, DAP, MOP, and NPKs) separately for the given period and by using the trend analysis method on this data, forecasting has been done for the period of six months i.e. from October 2019 to March 2020 for each type of fertilizer.

By using the regression equation: $y = a + bx$

y = Dependent variable

x = Independent variable

a = Intercept

b = Slope

According to the above equation regression analysis will be done in which "y" is considered as the dependent variable which is the forecasted demand for next six months, "a" is considered as the intercept of the equation which is calculated by using the formula of "intercept" in excel for the given period, "b" is considered as the slope of the equation which is also calculated by using the formula of "slope" in excel for the given period and "x" is the independent variable which is

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the period from which data is being used to forecast the demand for next six months period. Intercept and slope are calculated by using the formulas of both "intercept" and "slope" in excel including the past year sales of the fertilizers and by using the given period. Seasonality Index is the forecasting tool that is used to predict the demand in which month-wise seasonality is calculated by using the formula of "averageif" and "average" simultaneously in the excel.

Calculation of the trend of sales:

Trend = Intercept + Slope * number of periods

Forecast for the month = Trend * Seasonality of the respective month

6.1.1. Demand forecasting for Urea

Calculation of Intercept and Slope of the past sales of the Urea for the period April 2016 to September 2019.

Intercept: 2345.65

Slope: 9.58

Table 1. Seasonality index of each month for Urea

Month	**Seasonality Index**
April	0.49
May	0.85
June	1.11
July	1.18
August	1.17
September	1.06
October	0.76
November	1.07
December	1.38
January	1.18
February	0.85
March	0.92

In the above table 1, seasonality of each month has been calculated in which the seasonality of the months June, July, August is more than "one" because of the starting of the Kharif season and the seasonality of November, December, January is also more than "one" because of the starting of the Rabi season. According to the recommended doses of the Urea fertilizers, half of the dose is being applied as basal dose and later, the remaining dose is being applied according to the recommendation. That's why the seasonality is higher for the starting months of the season.

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Table 2. Forecasted demand for Urea

Month, Year	***Forecasted demand (In "000" tonnes)***
October, 2019	2109.66
November, 2019	2965.56
December, 2019	3835.72
January, 2020	3286.56
February, 2020	2396.28
March, 2020	2593.46
Total	**17187.24**

In table 2, demand has been forecasted for the next six months of the season which is from October 2019 to March 2020 (figure 3). Past data of sales has been used from April 2016 to September 2019 by using the regression analysis method. So, the total demand forecast for the Urea at the national level for the next six months will be 17187.24 (In "000" tonnes).

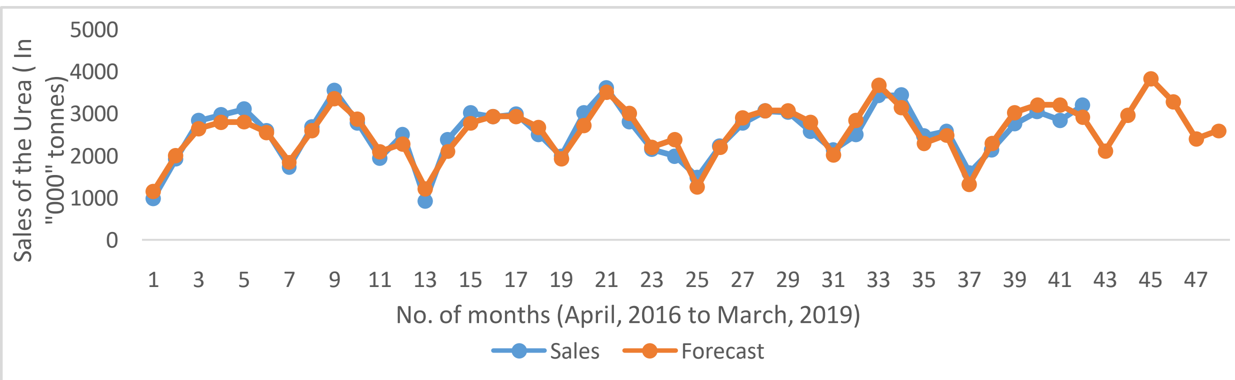

Figure 3: Comparison of sales and Forecast of Urea

The above graph shows that the smoothening of the forecasted demand of the fertilizers to the past sales data. The average accuracy of the forecasted demand is 92% (Table 3).

6.1.1.1. Contribution Analysis:

Now, with the help of the contribution analysis method, find out the contribution of each month according to the past sales of Urea in the month of Maharashtra state.

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Table 3. Contribution analysis

Month, Year	*Sales (In "000" tonnes) in India*	*Sales (In "000" tonnes) in Maharashtra*	*Contribution of each Month*
October, 2018	2134.03	69.87	3%
November, 2018	2498.04	66.92	3%
December, 2018	3419.88	112.94	3%
January, 2019	3437.56	147.25	4%
February, 2019	2467.69	174.18	7%
March, 2019	2578.88	227.15	9%

In the above table 3, the Contribution of the sales (In "000" tonnes) of Urea has been calculated of the months from October 2018 to March 2019 in Maharashtra state to the total sales of Urea in the country.

Table 4. Forecasting the demand of Urea in Maharashtra state

Month, Year	*Contribution of each Month*	*Forecasted demand (In "000" tonnes) in India*	*Forecasted demand (In "000" tonnes) in Maharashtra*
October, 2019	3%	2109.66	63.29
November, 2019	3%	2965.56	88.97
December, 2019	3%	3835.72	115.07
January, 2020	4%	3286.56	131.46
February, 2020	7%	2396.28	167.74
March, 2020	9%	2593.46	233.41

In the above table 4, the demand of the Urea has been forecasted for the Maharashtra state by using the contribution of the sale of the past year months. Forecasted demand for Maharashtra for the next six months season has been calculated by Contribution of each Month * Forecasted demand (In "000" tonnes) in India.

6.1.2. Demand forecasting for DAP (Di- Ammonium Phosphate)

Calculation of Intercept and Slope of the past sales of the Urea for the period April 2016 to September 2019.

Intercept: 695.53

Slope: 3.30

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Table 5. Seasonality index of each month for DAP is:

MONTH	SEASONALITY INDEX
APRIL	0.33
MAY	0.85
JUNE	1.24
JULY	0.88
AUGUST	1.20
SEPTEMBER	1.55
OCTOBER	1.42
NOVEMBER	1.66
DECEMBER	0.72
JANUARY	0.45
FEBRUARY	0.51
MARCH	1.16

In the above table 5, seasonality of each month has been calculated in which the seasonality of the months June and August is more than "one" because of the starting of the Kharif season and the seasonality of September, October and November is also more than "one" because of the starting of the Rabi season. According to the recommended doses of the DAP fertilizers, in most crops, full doses have been applied to the field as a basal dose.

Table 6. Forecasted demand for DAP

Month	***Forecasted demand (In "0000" tonnes)***
October, 2019	1189.65
November, 2019	1392.88
December, 2019	608.99
January, 2020	383.73
February, 2020	436.45
March, 2020	992.02
Total	**5003.72**

In table 6, demand has been forecasted for the next six months of the season which is from October 2019 to March 2020. Past data of sales has been used from April 2016 to September 2019 by using the regression analysis method. So, the total demand forecast for the DAP for the next six months will be 5003.72 (In "000" tonnes).

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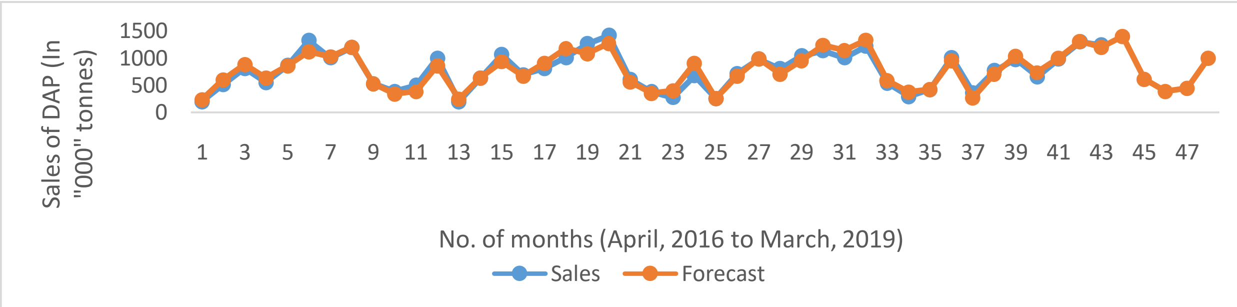

Figure 4: Comparison of sales and Forecast of DAP

The above graph shows that the smoothening of the forecasted demand of the fertilizers to the past sales data. The average accuracy of the forecasted demand is 89%.

6.1.2.1. Contribution Analysis

Now, with the help of the contribution analysis method, the contribution of each month according to the past sales of DAP in the month of Maharashtra state.

Table 7: Contribution analysis

Month, Year	*Sales (In "000" tonnes) in India*	*Sales (In "000" tonnes) in Maharashtra*	*Contribution of each Month*
October, 2018	1003.84	20.43	2%
November, 2018	1208.04	23.48	2%
December, 2018	535.65	30.22	5%
January, 2019	285.81	55.32	14%
February, 2019	416.25	73.52	17%

In the above table 7, the Contribution of the sales (In "000" tonnes) of DAP (Di- Ammonium Phosphate) has been calculated of the months from October 2018 to March 2019 in Maharashtra state to the total sales of DAP in the country.

Table 8: Forecasting the demand for DAP in Maharashtra state

Month, Year	*Contribution of each Month*	*Forecasted demand (In "000" tonnes) in India*	*Forecasted demand (In "000" tonnes) in Maharashtra*
October, 2019	2%	1189.65	23.79
November, 2019	2%	1392.88	27.86
December, 2019	5%	608.99	30.45
January, 2020	14%	383.73	53.72
February, 2020	17%	436.45	74.20

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March, 2020	8%	992.02	79.36

In the above table 8, the demand of the DAP has been forecasted for the Maharashtra state by using the contribution of the sale of the past year months. Forecasted demand for Maharashtra for the next six months season has been calculated by Contribution of each Month * Forecasted demand (In "000" tonnes) in India.

6.1.3. Demand forecasting for MOP (Murate of Potash)

Calculation of Intercept and Slope of the past sales of the MOP for the period April 2016 to September 2019.

Intercept: 239.40

Slope: 0.54

Table 9: Seasonality index of each month for MOP

Month	Seasonality Index
April	0.48
May	0.84
June	1.25
July	1.04
August	1.44
September	1.30
October	1.06
November	1.12
December	0.92
January	0.76
February	0.82
March	0.87

In the above table 9, seasonality of each month has been calculated in which the seasonality of the months June, July and August is more than "one" because of the starting of the Kharif season and the seasonality of September, October and November is also more than "one" because of the starting of the Rabi season. According to the recommended doses of the MOP (Murate of Potash) fertilizers, in most crops, full doses have been applied to the field as a basal dose.

Table 10: Forecasted demand for MOP

Month, Year	*Forecasted demand (In "0000" tonnes)*
October, 2019	277.91
November, 2019	294.72
December, 2019	243.03
January, 2020	200.82
February, 2020	217.94
March, 2020	230.36

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Total	1464.77

In table 10, demand has been forecasted for the next six months of the season which is from October 2019 to March 2020. Past data of sales has been used from April 2016 to September 2019 by using the regression analysis method. So, the total demand forecast for the MOP for the next six months will be 1464.77 (In "000" tonnes).

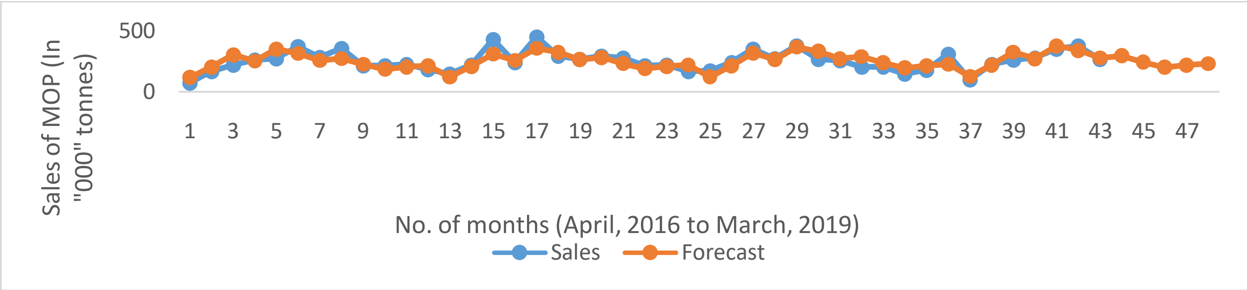

Fig 5: Comparison of sales and Forecast of MOP

The above graph shows that the smoothening of the forecasted demand of the fertilizers to the past sales data. The average accuracy of the forecasted demand is 83%.

6.1.3.1. Contribution Analysis

Now, with the help of the contribution analysis method, the contribution of each month according to the past sales of MOP in the month of Maharashtra state.

Table 11: Contribution analysis

Month, Year	*Sales (In "000" tonnes) in India*	*Sales (In "000" tonnes) in Maharashtra*	*Contribution of each Month*
October, 2018	252.7	22.93	9%
November, 2018	199.88	16.81	8%
December, 2018	203.44	21.22	10%
January, 2019	144.96	13.48	9%
February, 2019	174.3	17.67	10%
March, 2019	304.76	68.85	23%

In the above table 11, the Contribution of the sales (In "000" tonnes) of MOP (Murate of Potash) has been calculated of the months from October 2018 to March 2019 in Maharashtra state to the total sales of MOP in the country.

In the table 12, the demand of the MOP has been forecasted for the Maharashtra state by using the contribution of the sale of the past year months. Forecasted demand for Maharashtra for the next six months season has been calculated by Contribution of each Month * Forecasted demand (In "000" tonnes) in India.

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Table 12: Forecasting the demand for DAP in Maharashtra state

Month, Year	*Contribution of each Month*	*Forecasted demand (In "000" tonnes) in India*	*Forecasted demand (In "000" tonnes) in Maharashtra*
October, 2019	9%	277.91	25.01
November, 2019	8%	294.72	23.58
December, 2019	10%	243.03	24.30
January, 2020	9%	200.82	18.07
February, 2020	10%	217.94	21.79
March, 2020	23%	230.36	52.98

6.1.4. Demand forecasting for NPKs (Complex fertilizers)

Calculation of Intercept and Slope of the past sales of the NPKs in India for the period April 2016 to September 2019.

Intercept: 595.40

Slope: 6.82

Table 13: Seasonality index of each month for NPKs

Month	**Seasonality Index**
April	0.28
May	0.66
June	1.17
July	1.13
August	1.32
September	1.41
October	0.94
November	1.01
December	0.95
January	0.91
February	0.86
March	1.38

In the above table 13, seasonality of each month has been calculated in which the seasonality of the months June, July and August is more than "one" because of the starting of the Kharif season and the seasonality is also more than "one" because of the starting of the Rabi season.

Table 14: Forecasted demand for NPKs

Month, Year	***Forecasted demand (In "000" tonnes) in India***
October, 2019	838.50
November, 2019	900.28

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December, 2019	861.07
January, 2020	830.21
February, 2020	791.64
March, 2020	1270.65
Total	5492.35

In table 14, demand has been forecasted for the next six months of the season which is from October 2019 to March 2020. Past data of sales has been used from April 2016 to September 2019 by using the regression analysis method. So, the total demand forecast for the NPKs in India for the next six months will be 5492.35 (In "000" tonnes).

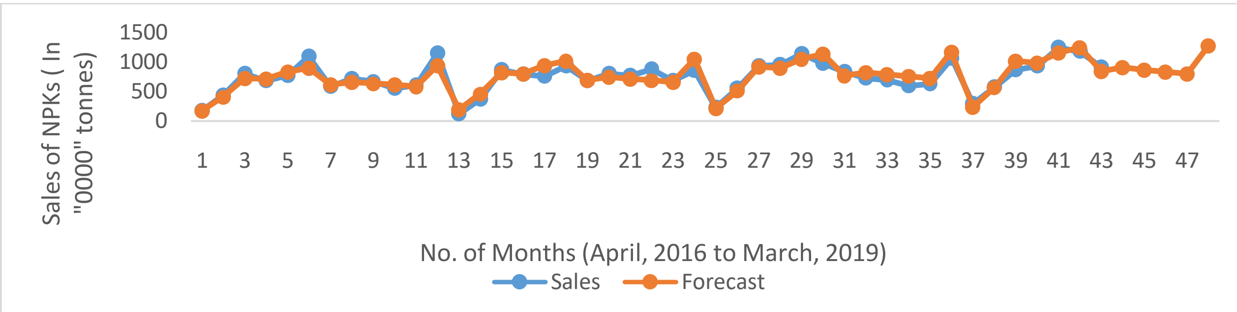

Figure 6: Comparison of sales and Forecast of NPK fertilizer

The above graph shows that the smoothening of the forecasted demand of the fertilizers to the past sales data. The average accuracy of the forecasted demand is 89%.

6.1.4.1. Contribution Analysis

Now, with the help of the contribution analysis method, the contribution of each month according to the past sales of NPKs in the month of Maharashtra state.

Table 15: Contribution analysis

Month, Year	*Sales (In "000" tonnes) in India*	*Sales (In "000" tonnes) in Maharashtra*	*Contribution of each Month*
October, 2018	831.54	70.04	8%
November, 2018	723.64	64.87	9%
December, 2018	692.77	101.27	14%
January, 2019	595.68	141.93	23%
February, 2019	626.76	210.26	34%
March, 2019	1058.43	255.08	24%

In the above table 15, the Contribution of the sales (In "000" tonnes) of NPKs has been calculated of the months from October 2018 to March 2019 in Maharashtra state to the total sales of NPKs in the country.

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Table 16.Forecasting the demand of NPKs in Maharashtra state:

Month, Year	*Contribution of each Month*	*Forecasted demand (In "000" tonnes) in India*	*Forecasted demand (In "000" tonnes) in Maharashtra*
October, 2019	8%	838.50	67.08
November, 2019	9%	900.28	81.02
December, 2019	14%	861.07	120.55
January, 2020	23%	830.21	190.95
February, 2020	34%	791.64	269.15
March, 2020	24%	1270.65	304.96

In the above table 16, the demand of the NPKs has been forecasted for the Maharashtra state by using the contribution of the sale of the past year months. Forecasted demand for Maharashtra for the next six months season has been calculated by Contribution of each Month * Forecasted demand (In "000" tonnes) in India.

7. Mapping the demand planning process of fertilizer companies in India

This section makes an attempt to document the actual demand planning process followed in some of the fertilizer companies.

7.1. Demand planning process of XYZ and ABC companies

Case 1:

Demand planning process of the XYZ Company has been mapped by doing the in-depth phone call interviews with the sales representatives of the company at each level of hierarchy. Company is one of the leading manufacturers of N, P and K fertilizers in India. Company offers more than 35 products including bulk fertilizers, specialty fertilizers, Water soluble fertilizers etc. 15 sales representatives have been interviewed and questions have been asked on the basis of their responsibility in the demand planning process of the company. Questions related to the demand planning have been asked like; on what level they used to forecast the demand (Product-wise or region-wise), For how long the forecasting is being planned, How they collect the data and time of meetings they do to forecast the demand of fertilizers, what are the sources of reference they are taking to collect the data, Strategies followed by them to meet their annual sales plan etc.

Case 2:

Company ABC is also a pioneer in the fertilizer sector in India. Company manufactures a wide range of fertilizers including the segments of fertilizers, specialty nutrition fertilizers which are sold in its leading markets. To map the demand planning process of the company, In-depth phone call interviews has been taken to the sales hierarchy of the organisation at each hierarchical level.

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The demand planning process of company XYZ has been mapped. This is based on the result of in-depth interviews of the sales representatives of the company at each level of the hierarchy. Forecasting is being done for every next 3 months and also it is get revised every month. A tool is also used to forecast the demand and to put the demand number in that tool. Weekly meetings are being done to forecast the demand, demand planner plays a very important role to negotiate with the ASMs (Area Sales Managers) to increase the demand number in their respective areas and then a national review meeting is also been done. Then, a final sales plan is being made by S & OP (Sales & Operations Planning) team. Then the sales plan is being given to the sales representatives. To achieve the sales plan, sales representatives make the strategies like; divide the sales plan according to the potential areas, negotiation is being done with the dealers in the potential areas, etc. There is no particular template is used during the whole demand planning process and there is no as such any statistical model is used to forecast the demand. The average accuracy of the demand forecasted is also very low i.e. around 40 percent to 50 percent. (Annexure table 1)

The demand forecasting process of the ABC Company has been mapped. The demand planning process follows in this company is different as there is no tool is used to record the demand number. Weekly meetings are also done here to collate the demand number and the important role is played by the Business Analyst who makes the proper template to collect the demand number and other information related to the particular market conditions. The template consists of the various factors which affect the demand planning process, rainfall conditions, cultivated area under each crop, irrigation sources & conditions, past sales data of fertilizers and the demand number of the fertilizer, etc. all these information is collected primarily by the sales team from each area offices and then analyzed by the Business Analyst. Then in the final review meeting, the final demand number is decided. The average accuracy of the demand forecasting of the company is around 80 percent. (Annexure table 2)

8. Conclusion

In this research study, a model has been developed to forecast the demand for fertilizers (Urea, DAP, MOP and NPKs). Short term forecasting has been done for six months period from October 2019 to March 2020. As the result shows the accuracy of forecasted demand for each fertilizer i.e. for Urea it is 92 percent, for DAP it is 89 percent, for MOP it is coming 83 percent and for NPKs it is 89 percent. In short term demand forecasting, the effect of various factors is showed by calculating the seasonality of each month. The demand planning process followed by the companies must have a proper template to get the right information about the fertilizer market from each areas offices. Primary data related to the fertilizer market should be collected to achieve high accuracy in forecasting the demand for fertilizers.

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Annexures: Table 1: Demand planning process of company XYZ

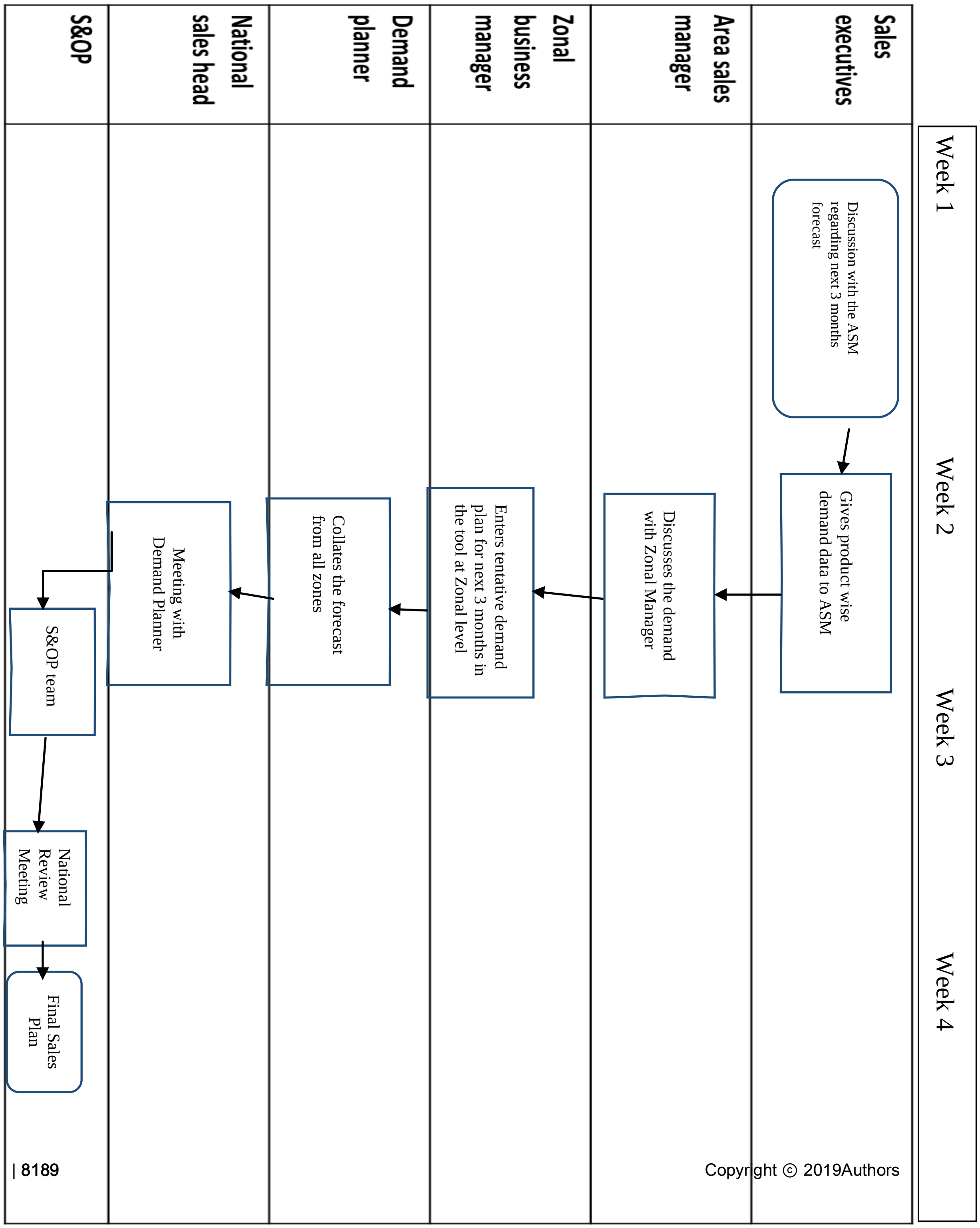

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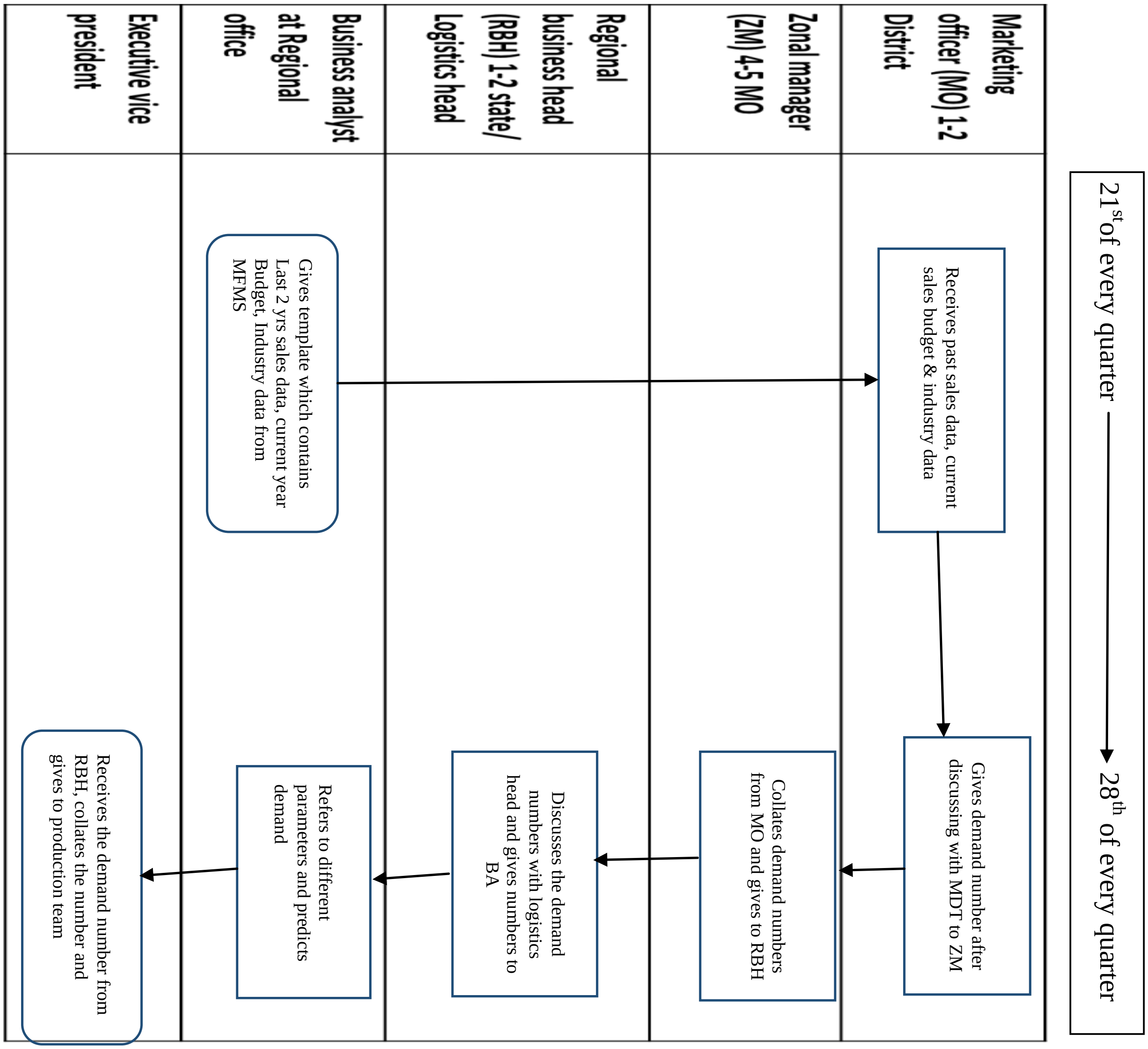
Table 2: Demand planning process of company ABC



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"Consumers Perception towards Hydroponically Grown Residue-Free Vegetables"

By

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Abstract:

Hydroponics is a method of growing plants without using soil (i.e. soil less). This technique instead uses a mineral nutrient solution in a water solvent, allowing the nutrient uptake process to be more efficient than using soil.With the advent of civilization, open field soil-based agriculture is facing some major challenges i.e. most importantly decrease in per capita land availability, soil fertility declining, and productivity is not increasing. Further with increased level of fertilizer application, poor soil fertility in some of the cultivable areas, less chance of, frequent drought conditions and unpredictability of climate and weather patterns, river pollution, rise in temperature, poor water management, decline in ground water level and wastage of huge amount of water etc. are threatening food production under conventional soil-based agriculture.Naturally, soil-less culture is becoming more relevant in the present scenario, to cope-up with these challenges. In soil-less culture, plants are raised without soil. Improved space and water conserving methods of food production under soil-less culture have shown some promising results all over the World.

The study on 'Consumer perception towards hydroponically grown vegetables' is basically conducted to understand if the people of society are aware about the hydroponic technique which is most upcoming technique used in growing vegetables in these days. Many people still follow traditional way of farming but now it's time to upgrade farming methods to increase production and produce residue free produce. This technique is basically soil-free and chemical-free and very useful for healthy produce without disturbing quality and content of produce. The researchers have personally visited farm and studied about this technique.

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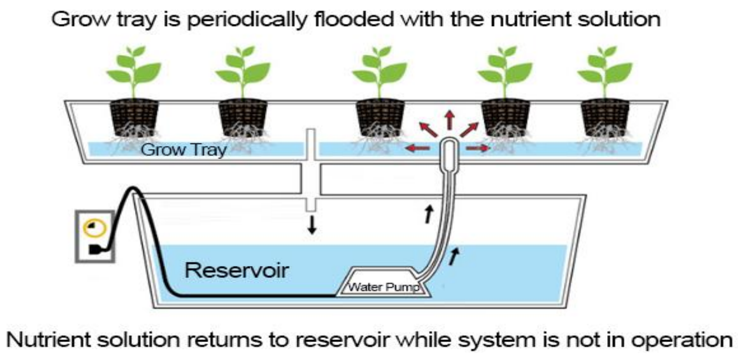
In Pune few companies are coming up with this idea but it is seen that very less awareness is there among end users hence more marketing is require to increase demand.

Key Word: Hydroponics, soil-less culture, residue free vegetables.

Introduction

The science of soil-less gardening, It basically involves growing healthy plants without the use of soil medium by using a nutrient like a mineral rich water solution instead. A plant just needs selected nutrients, some water, and sunlight to grow. Plants grow a lot better with their roots in water instead in soil. The study on 'Consumer perception towards hydroponically grown vegetables' is basically conducted to understand if the people of society are aware about the hydroponic technique which is most upcoming technique used in growing vegetables in these days. Many people still follow traditional way of farming but now it's time to upgrade farming methods to increase production and produce residue free produce. This technique is basically soil-free and chemical-free and very useful for healthy produce without disturbing quality and content of produce. The researchers have personally visited farm and studied about this technique.



Source: http://hydroponiacs.com/wp-content/uploads/2014/04/e-and-flood-system.jpg

Now a days hydroponics technique is fast becoming a popular choice for many farmers around the world due to its more sustainable approach to resource usage than the usual growing methods. Indian farmer are not much aware of hydroponics systems, as it require some skills to operate this system. The main challenge is low literacy rate among farmers, which is low and in order to prepare them, we need to guide maximum number of farmers so that those farmers could guide and teach another one. For the farmers those have less fragmented land can perform hydroponic culture in greenhouse to increase crop productivity. In cases of crop loss by natural disaster, they must have another option of farming to survive and grow organic, pesticides free vegetables which would further enhance economic growth of our country.

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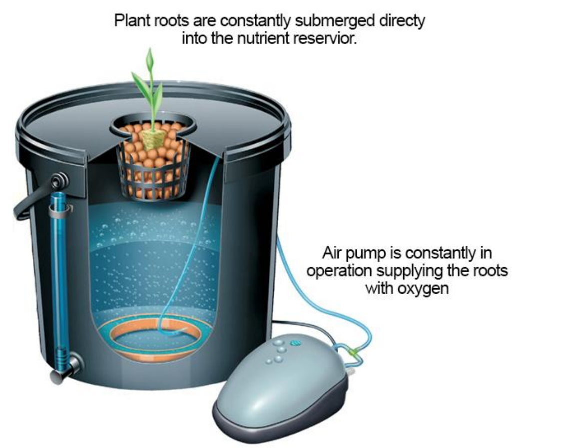
Advantage of Hydroponics:-

- Produce healthy crops with high yield, avoid soil borne insects and pests, diseases attack or weed infestation.
- Needs less space compare to traditional methods.
- Crops grow two times faster in hydroponics and yield is doubled leading to more production from same amount of space.
- No wastage of water as water is reversed used in this technique uses only 1/20th of water to crops compare to **traditional farming.**
- **Requires less labour.**
- No worries of changing seasons, crops can be grown all year around.
- Environment friendly practice, no harm to nature.



Source: http://hydroponiacs.com/wp-content/uploads/2014/04/dwc-system1.jpg

Scope for Hydroponics in India:-

India ranks second in population after china, and it will continuously increasing; but land, water and other resources are limited. In near future we can't feed our increasing population by using current farming techniques. Israel is country having very limited sources as compare to India still manage to gain higher production in minimum space by adopting advance agro-technique. Hydroponics has been used successfully in Israel which has a dry and arid climate. Hydroponics is the fastest growing sector of agriculture, could be very useful for food production in the future. As the population is increasing day by day and land decline due to poor management, people shifts their focus on new technology like Hydroponics and Aeroponics to feed nation. Due to changes in climatic factors and natural disaster like drought and floods, are some of the reasons to switch to new technology, which promises food productions safely.

Challenges:-

Hydroponics system's cost is high, so it is not affordable by poor farmers of India. It requires deep skills and practical knowledge to grow crops. Less awareness, so result is unfocused sector of agricultural in India. Providing skills and training to all types of farmers from poor to average is not an easy task. Ensure for better outcome and high yields commitment for the farmer and

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helping them to create interest is another reason. If the farmers willing to work in this area, and having less knowledge about system, they need to hire a horticulturist or skilled staff. And to hire a staff at affordable salary is actually a big problem.

Objectives

1. To know if consumers have enough information about hydroponic technique.
2. To know whether customers prefer to buy hydroponically grown produce.
3. To know if hydroponically grown vegetables are easily available in market.
4. To know which factors consumer consider important while buying vegetables i.e. price or quality.

Research Methodology

1. **Sampling-**
   Simple random method used for this survey. 150 Respondents were selected from Sahakarnagar, Baner, Kothrud, Katraj, Balewadi and Loni-kalbhor area of pune for the survey. Researchers target those customers who were there for buying vegetables.

2. **Primary data –**
   Primary data is data that is collected by a researcher from first-hand sources, using methods like surveys, interviews, or experiments. It is collected with the research project in mind, directly from primary sources.

   Survey Method-
   Data collected by using close ended structured questionnaire designed to understand the consumer perceptions about hydroponically grown vegetables.

3. **Secondary method –**
   Secondary information is collected through various websites and booksmentioned in reference to collect information regarding hydroponics for the study of researcher.

4. **Quantitative analysis-**
   Information is directly collected from respondent with the help of structure questionnaire. Quantitative analysis method is more suitable for this study hence, it is used.

5. **Sample Size-**

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150 consumers from different areas of pune are tapped for study in order to cover whole city and to understand if perception of changes according to locality.

6. **Limitations –**
    1. Region taken for study is only crowded areas of pune city likeKothrud, Katraj, Baner, Balewadi, Taljai hills etc.
    2. Due to time constraint sample size kept limited.

Review of Literature-

Top 10 Hydroponic Fruits & Vegetables and their Health Benefits

By Easy Grow Ltd | Apr 22, 2015 | Growing Blog, Topical Top Ten

Hydroponics is a method of growing plants, in water, without soil. Minerals and nutrients are added to the water at optimum levels so the plants can devote its energy into producing fruits and vegetables and results in a larger yield.
Using hydroponics you can grow just about anything. Here are our top ten fruits & vegetables to grow in a hydroponic greenhouse:

Tomatoes

Vining plants such as tomatoes are ideal for indoor gardens as they require a small amount of ground space and you'll have room to train them up to the ceiling. Being able to watch and control the nutrients the plant received enables the grower to enjoy a continuous harvest all year long without sacrificing taste. Tomatoes are a rich source of vitamins A, C and folic acid. They contain strong antioxidants that help protect against the risk of heart disease, diabetes and cancer.

Lettuce

Lettuce is a top choice for hydroponic gardeners as it requires little space, little attention and you can harvest leaves as it grows. You'll get your first harvest in a matter of weeks when you can enjoy the rewards of your first crispy crop. Lettuce is a very low calorie veg that contains phyto-nutrients that possess health promoting and disease preventing properties. Rich in vitamins A, C and K and contains minerals such as iron, calcium magnesium and potassium which are essential for body metabolism.

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Cucumber

Water loving fruits make a good choice for your hydroponic garden. Given enough space and support cucumbers will grow abundantly. Cucumbers are rich in micro-elements iron, sodium, potassium, magnesium, calcium and zinc. They also contain vitamins B, C and folic acid. These elements make cucumbers effective at cleaning the body from cholesterol, slowing down the process of ageing and regulating metabolism.

Spring onions

Spring onions are, in fact, very young onions harvested before the bulb gets gets to swell and grow. One pot can sprout dozens of onions and be harvested every 3 or 4 weeks! The antioxidants in spring onions help in preventing damage to DNA and cellular tissue by inhibiting the action of free radicals. Spring onions are loaded with vitamins C and K which are both essential for healthy bones. Spring onions natural properties are most commonly used to treat viral infections such as flu and colds. They also contain vitamins B and A.

Peppers

Peppers will grow in very similar conditions to tomatoes, however raising night time temperatures and decreasing daytime temperatures improves fruit production after plants reach their mature height. Peppers not only add flavour and spice to your food but are low in calories and high in vitamins and nutrients. Full of vitamins A and C and a great source of fibre, folic acid and potassium give them great health and disease fighting properties.

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Spinach

Just like lettuce other leafy vegetables like spinach grow well in hydroponic systems. Spinach is fast growing and prolific if you keep it harvested. Spinach is an incredibly healthy green leafy vegetable well known for its antioxidant properties. It provides protein, iron, vitamins and minerals. Spinach is an excellent source of vitamins A, C, K, E, magnesium, folic acid, copper, zinc and many more making one of the healthiest green leafed vegetables going. It protects the heart, lowers cholesterol, helps with digestion, reduces ageing and provides a rich source of iron.

Strawberries

Strawberries thrive in wet conditions and grow well in hydroponic conditions. Providing bigger fruits than in soil and can provide harvest all year round. Strawberries are high in antioxidants and vitamin c which are well known immunity boosters. They also aid in lowering cholesterol and high blood pressure.

Blueberries

Blueberries require high acidic soil conditions and therefore grow better in hydroponic conditions. Controlling the ph content and nutrients are much easier and will make for a much bigger, healthier crop. Blueberries are well known for being high in antioxidants that protect the brain and nervous system. They are ranked one of the highest fruits for providing antioxidants and vitamins needed for a healthy body.

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Basil

Herbs are a very popular choice as require little care and can produce an impressive crop. Not only do herbs provide taste and fragrance but they have a wide variety of health uses. Research shows basil helps reduce inflammation and swelling, it is high in antioxidants and helps protect against free radicals that cause ageing.

Coriander

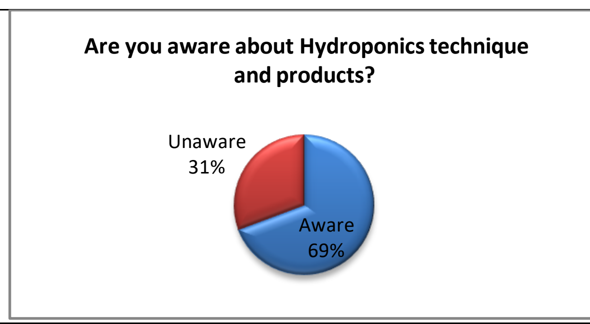
Coriander is a great herb to grow that only takes around 4 weeks and can produce 2-3 harvests. It requires no special requirements and while plenty of light will give you the heaviest harvest. Coriander has multiple health benefits. It contains vitamin c, vitamin k and protein and is a source of magnesium, iron and fibre. It is know to help with skin inflammation, high cholesterol, mouth ulcers, digestion and many other ailmen

Data Analysis and interpretation

The data collected through questionnaire was put for analysis by using SPSS tool. Following is the analysis of each question. Questions used in questionnaire are closed ended and most of the questions are polar questions because respondents we were expecting for the survey could not able to answer complicated questions as they are in rush and middle of vegetable market. Hence for convenience researcher kept questions short and simple as much as possible. Following is analysis of each question.

1. Are you aware about Hydroponics technique and products? (Yes/No)

Response	Frequency	Percent
Aware	104	69.3
Unaware	46	30.7
Total	**150**	**100.0**



Interpretation – About 69 % people were aware about hydroponic technique and 31 % people do not know about hydroponics before survey.

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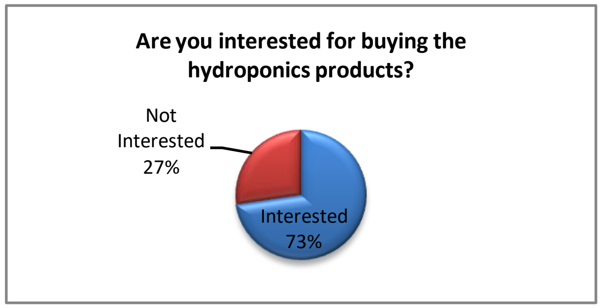
2. Are you interested for buying the hydroponics products? (Yes/ No)

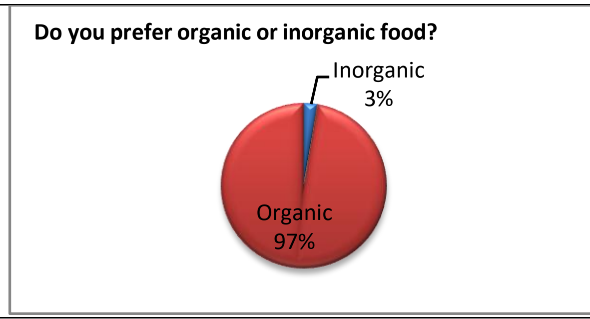
Response	Frequency	Percent
Interested	109	72.7
Not Interested	41	27.3
Total	**150**	**100.0**



Interpretation – About 73 % people were interested for buying the hydroponics productsand 27 % people were not interested for buying the hydroponics products.

3. Do you prefer organic or inorganic food? (Organic/ inorganic)

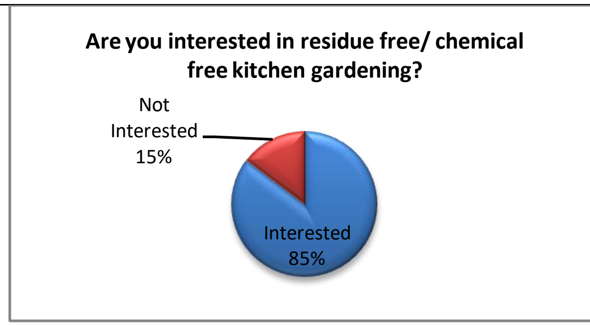
Response	Frequency	Percent
Inorganic	4	2.7
Organic	146	97.3
Total	**150**	**100.0**



Interpretation – About 97 % people prefer organic food for consumption and 3 % people prefer inorganic food (Due to price constraints)

4. Are you interested in residue free/ chemical free kitchen gardening? (Yes/No)

Response	Frequency	Percent
Interested	128	85
Not Interested	22	15
Total	**150**	**100.0**



Interpretation – About 85% people were interested in residue free/ chemical free kitchen gardening and 15 % did not show any interest in kitchen gardening (Mostly due to unavailability of space)

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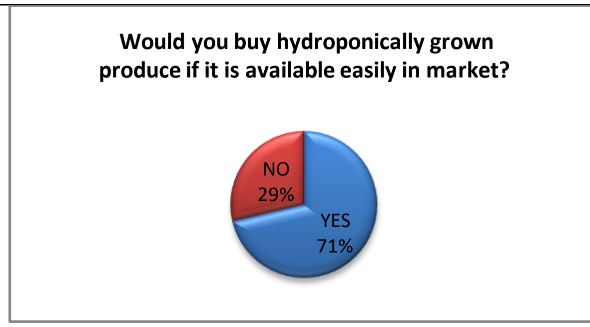
5. Would you buy hydroponically grown produce if it is available easily in market? (Yes/No)

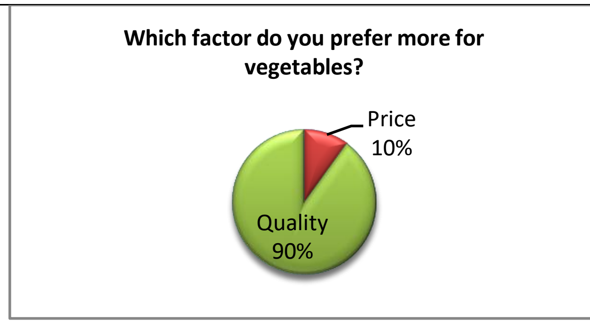
Response	Frequency	Percent
YES	107	71.3
NO	43	28.7
Total	**150**	**100.0**



Interpretation – About 71 % people showed their interest in buying hydroponically grown vegetables if it is easily available in local market, though 29 % people were not interested (Due to lack of knowledge i.e. how to cook.)

6. Which factor do you prefer more for vegetables? (Price/Quality)

Response	Frequency	Percent
Price	15	10
Quality	135	89
Total	**150**	**100.0**



Interpretation – About 90% people prefer quality over price in vegetables while 10 % people were prefer low price vegetables.

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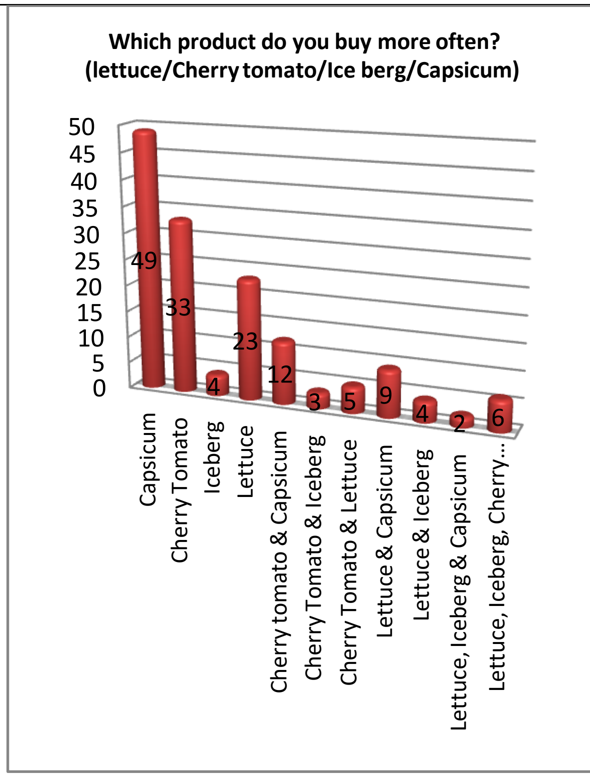
7. Which product do you use more often? (lettuce/Cherry tomato/Ice berg/Capsicum)

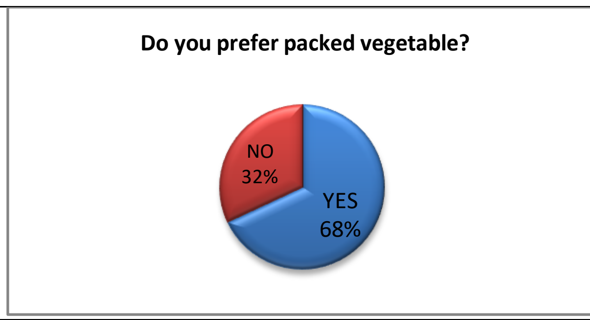
Response	Frequency	Percent
Capsicum	49	33
Cherry Tomato	33	22
Iceberg	4	3
Lettuce	23	15
Cherry tomato & Capsicum	12	8
Cherry Tomato & Iceberg	3	2
Cherry Tomato & Lettuce	5	3
Lettuce & Capsicum	9	6
Lettuce & Iceberg	4	3
Lettuce, Iceberg & Capsicum	2	1
Lettuce, Iceberg, Cherry Tomato & Capsicum	6	4.0
Total	**150**	**100.0**



Interpretation – Most of the people use capsicum and cherry tomato more often. Very few people buy lettuce and ice-berg. Refer above charts for figures.

8. Do you prefer packed vegetable? (Yes/ No)

Response	Frequency	Percent
YES	102	68.0
NO	48	32.0
Total	**150**	**100.0**



Interpretation – About 68 % people prefer packed and ready to cook people and 32 % people prefer unpacked and fresh food available in local market.

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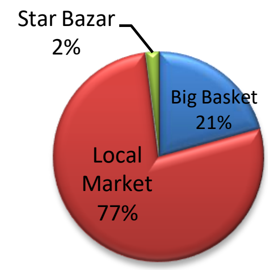
9. From where do you buy vegetables more often? (Local Market/ Star Bazar/Big Bazar)

Response	Frequency	Percent
Big Bazar	31	20.7
Local Market	116	77.3
Star Bazar	3	2.0
Total	**150**	**100.0**

From where do you buy vegetables more often?

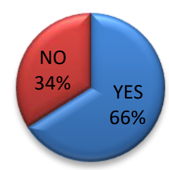


Interpretation – According to survey it is found that people buy vegetables from local market (77 %), Big bazar (21%) and star bazar (2%). Still people prefer local market for buying vegetables due to availability of fresh vegetables over there.

10. Do you adopt this hydroponics technology at your place? (Yes/No)

Response	Frequency	Percent
YES	99	66.0
NO	51	34.0
Total	**150**	**100.0**

Do you adopt this hydroponics technology at your place?

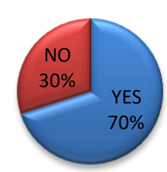


Interpretation – According to survey it is found that 66 % people wants to adopt hydroponic technology at their own place and 34 % people were not interested in adopting this technology

11. Are you interested for training on Hydroponics? (Yes/ No)

Response	Frequency	Percent
YES	105	70
NO	45	30
Total	**150**	**100.0**

Are you interested for training on Hydroponics?



Interpretation – About 70 % people interested for training on hydroponics while 30 % did not interested for training on hydroponics.

Results and Discussion-

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- It is found that only most of the people know about hydroponics and many of them were interested in buying hydroponically grown vegetables.
- Almost all the people prefer organic food for consumption, but it is found that due to price people go for inorganic food products.
- Almost all the respondents show their interest for chemical free kitchen gardening, which means people being conscious about health now a day.
- People are interested in buying hydroponically grown vegetables if it is easily available in market. So there is scope for marketing of this produce.
- While responding almost all the respondentsprefers quality over price concept in vegetables, but practically in bulk they prefer price over quality.
- Most of the health conscious people used hydroponically grown vegetables in which capsicum widely used.
- Most of the respondents want packed vegetables.
- About ¾ people buy vegetables from local market instead of shopping malls like Star Bazar and Big bazar.
- Many people show interest in adopting hydroponics technology at their own place and also interested for workshop on hydroponics.

Conclusion:-

Hydroponic systems are highly effective techniques used in several agricultural domains and also against natural calamities. However this system requires less number of workers, but still it is expensive and complex but the productivity is high. Consumers are more health conscious and prefer residue free vegetables. Production cost is high in this method results into higher price than regular produce so middle class or poor people prefer price over quality. In Pune city most of the people are associated with IT sector; they don't have much time for shopping vegetables in local market so prefer packed, chemical free and ready to eat vegetables. So there is wide scope for growers, processing and packaging industries. Even people are interested in adopting small unit of hydroponics model at their balcony and terrace. Health consciousness is increasing day by day due to increase in cancer patients because of chemical saturation through food. There is huge demand for lettuce, broccoli, ice-berg etc. from 5- star hotels; Hence scope for commercial production of these exotic vegetables on large scale. Also these vegetables used in salads, burgers, pizza by franchises like MacDonald's, Burger king, Subway etc. fast food outlets. People in Pune ready to accept these vegetables for consumption as well as production.

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3. https://www.journalijar.com/article/20707/challenges-and-possibilities-in-hydroponics:-an-indian-perspective/
   https://www.easy-grow.co.uk/top-10-hydroponic-fruit-vegetables-and-their-health-benefits/ benefits/
   (Review of literature)
5. https://www.nationmaster.com/country-info/compare/India/Israel/Agriculture/table

Annexure- Questionnaire

Dear Respondent,

I would seek your kind cooperation and request you kindly to give the answer to my questionnaire to make my research work successfully. I also assure you that that the information will be kept as confidential and the same will be used only for research purpose.

Name: ……………………………………………………………………………
Occupation: ……………………………………………………………………………
Address: ………………………………………………………………………….........
Mobile No: ……………………………………………………………………………
Date: / /2019
Place: Pune

1. **Are you aware about Hydroponics technique and products?**
   - ☐ Yes
   - ☐ No
2. **Are you interested for buying the hydroponics products?**
   - ☐ Yes
   - ☐ No
3. **Do you prefer organic or inorganic food?**
   - ☐ Organic
   - ☐ Inorganic
4. **Are you interested in residue free/ chemical free kitchen gardening?**

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- ☐ Yes
- ☐ No

5. **Would you buy hydroponically grown produce if it is available easily in market?**
   - ☐ Yes
   - ☐ No
6. **Which factor do you prefer more for vegetables?**
   - ☐ Price
   - ☐ Quality

7. **Which product do you buy more often?**
   - ☐ Lettuce
   - ☐ Cherry tomato
   - ☐ Ice berg
   - ☐ Capsicum
8. **Do you prefer packed vegetable?**
   - ☐ Yes
   - ☐ No
9. **From where do you buy vegetables more often?**
   - ☐ Local Market
   - ☐ Star Bazar
   - ☐ Big Bazar
10. **Do you adopt this hydroponics technology at your place?**
    - ☐ Yes
    - ☐ No
11. **Are you interested for training on Hydroponics?**
    - ☐ Yes
    - ☐ No

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Necessity of Nutritional Shift towards Vegetarianism: An Overview

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Abstract

Nutrition should help to promote emotional, energetic & spiritual quality resulting in holistic health. Balanced diet is the right amount of variety of food that can meet all recommendations for nutrients. Integration between us and the food is more important than just mechanical absorption of food. Currently there is huge confusion amongst consumers regarding balanced diet whether to choose vegetarian diet or non-vegetarian diet. The main objective is to awaken the sleeping souls that vegetarian diet can be complete diet for nutrient adequacy. Though non-vegetarian diet is highly nutritive one can completely replace it with vegetarian diet because a well-planned and varied vegetarian diet is complementary to environmental, physical, psychological and spiritual aspects. Animal based food has adverse effect on environment in the form of carbon footprint. Slaughtering leads to Einstein Pain Waves (EPW/nociception waves), global warming, genetic issues and natural calamities, etc. Food consciousness is therefore essential for the integrated development of mankind and teleosis. Adopting vegetarianism or lowering meat consumption will promote longevity and sustainability of mother Earth. Hence, vegetarian diet is a boon to health. Thus, preference to vegetarian diet will help one to live healthy and disease-free life.

Keywords : Sleeping souls, Carbon footprint, Einstein Pain Waves, Food Consciousness, Vegetarianism

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INTRODUCTION

Nutrition deals with the various food components of our diet which are digested, absorbed and metabolized to carry out various activities of the body.Nutrition should help to promote emotional, energetic and spiritual quality resulting in holistic health. Balanced diet is the right amount of variety of food that can meet all recommendations for nutrients like carbohydrates, fats, proteins, vitamins and minerals. It is not always necessary to have non vegetarian diet to fulfill the nutrient requirement. A complete vegetarian diet can be balanced diet rather than non-vegetariandiet. In India 30%- 40% part of population prefers vegetarian diet. Vegetarian diet offers protection from 15 leading inflammatory diseases such as cancer. Currently there is huge confusion amongst consumers regarding balanced diet whether to choose vegetarian diet or non-vegetarian diet. Integration between us and the food is more important than just mechanical absorption of food. Our intention is to awake meat eaters about how their diet patterns are influencing physical, psychological, spiritual and environmental aspects which are deeply connected to welfare of mankind and all living creatures.Hence, vegetarian diet is affordable and can be implemented alone for preventing diseases and as conventional remedies when disease is previously present.

PHYSICAL HEALTH

Longevity of people is being affected due to tendency of modern generation towards non-vegetarian food. Vegetarian diet helps to promote health by improving mood, reduce blood cholesterol levels and risk of developing cataracts and kidney stones. It also suppress the risk of developing cancer and cardiovascular diseases.

According to IARC(International Agency for Research on Cancer) processed meat is considered as carcinogenic in nature. Extent of consumption of processed and red meat is directly proportional to risk of developing gastric cancer, pancreatic cancer, cervical cancer and endometrial cancer, etc. It has seen that processed meat is greatly associated with cardiovascular diseases and T2DM (Type 2 Diabetes Mellitus) and certain types of cancers. Consumption of meat may lead to cardiovascular diseases, diabetes, hyperlipidemia and depression.Cardiovascular diseases are directly related to saturated animal fat, total animal fat and dietary cholesterol. American Institute for Cancer research found that the convincing dietary factor related to increased risk of colon cancer is due to meat consumption. Red meat consumption causes prostate cancer and pancreatic cancer and processed meat consumption cause stomach cancer. Meat eaters had twice the risk of emerging appendectomy and iodine deficiency than non-meat eaters. According

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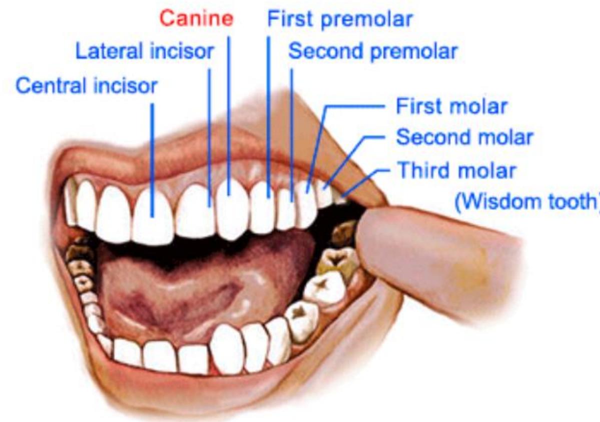
to the Oxford Vegetarian Study incidence of ischemic heart disease might be 24% lower in lifelong vegetarians than non-vegetarians.

PSYCHOLOGICAL HEALTH

Lower presence of arachidonic acid in vegetarian diet compared to non-vegetarian diet tends to mood improvement. Satvic food gives one alertness energy and create a keener consciousness. Rise in tamasic thoughts such as sexual thought, greed, anger,etc. are due to increase in tama component obtained from non-vegetariandiet. Occurrence of stress hormones in animal based food is higher than that of plant based food. The main reason for the higher content of stress hormone in meat is due to various reasons such as rearing in congested areas, conflicts between them, transportation injuries, starvation,stunning pain and fear of death. Animal stress hormones are cortisol, catecholamine(adrenaline and noradrenaline). Plant stress hormone is abscisic acid.

Does plants also experience pain when killed? It has been observed that plants also experienced pain when cut off or its parts are severed. The extent of pain waves released is less than animals. There is no pain to the plant when the fruit or vegetable is naturally fallen from a tree due to ripening.

Role of canine teeth in human beings: Carnivores have canineteeth's for tearing food whereas humans have both canine and molar teeth's. But, it doesn't means that human should eat non vegetarian food because man is three degrees above animals namely mind, matter and life.



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SPIRITUAL HEALTH

Integrated development of spirit, mind, body and energy refers to food consciousness. As mentioned earlier cosmic energy stored in the food are liberated due to holistic digestion. Teleosis is an inner urge for perfection resulting in a sense of completeness, wholeness, maturity and happiness (Vithoulkar, 1996). According to Indian philosophy, depending upon the properties or characteristics exhibited by the food it is classified as satvic food, rajasic food and tamasic food. All foods show influence on psychological nature of man that's why they are classified depending upon gunas,

1) Satvic food:
   Satvic foods consists of all fresh foods which aids one to be peaceful, clear and harmonious. Satvic food do not cause feeling of heaviness and neither pull's energy from one's

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body. It has been observed that rajasic or processed food has higher Thermogenic Effect of Food (TEF) as compared to Satvic food.
In other words, Satvic foods are better utilized than the processed rajasic foods (Sreelakshmi, R.& N. Shakuntala Manay,2004)

2) Rajasic foods:

The foods which improves speed of metabolism and give stimulating effect to the nervous system is called as rajasic foods. These foods have high energy and tend to give stimulating effect and sensual pleasure. Habit forming substances like tobacco, tea, coffee and spices are characterized as rajasic foods .Rajasic foods can be considered appropriate for military forces,ruler's, corporate executives and politicians etc. One question may arise that on which basis above statements are confirmed? Reading taken by Electroencephalography(EEG) have proved this fact in a study held about thermogenic effect of food and its impact on psychological and physiological changes in human body were examined . It conclude that satvic food emitted alpha readings which indicates a vibratory state relating to mental peace and calm. On the other hand, negative impact on the brain is caused by waves induced from rajasic food resulting in emission of beta waves which leads to restlessness and anxiety in mind. Therefore according to Sreelakshmi, R.& N. Shakuntala Manay,2006 the consumption of satvic food helps to reduce body weight but in case of rajasic food weight gain is recorded. Satvic foods show high density of micronutrients and low fat content whereas tamasic food is low in density of micronutrients and has high fat content (Vaishali V. Agte& Shashi A. Chiplonkar,2007).

3) Tamasic foods:
Decayed, stale, boiled, decomposed, processed, cooked and recooked foods are considered as tamasic. Consistent consumption of tamasic foods shows gain in body weight and becomes responsible for degenerative disorders. Examples of tamasic foods are drugs, alcohols and fast foods. Such foods create lethargy, heaviness and irritability.

Hence satvic diet will help people to be balanced and calm, live healthy life, cure diseases and remain free from fear.
Satvic food is characterized for purity and knowledge.
Rajasic food is characterized for over stimulating action and passion.
Tamasic food is characterized for dullness, ignorance and inertia.

As compared to plants thoughts of revenge and anger are far more pronounced in animals as they have immature mind and intellect. The activity of eating non-vegetarian food is tamasic as tama is dominantly present in meat.

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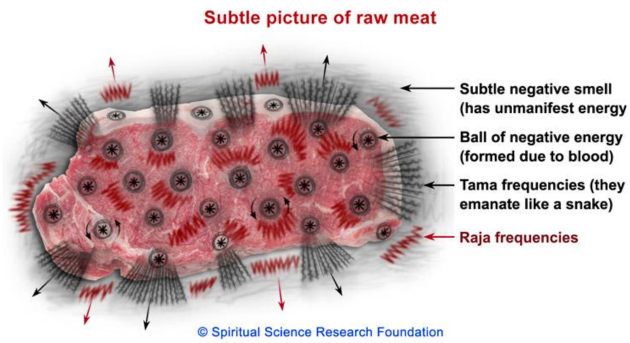
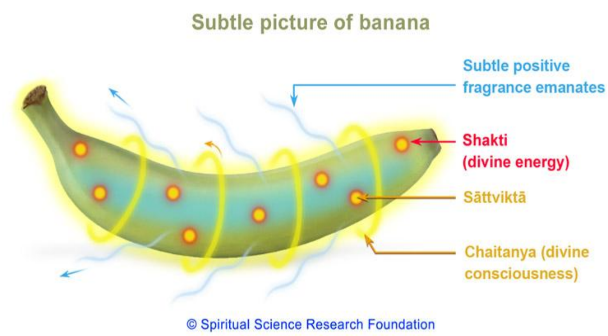


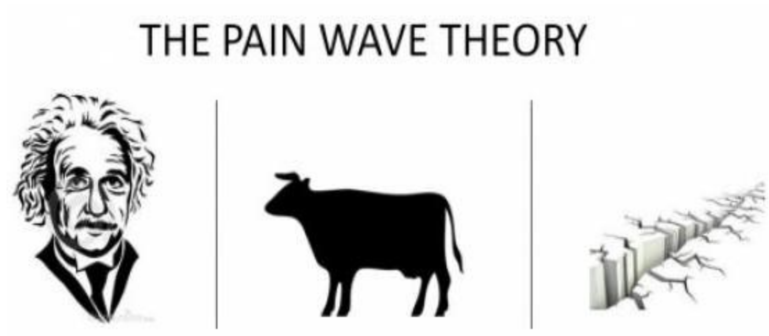
Sattva components are in higher proportion in vegetarian diet.



ENVIRONMENTAL HEALTH

Collective animal genocide results into devastating natural calamities like earthquake.Plant based food has considerably lower carbon footprint than meat. Carbon footprint is the result of emission of methane from intestinal fermentation occurring in ruminants.Greenhouse gases emission and nitrogen will lower only when production of livestock and manure will decrease.

Slaughtering of animals leads to emission of Einstein Pain Waves (EPW) or nociception waves. These pain waves are released when living creature is killed. Waves coming out from them while killing are of slow speed. When number of waves comes together its intensity multiplies and after collaboration it vibrates the earth.Animal genocide in large quantity will invite unavoidable natural and metaphysical calamities. Genetic issues are correlated to Einstein pain waves.It is not necessary that earthquake will come at that place only where slaughtering takes place. Due to effect of pain waves earthquake can occur in any part of the globe.Visprabhaw thesis by Dr. Madan Mohan Bajaj proposed scientific research paper. He proved Einstein Pain Waves phenomenon and mechanism of earthquake in terms of BIS(Breakdown of Integrated System). Einstein pain waves are contradictory of compassion waves. Einstein pain waves are harsh, destructing and dangerous and have been contributed to several earthquakes. Dying animals generate acoustic anisotropy which disturb the arrangement of tectonic plates.



Animal slaughter and earthquakes.

Photo courtesy: Blastingnews

Dr. Bajaj discovered EPW phenomenon on the basis of following observations: 1) Seeing the earthquake light. 2) Increase of radiations in the under earth water. 3) The increase of anisotropy of sound and pressure

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on the rocks. 4) Creation of poisonous gases like fasgene.

Deliberate killing of living creature causes emission of nociceptone particles. These nociceptone particles when aggregate create huge turbulence in oceans and seas and create pressure hence causes tornadoes, hurricanes, storms, typhoons and cyclones. World's largest tropical forest which is none other than Amazon rainforest is being deforested for cattle rearing.

Adopting vegetarianism will help to minimize environmental issues such as global warming and climate change. Meat animal rearing is directly associated with high carbon footprint which accelerates the global climate change. Environmental issues such as deforestation, pollution, solid waste decomposition, ozone layer depletion, biodiversity loss, acid rain, global warming, etc. are caused due to animal rearing and slaughtering. Meat production emits greenhouse gases like carbon dioxide, methane and nitrous oxide. Livestock farming affectsthe environment in two ways that is direct and indirect. Direct impact is by meansof intestinal fermentation caused by animal's metabolism, manure and urinary excretion. Whereas, impact due to cutting crops for animal feeding, carbon dioxide emission from manures fertilizers as well as emissions from transportation of refrigerated meat products and processing. Vegetarian diet gives half carbon footprint that of a non-vegetarian diet. 1 gallon of gasoline emits 2.4 kilogram carbon dioxide approximately whereas, 1 kilogram of beef has same environmental impact as 6.2 gallons of gasoline. Scarborough et al., reported greenhouse gas emission in kilogram of carbon dioxide per day as: 7.19 for high meat eaters, 5.63 for medium meat eaters, 4.67 for low meat eaters, 3.81 for vegetarians and 3.91 for fish eaters.As per the researchers non-vegetarian diet has more contribution than vegetarian diet on ecological imbalance, global food insecurity, natural disasters,economic issues, social issues and biodiversity loss etc.Rearing and feeding of meat animals gives an extra trophic level in the food chain. These extra trophic levels lead to loss of matter and energy and reduces the production efficiency. In an ecosystem plants absorb and utilize sunlight for photosynthesis and transform this energy throughout the ecosystem. But it is to be noted that when energy conversion occurs a less organized and useful form of energy is obtained. But during each energy conversion stage some extent of energy is lost in the form of heat energy. Therefore, if more convergence occur between capture of energy by plants and the feeding level the less energy will be available to that level to meet the increasing demand for animal products.

A considerable part of crops, cereals, water, food grains, land and energy are mandatorily required for the growth and reproduction of livestock which further results into greenhouse gases emission and such additional emitted greenhouse gases notably increase risk of climate change and global warming.

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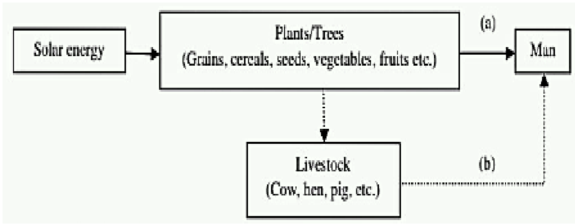

Figure: Trophic level(s) in vegetarian's ('a') and non-vegetarian's ('b') diet.

Compared to vegetarian food meat products require up to 10 fold the amount of resources like land, energy and water. This results in to increased water pollution, soil erosion, wildlife habitat degradation and increased fertilizers and pesticides inputs. As per United Nations data, rearing animals for meat uses approximately 30% of the available land and 20% water to grow feed grains.According to Mishra (2012), production of 1 pound meat requires 2400 gallons water whereas to grow 1 pound wheat only 25 gallons of water are sufficient. The production of 1 kilogram of animal protein required about hundred times more water than one kilogram of grain protein production (Pimentel, D. & Pimentel, M., 1996).

ECONOMICAL ASPECTS

In this modern era due to increase in per capita income and GDP it is observed that rate of meat consumption is proportionally rising. Currently large fertile land is being used for animal rearing whereas growing crops are used for feeding them this eventually results in food insecurity. Prices of food grains are increasing due to increase in animal rearing because of excessive export of food grains for feeding meat animals.

NUTRITIONAL ASPECT

Similarly vegetarian diet pattern may lack in protein, iron, calcium, zinc and vitamin B12 deficiencies but varied pattern can cope with this and form the perfect vegetarian diet as balanced diet.

Proteins are the source of energy.Beans, legumes, pulses, cereals, soya product (tofu, tempeh, and veggie burgers), peas, nuts, starch vegetables, mushrooms, nut, butter and milk products are the good sources of protein.

Iron deficiencies can be recovered by some dried fruits(raisins, dried apricot, prunes), iron fortified breakfast cereals, molasses, spinach, lentils, kidney beans, turnip greens, whole wheat bread and peas.

Calcium is necessary for maintaining bones strength and stronger bones and teeth. The vegetarian source of calcium include milk products, some dark green leafy vegetables (turnip greens, mustard greens, collard greens, bok choy), soya products (Soya based beverages, tofu), fortified breakfast cereals and calcium fortified orange juice.

Zinc helps in proper functioning of immune system and various biochemical reactions. The vegetarian source of zinc are pumpkin seeds, various beans(chickpeas, kidney beans and white beans),wheat germ, milk products and zinc fortified breakfast cereals.

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Vitamin B12 is found in fortified foods for vegetarians to eliminate animal products. Its sources are fortified foods such as soya based beverages, nutritional yeast, veggie burgers, breakfast cereals and milk.

Carbohydrate helps in utilization of proteins and fats. Its sources are cereal grains (wheat, rice,etc.) or tubers (potato, sweet potato,and cassava), fruits and sugarcane.

Vitamin D sources are fortified margarines, breakfast cereals, fortified soya milk, cheese and margarines.

n- 3 fatty acids are important for cardiac, immune and cognitive functions. Its sources are flaxseeds, walnuts, flaxseed oil, canola oil, olive oil and or vegan DHA supplement.

Fruits, vegetables, legumes, nuts, grains and soya protein are the part of vegetarian diet which will show positive health benefits. Balance of vegetarian nutrients from exchanging food pattern is of more importance for pregnant or lactating women,infants and menstruating women. For optimal health status vegetarian dietary patterns must be moderated and vary according to individual with diet rich in fruits and vegetables, low saturated fatty acids, salt and refined sugar.

BENEFITSOF VEGETARIANISM

Low risk of diabetes, reduction of blood cholesterol levels, improvement of mood, reduction in risk of developing cataracts and kidney stones, reduction in risk of developing cardiovascular and cancer diseases. It contain high amount of dietary fibre, n-6 fatty acids, vitamin E, B9 and C, magnesium, potassium, carotenoids, plant sterols and many other phytochemicals which provides various health benefits. Prevention of oxidative stress through antioxidant present in plant based diet lower risk of obesity and overweight.28% less risk of ischemic heart disease.

CONCLUSION

Meat consumption is not sustainable neither economically nor environmentally. Hence it is necessary to change the diet patterns and emphasize on vegetarian food to sustain our planet.Human requirement for a healthy balanced diet can be met through variety of plant foods although plant-based foods has lower digestibility and lack in one or more essential amino acids.Number of researches evidences strongly supports the healthy vegetarian diet which consists of ample quantity of processed foods, no animal food, more quantity of vegetables, fruits and cereals are sufficient to provide complete nutrition for health benefits and disease prevention.Hence, vegetarian diet is a boon to health. Thus, preference to vegetarian diet will help one to live healthy and disease-free life.

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Mangroves Support Function as a Nursery and its Linkage to the Indian Fishing Sector

Shiel Parsani[1] and Varun Miglani[2]*

Abstract

Mangroves are natural nurseries for fish and help provide nutrients for juvenile fish. While this ecological importance is known, studies from the last two decades display contradictory findings as to whether mangroves increase the population of fish. The unclear role of mangroves leads to improper policy making and decisions in any cost-benefit analysis. This paper studies the effect mangroves area on the fish population of coastal states of India. Panel data regression has been conducted to determine the trends of the areas under mangrove forests for 1997–2017 and its association with fish catch. The growth trend for mangroves in India, though marginal, is increasing and is witnessed in Gujarat and Maharashtra. Barring Kerala and Odisha, all other coastal states display positive association between mangroves areas and fish catch. Using panel data regression, random effect model, it was found that 1 km^2 increase in the total area under mangrove results in a 500 tonnes increase in the fish catch per annum. Findings also conclude that the total share of the fish catch in India that were mangrove dependent is 35%. Thus, the fishing industry increase in the yield while simultaneously not leading to the overexploitation of the mangrove dependent fish.

Keywords: Mangroves, fisheries, support functions, trends

1. Introduction:

1.1. Background:

Mangroves are a unique type of forest, both structurally and biologically. They are usually found along the coastal shores and act as a link between the marine ecosystem and the coastal land. They are characterised by thick, dense forests, often with their roots displayed. They possess the ability to control and regulated the water during high tides and thus continually protect and prevent damage to human structures and life along the coast and therefore prove vital protection against tsunamis (Polidoro, et al., 2010). According to 2010 estimates, mangroves cover an area of 150,000 km^2 or approximately 15 million hectares

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[2] Paper shall be presented using a PowerPoint presentation.
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worldwide and is estimated to prevent damages due to floods worth $82 billion annually (Losada, et al., 2018).

Characterised by a coastline that is approximately 8,118 km long, India takes pride in the importance of the fishing sector (Dehadrai & Yadava, 2004). With over 3,937 fishing villages situated along the coast, India has exported ₹ 33,442 crores worth of fish produce in 2018 (Dhillon, Dhaliwal, & Brar, 2018). It is found that over 80% of the world's fish catch has a dependence on mangroves (El-Regal & Ibrahim, 2014). Findings in India show that approximately 40% of the commercial fish are mangrove-dependant and the mangroves contribute to almost 1.8 tonnes per hectare per year out of the 6.1 million tonnes of the total fish production in the India (Anneboina & Kumar, 2017).

Almost 35% of the total mangrove cover around the world has been degraded or depleted over the past 20 years and the rate at which the habitat is getting lost is slowly increasing each year (Bengwayan, 2018). With population readily migrating to the coastal regions due to reasons of globalisation and urbanisation, there has been an increase in development along the coastal lines (Neumann, Vafeidis, Zimmermann, & Nicholls, 2015). With the influx of human population and land space being finite, it comes as no surprise that mangrove forests are cut down to accommodatehuman development and thus certain mangrove species run the risk of being extinct (Luther & Greenburg, 2009). Approximately 40% of the mangrove cover in India has been lost to human activities and rising population (Polidoro, et al., 2010).

Should there have been an absence of mangroves in the 2000s, almost $1.5 trillion of the world's GDP would have potentially been at risk. Aside from this nearly 8% of India's GDP, that is contributed by the fishing sector, would also have been put at risk (Losada, et al., 2018). Evidence shows that mangroves are important to the fishing sector, and empirical analysis that shows a conclusive data linkage has not been adequately addressed for India. Thus, there is a need to prove statistically the overwhelming dependence of the fishing sector with mangroves and how mangrove depletion can prove detrimental to the future fishing communities.

Mangroves are naturally used by fish as a nursery to help provide nutrients for the newborn fish. While this ecological importance of mangroves is known, studies from the last two decades have shown a contradiction in their findings as to whether mangroves increase the population of fish (Blaber, 2007; Faunce & Layman, 2009). The unclear role of mangroves leads to improper policy making and decisions in any cost-benefit analysis. Further, the role that mangroves play in the livelihood of fishing communities has not been adequately addressed.While similar studies like this has been conducted in different regions around the world, there have been only a few investigations that have been conducted in India. This paper studies the effect mangroves area on the fish population of coastal states of India.

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The research paper tries to bridge the gap between theoretical proofs behind the mangrove's ecological importance by providing empirical evidence. The linkage between mangroves and fisheries would serve to help the fishing sector to give added emphasis to the benefits that mangroves provide as nurseries.

The paper is divided as follows: Section 2 discusses the data sources and method of analysis. Section 3 and 4 discussestrends in India's mangroves and association with fish catch in coastal States of India, respectively. Section 5concludes with key findings and future areas of work.

2. Data and Methodology

2.1. Data sources

The data for the area under mangroves for the period 1997–2017 has been collected state wise from the Forest Survey of India (FSI) website. Data required for the fish catch production has been collected from the 'Handbook on Fisheries Statistics 2014' which is published by the Fishery Survey of India while the data on fish catch according to their species and type has been collected from the Central Marine Fisheries Institute website. Altogether, the data for fish catch has been collected for 17 years (2001–2017).

2.2. Method of Analysis

Descriptive and regression analysis has been performed to determine the effects mangroves have on fisheries of the coastal states of India and to answer the question of the effect mangroves have in fish populations, a panel data regression using random effects has been run.

A pollution variable BoD has been added to include the effect pollution has had on the effects of the fish catch. BoD is the biological oxygen demanded by organisms to do particular functions. BoD is measured in mg/l. The higher the level of BoD, the higher is the pollution in the water body. Less than 2mg/l is considered as a good level of BoD, less than 3 mg/l is considered acceptable while 4-6mg/l is considered harsh conditions(CPCB, 2016). Any level above this is polluted. The data required for the water pollution in the respective areas has been collected from the website of ENVIS Centre on Control of Pollution Water, Air, and Noise.

To determine the effects that mangroves have on the fisheries, a panel regression model using random effects consisting of the area covered by mangroves and the quantity of fish was made.

$$Y = \beta_0 + \beta_1 X_{1,it} + \beta_2 X_{2,it} + \mu_{it}$$

Where Y is the dependant volume of fish variable. The mangrove area and the pollution variable shall be the independent X_{it} variables,β_{it} are the parameters to be estimated and μ is the error term and 'i' represents the entity and 't' denotes the time

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Analysis has also been conducted to determine the trends of the areas under mangrove forests for the last 20 years, that is, 1997–2017. Coinciding along with the main theme of the research, relationships between the marine fish catch and the area under mangroves for all the coastal states (including union territories of Daman & Diu and Puducherry) have been analysed through statistical tools.

Since the data collected is not from an isolated, controlled environment, it becomes difficult to concretely say that the resultant change in the fish population is only due to a change in mangrove cover and pollution. Thus, this study shall assume to hold all other variables that could influence a change in fish population as constant.

3. Trends in India's Mangroves

The mangrove area's distribution across India is quite large. According to a report published by the Government of India the total area of mangrove in India was about 6700 km^2 (cited in Chatterjee (2018)). This meant that India's mangroves covered 8% of the world's total mangrove area (Samanta, 2017). However, the Forest Survey of India 2017 reported that India's mangroves covered a total area of 4,921 km^2. This discrepancy in reports is because many agencies use satellite imagery to assess the area of mangrove. While this method is less time consuming, it leads to an incorrect assessment of the mangrove area.

A major chunk of the mangrove forest comes from the Sundarbans of West Bengal which is a delta formed by the confluence of 3 rivers in the Bay of Bengal. It has been declared a UNESCO World Heritage site since it is one of the largest remaining mangrove delta in the world. Aside from this, Andaman and Nicobar Island and Gujarat majorly contribute to the mangrove forest cover in India. These three states alone, make up about 80% of India's mangroves.

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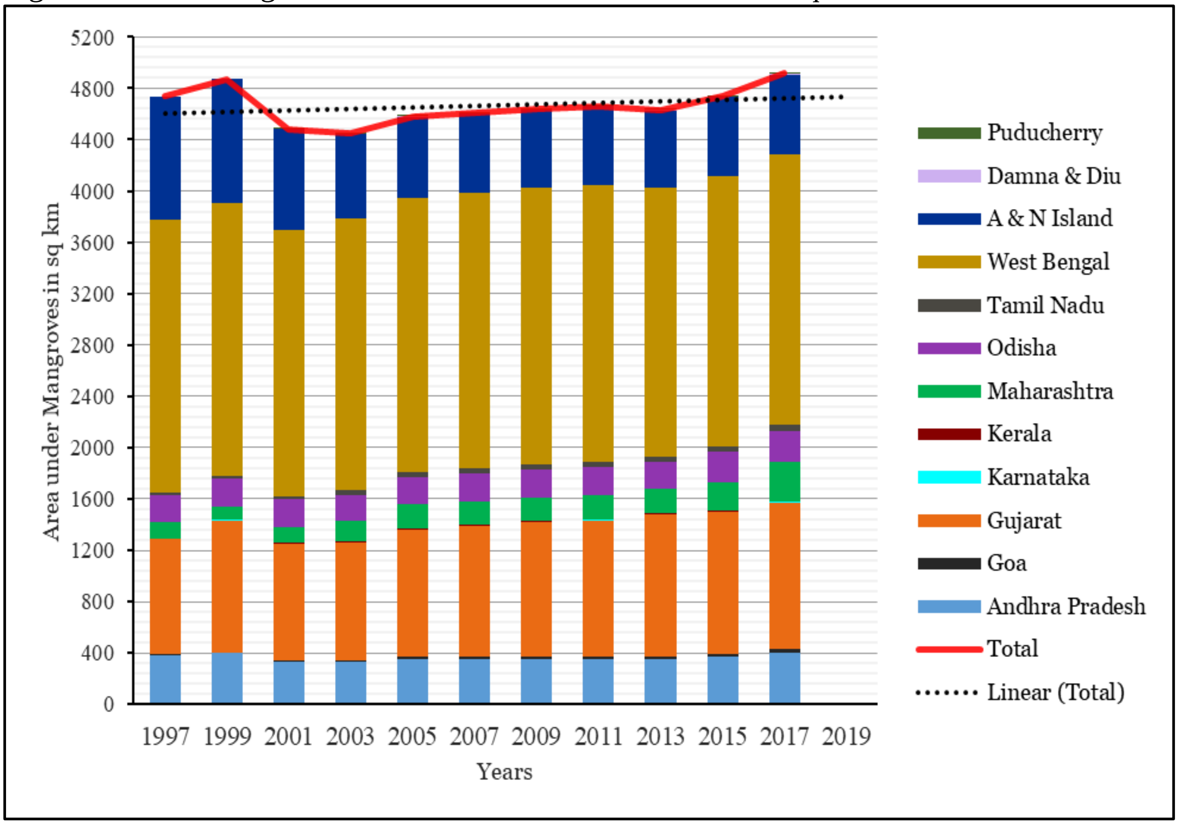
Figure 1: Total Mangrove Area in India shown State-Wise in sq. km for 1997 - 2017



Source: Forest Survey of India, 2017

Figure 1 shows the total mangrove area for to the coastal states of India since 1997. The mangroves of India have experienced a sudden drop in its cover from 1999 to 2005. The general loss of mangroves is generally due to erosion, deforestation, and other human interferences. However, India's mangroves took a major hit due to the super cyclone in Odisha in 1999 followed by the tsunami that hit India in 2004(Sahu, Suresh, Murthy, & Ravindranath, 2015). Conservation and protection that followed led to the mangrove cover slowly recovering from the damages from the natural calamities. The growth trend for mangroves in India, though marginal, is increasing.

Figure 2, shows that the western states of India have witnessed a major increase in their mangrove cover since 1997. According to the FSI 2017 report, Gujarat alone has contributed to 50% of the increase of India's mangrove cover in the past 20 years. With the Kachchh and Jamnagar increasing by 12 km^2 and 11 km^2 respectively. From Figure 2, it is observed that states like Maharashtra and Goa have also experienced a 180 km and 21 km^2 increase in their mangrove area over the last two decades. Although Gujarat is the major contributor to the overall mangrove cover of India on the west coast. But, the majority of its area consists of open mangroves and moderately dense mangroves, only 7% of its area is dense mangrove.

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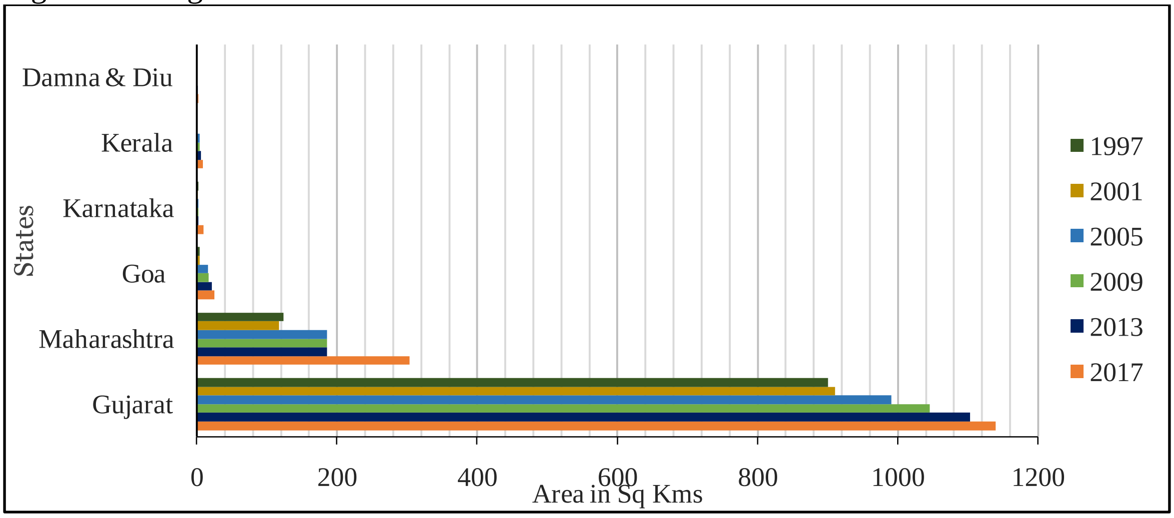
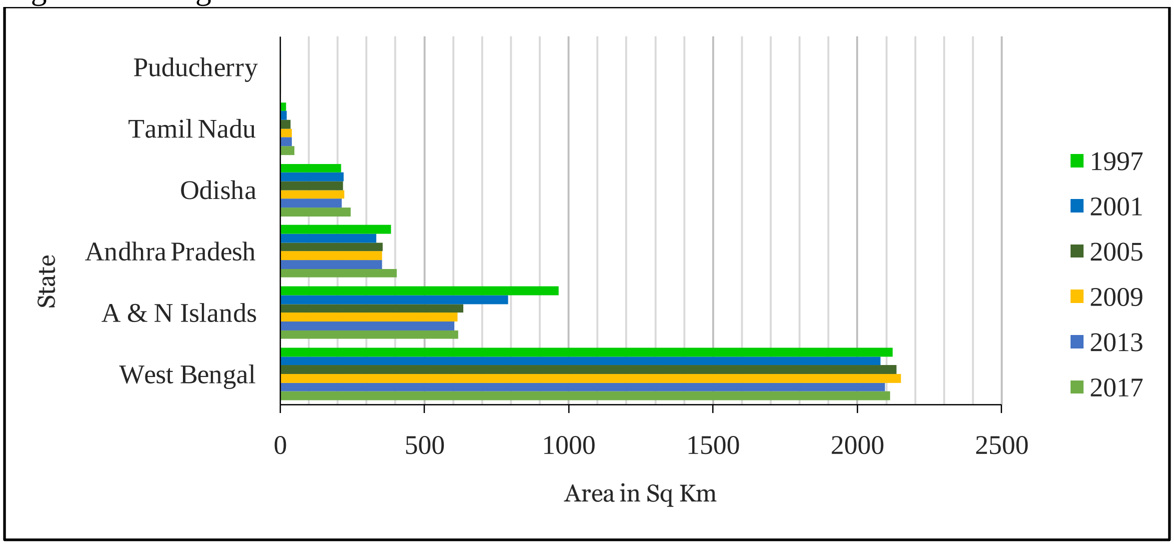
Figure 2: Mangrove Area for Western States/Union territories 1997-2017



Source: Forest Survey of India, 2017

Figure 3: Mangrove Area for Eastern States/Union territories 1997-2017



Source: Forest Survey of India, 2017

An analysis of the eastern states of India shows that while states like Tamil Nadu, Andhra Pradesh, and Odisha have individually increased their mangrove cover, the eastern states collectively have suffered a loss of 275 km^2 over the last two decades. The major contributors to this loss are Andaman and Nicobar Islands that has lost over 36% of their cover, which is observed in Figure 3. This loss in mangrove area to the eastern states is majorly attributed to the damages sustained during the tsunami of 2004 and the cyclone of 1999 (Sahu, Suresh, Murthy, & Ravindranath, 2015). The natural disasters that severely damaged the east coast was detrimental to the environment as eastern states like Andaman and Nicobar Islands and the Sundarbans of West Bengal are home to the highly dense areas of mangrove forest in India.

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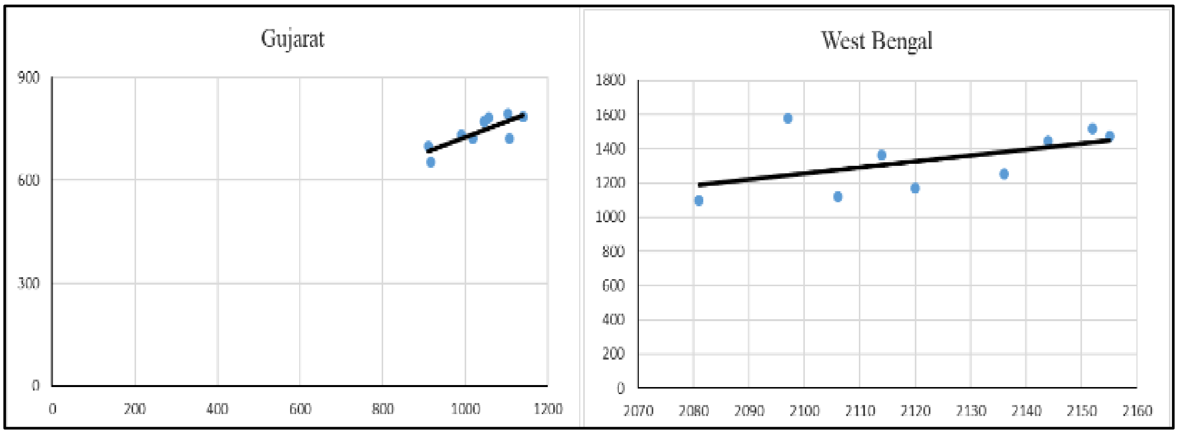
4. Determinantsof Fish Production

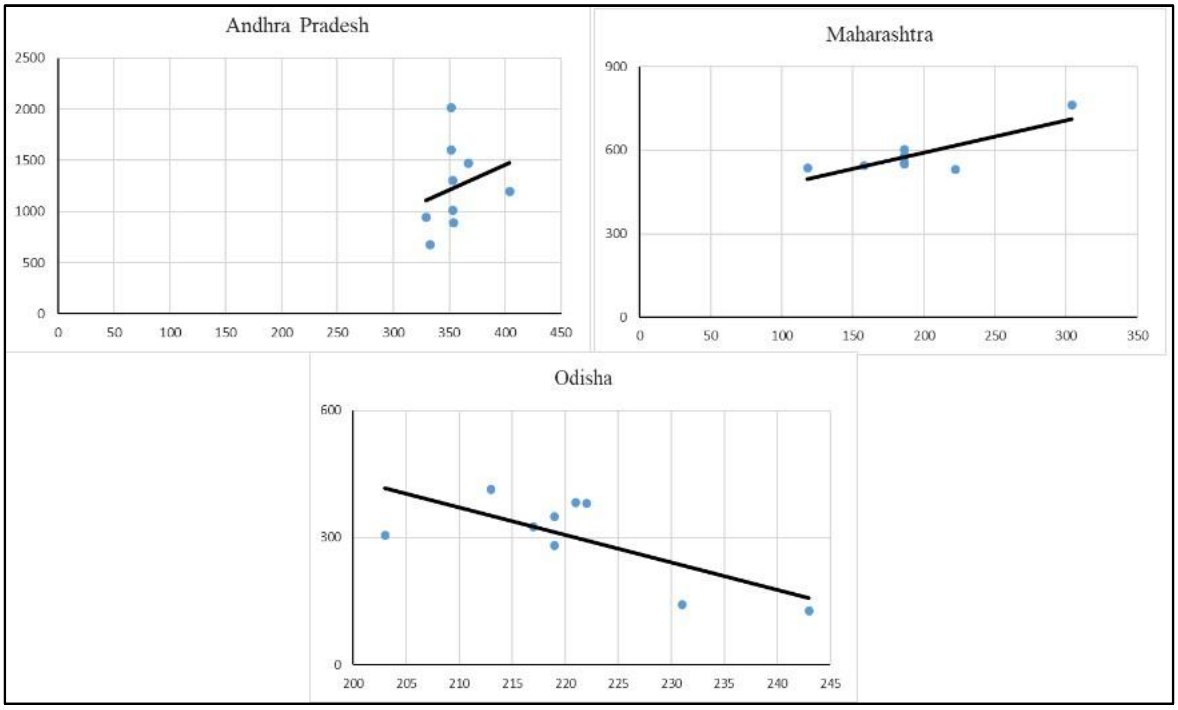
Taking into account the support function that mangroves play as a natural nursey to various fish species, data was collected State wise across the east and west coast of India. Data was collected and analysed for the fish catch and the area under mangroves for each coastal state. These data points were plotted against each other in a scatter plot. The analysis was broken up according to the size of the area under mangroves that each state had. Fish Catch (in ‘000 tonnes) was plotted on the Y-axis and Mangrove Area in km^2 was plotted on the X-axis.

Figure 4: Relation between mangrove cover and fish catch for States with large mangrove area.



Source: FSI, 2017 & CMFRI, 2017

Figure 5:Relation between mangrove cover and fish catch for States with moderate mangrove area.



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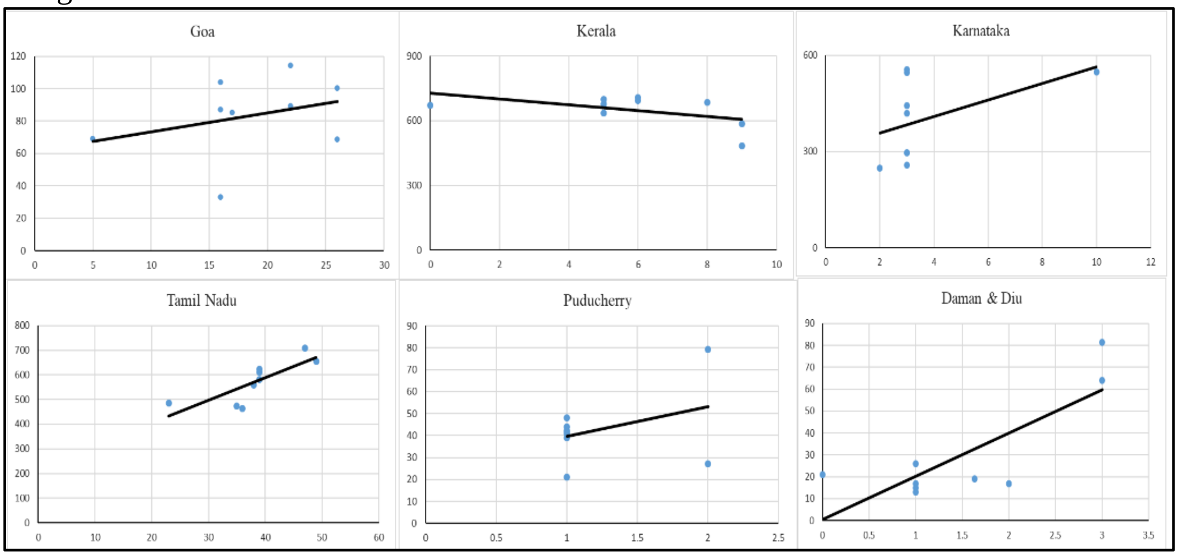
Source: FSI, 2017 & CMFRI, 2017

The scatter plot in Figures 4 and 5 shows the relationship between the fish that were caught for 2001-2017 with a gap of one year in between each observation. Gujarat and West Bengal were categorised as the two states that had a high mangrove cover of greater than 800 km^2. Simultaneously these states corresponded with a high fish catch of greater than 800,000 tonnes. From observing the trend lines, it can be observed that both states display a positive relationship between fish catch and mangrove area with slopes of 0.45 and 0.34 for Gujarat and West Bengal, respectively. Figure 5 shows the relationship between the states with a moderate level of mangrove area and their respective quantity of fish caught. Both the states of Andhra Pradesh and Maharashtra show a positive relationship between the fish catch and the area under mangroves. Each state has a positive slope of 4.8 and 1.15. On the other hand, Odisha shows a negative relation between its fish catch and its area under mangroves with a slope of -6.5. Reason for this is attributed to the fact that a majority of the population have fishing as a source of income, areas like Vetka were declared as a national park thus the ownership of resources fell under the government. Therefore, there exists a control on the exploitation of the resource. Coupled with this is the fact that many of the fishermen do not have the resources to acquire better fishing gear and technology like gillnets and mosquito nets (Banerjee , 2017).

Figure 6: Relation between mangrove cover and fish catch for States with moderate mangrove area.



Source: FSI, 2017 & CMFRI, 2017

Figure 6 shows the scatter plots for fish catch and the mangrove area for states that have a very little area under mangrove forests. The states like Tamil Nadu, Karnataka and Goa while having less than 50 km^2 area and above 10 km^2 of mangrove show a positive relationship between its fish catch and the mangrove area. Their slopes are 9.1, 25.6 and 1.17 respectively. Union territories like Puducherry and Daman and Diu both show positive

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relations with fish caught and their mangrove area. They displayed slopes of 13.1 and 19.7, respectively. Kerala, on the other hand, displayed a slight negative relation between fish catch and its mangrove area.

Table 1: Mangrove Dependent Fish and Mangrove area of coastal states on India for 2017

Coastal States in India	**Mangroves Area 2017 (in Sq Km)**	**Mangrove Dependent Fish Catch 2017 (in '000 tonnes)**			**Mangrove Dependent Fish as % of Total Marine Fish Catch**	**Examples of Fish**
		Dermesals	**Crustaceans**	**Molluscs**		
Andhra Pradesh	404	35.9	20.9	3	29.9	Prawns, Crabs, Eels, Sardines and Mackerel
Goa	26	5.2	1.9	0.5	7.6	Barracuda, Kingfish, Crabs, Prawns and Squid
Gujurat	1140	174.1	197.6	61.7	55.1	Sharks, Catfish, Rock Cods and Croakers
Karnataka	10	119	30.9	26.1	32.1	Rock Cod, Perches, Pig-face breams, Snappers and Stomatopods
Kerala	9	105.7	53.9	43.9	34.8	Stolephorus, Sardines, Threadfin breams, Ribbon fish
Maharashtra	304	93.6	81.8	38.4	56.1	Catfish, Croakers, Threadfin breams, Silverbellies, Crabs and Prawn
Odisha	243	26.2	12.3	1.9	6.2	Soles, Cuttlefish, Snappers, Croakers and Prawns
Tamil Nadu	49	196.7	41.6	62.6	44.4	Rays, Eels, Pig-faced breams and Cuttlefish
West Bengal	2114	40.5	35.5	4.5	22.3	Croakers, Soles, Prawns, Crabs, Sharks and Threadfin breams
Daman & Diu	3	17	2.9	6.7	41.4	Rock Cod, Squid, Crab, Lobster and Pomphrets

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Puducherry	2	5.9	4.1	4.5	53.8	Rays, Goatfish, Silverbellies, Pomphret and Prawn
A & N Islands	617	-	-	-	-	-

Source: FSI, 2017 & CMFRI, 2017

Table 1 shows the coastal states of India with the distribution of fish catch broken up into three categories, namely, demersals, crustaceans and molluscs. The demersals are the fish species that live near the sea bed. While the analysis shows mangrove area data for 12 coastal states, the data was not completely available or not made public for the Andaman and Nicobar Islands. Thus, for further analysis, the state has been excluded from the study even though the state has over 617 km^2 area of mangrove cover.

It is important to be noted that the Table 1 displays marine fish catch that are dependent on mangroves as a habitat or use mangroves as a support function while breeding. These include commercially important fish types such as prawns, crabs, Pomphrets, cods and snappers(CMFRI, 2017). The total amount of mangrove dependent fish has been calculated using the total fish catch that includes pelagic fish, which are less dependent on mangroves for the survival and sustenance. Thus, it can be observed that a large percentage of the fish caught are generally dependant on the mangroves in the area. Such dependency proves how vital mangroves are with regards to the fish population.

5. Panel Regression with Fixed Effects

The Panel regression with the fish catch as the dependent variable and the mangrove area and pollution level BoD as the independent variables was run with fixed effect and random effect separately. (Refer Figure 7).

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Figure 7: Results for Panel Regression with Fixed Effects

```
. xtreg FishCatch MangroveArea BoD, fe

Fixed-effects (within) regression               Number of obs      =        99
Group variable: State1                          Number of groups   =        11

R-sq:  within  = 0.0499                         Obs per group: min =         9
       between = 0.5213                                        avg =       9.0
       overall = 0.4721                                        max =         9

                                                F(2,86)            =      2.26
corr(u_i, Xb)  = -0.4554                        Prob > F           =    0.1107

------------------------------------------------------------------------------
   FishCatch |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
MangroveArea |    .729184   .5792769     1.26   0.212    -.4223803    1.880748
         BoD |  -10.89383   11.45704    -0.95   0.344    -33.66966    11.88201
       _cons |   318.9219   233.2982     1.37   0.175    -144.8596    782.7034
-------------+----------------------------------------------------------------
     sigma_u |  344.53041
     sigma_e |   149.7767
         rho |  .84105164   (fraction of variance due to u_i)
------------------------------------------------------------------------------
F test that all u_i=0:     F(10, 86) =    35.64              Prob > F = 0.0000
```

The R^2 for the fixed effect model is 0.47 (Figure 7). The coefficient for the mangrove area is positive. This tells us that the variable has a positive relationship with fish catch. While, on the other hand BoD, that is, pollution has a negative impact on the fish catch. Thus, should there be an increase of pollution, there would be a decrease in the fish catch per state. However, the *p* values for both the independent variables are greater than 0.05.

The model was run once again using panel regression with random effects (refer Figure 8). The variable mangrove area was significant displayed a positive relationship with fish catch with coefficient of 0.5. This means that a 1 km^2 increase in the total area under mangrove for the coastal states of India results in a 500 tonnes increase in the fish catch per annum (since the data was recorded in '000 of tonnes). This constitutes to a 5 tonnes increase per hectare per annum. While the BoD variable, that is pollution, showed a negative relation with the fish caught. This coincides with the logic and theory. However, the *p* value for BoD variable is 0.14 which is greater than 0.05 thus it tells us that the relation found has a 14% chance of being random. The *F* statistic shows us that the model that has been run is significant in nature. The final regression model has been discussed in subsequent heading of statistical findings.

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Figure 8: Results of Panel Regression with Random Effects

```
. xtreg FishCatch MangroveArea BoD, re

Random-effects GLS regression                   Number of obs      =        99
Group variable: State1                          Number of groups   =        11

R-sq:  within  = 0.0480                         Obs per group: min =         9
       between = 0.5329                                        avg =       9.0
       overall = 0.4829                                        max =         9

                                                Wald chi2(2)       =     14.14
corr(u_i, X)   = 0 (assumed)                    Prob > chi2        =    0.0008

------------------------------------------------------------------------------
   FishCatch |      Coef.   Std. Err.      z    P>|z|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
MangroveArea |   .5001385    .151186     3.31   0.001     .2038193    .7964577
         BoD |  -14.38983   9.941685    -1.45   0.148    -33.87517    5.095516
       _cons |   415.0777   120.6362     3.44   0.001     178.6351    651.5203
-------------+----------------------------------------------------------------
     sigma_u |  326.34012
     sigma_e |   149.7767
         rho |  .82600716   (fraction of variance due to u_i)
------------------------------------------------------------------------------
```

Figure 9: Results of the Hausman Test

```
. hausman fixed Random

                 ---- Coefficients ----
             |      (b)          (B)            (b-B)     sqrt(diag(V_b-V_B))
             |     fixed        Random       Difference          S.E.
-------------+----------------------------------------------------------------
MangroveArea |     .729184     .5001385        .2290455        .5591999
         BoD |   -10.89383    -14.38983        3.496002        5.694434
------------------------------------------------------------------------------
                           b = consistent under Ho and Ha; obtained from xtreg
            B = inconsistent under Ha, efficient under Ho; obtained from xtreg

    Test:  Ho:  difference in coefficients not systematic

                  chi2(2) = (b-B)'[(V_b-V_B)^(-1)](b-B)
                          =        0.49
                Prob>chi2 =      0.7834
```

After running the fixed and the random-effects model, the Hausman test was run. This test checks to see which test is recommended for the model that the researcher is running. The test assumes that the null hypothesis is to use random effects while the alternative is to use fixed effects (Chmelarova, 2007). The test results in Figure 9 shows us that the *p* value is 0.78 which is greater than 0.05 therefore the null hypothesis is not rejected. Thus, random specification results is be preferred over the fixed effect specification.

Following Anneboina and Kumar (2017) method of calculating the total fish contribution, the total area under mangroves in India in 2017 was given as 4,92,100 hectares (FSI, 2017). Thus, the fish contribution of total mangroves in the coastal states of India in

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2017 is calculated by multiplyingthe total mangrove area for Indiabythe hectare fish values estimated for India in 2017. The total fish catch with contribution from mangroves is given as 15,46,844 for 2017. The total fish catch for the year 2017 in the coastal states was 43,62,705 tonnes according to CMFRI figures. Thus, the total share of the fish catch that were mangrove dependent fish is 35%.

6. Conclusion

The aim of this paper was to provide a linkage between the mangrove's support function that it provides as a nursing ground for fish species and the fishing sectors, in particular the fisheries in the coastal states of India. To quantify this linkage, the data that was collected was run through a panel regression with random effects while keeping in mind the trends of the mangrove area in India.The result produced was in line with the logic and intuition behind the theoretical concept keeping the limitations of the study in mind. The results also coincide with Anneboina and Kumar(2017), that concluded that there was a 1.86 per tonne per hectare increase in the fish production along with a 23% dependence of fish catch on mangrove area in India for the year 2011.

The results showed that 35% of the total fish catch was dependent on the mangrove and its habitat. The study thus quantified the amount that the fisheries catch depends on the area of mangroves that a coastal region has. This is of vital importance as the policy structure produced by the government can correctly access the value that mangroves provide to the fishing sector. Furthermore, it shows the ecological importance of mangroves to fish species.

Should the government decide to amplify the protection mangroves, the country can begin to increase the fish yield by approximately 5 tonnes per hectare per annum. This will also mean that the fishing industry can indulge in a further increase in the yield while simultaneously not leading to the overexploitation of the resource (i.e., mangrove dependent fish). If one were to include the fact that many mangrove species are commercially important such as cods, snappers, pomphrets and molluscs, the GDP of India and the fishing industry in India would grow.

In the process of this study, it was observed that while mangroves contribute to the fish population density and as a result the fish catch of the fisheries, it is not the only variable. In fact, the governmental policies that impact the mangroves and regulate fishing activities plays a vital role in the fish caught in different states. Studies in the future could attempt to study the effects government policies have on the fish production of mangrove-covered areas. Furthermore, while this study quantified the dependence and the per hectare increase in fish catch due to mangroves, it does not put this in terms of monetary value. Providing this monetary value can result in better valuation models for mangroves.

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The Adoption of E-commerce by Rubber Industry MSMEs in Pune

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Abstract

The Indian Rubber industry is one of the crucial raw material industry which has been growing significantly in strength and importance due to India's enhanced role in the global economy. The small sector enterprises account for over 50% production of rubber goods in the non-tyre category. Studies show that the synergy between E-commerce and rubber SMEs can help sustain the uptrend observed over the past few years. However, many micro, small, and medium-scale enterprises (MSMEs) dealing in the manufacturing and processing of rubber products are still reluctant to opt for E-Commerce to enhance their global commodity chain. The paper focuses on understanding the reasons for this reluctance of such MSMEs in Pune. Data was collected through structured interviews in February-March 2018 from a purposively selected sample of 50 MSMEs (10 adopters of e-commerce and 40 non-adopters) dealing in the manufacturing and processing of rubber products. Paper found that scale of operations has a positive impact on the adoption of E-Commerce, market competitiveness individually does not impact adoption, but does so positively with the technical know-how of the owner/manager. Favorable government policies boost E-Commerce adoption by firms. The paper helps in identifying the importance of particular factors influencing the rubber industry's marketing strategy and the primary reasons behind adopting and not adopting E-Commerce.

Keywords: E-Commerce Adoption, Rubber Industry, Marketing Strategy, MSMEs.

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1. Introduction

Rubber industry serves as a mother industry to various other industries, as rubber is widely used by every sector of the economy. The small-scale enterprises solely account for over 50% of the production of rubber goods in the non-tyre category (Indian Brand Equity Foundation [IBEF], 2010). It is pivotal for socio-economic development -because of its extensive applicability as an industrial raw material as well as intensive contribution made by MSME sector.

Market trends over the years have changed with the changing global commodity chains. Traditional sales modus operandi is found redundant in the present world. Today, the creation of a unified image and delivering requisite information to the consumers is one of the greatest concerns of small scale industries (All India Rubber Industries Association, 2016). The current market reality is that the customers are more aware and are digitally connected. Studies signify E-commerce industry in today’s scenario is impeccable to an industry’s growing market share (Mukherjee, 2017). Muhammad, Rodrigues andFernandes (2010), observe three kinds of globalization eras, each with a different global commodity chain being developed. Thepresent phase is of Digital Globalization which came through the advent of the Information Revolution.

Currently, India is the third largest producer and fourth largest consumer of natural rubber. It is also the fifth largest consumer of natural rubber and synthetic rubber together in the world (IBEF, 2010). Rubber industry in India has huge development prospects provided they keep pace with the changing environment. With digital globalisation many large-scale rubber enterprises have been able to match the pace of developing global commodity chains but still, MSMEs in India are unable to take advantage of the information growth (Mukherjee, 2017). According to Raghavan, Wani and Abraham (2018), the two tectonic changes namely: demonetization and GST have acted as a catalyst in moving towards the digital platform, but still, about 73% Small and Medium Enterprises have not adopted E-business technologies (Snapdeal& KPMG, 2015). These industries are unwilling to adopt e-commerce primarily because of lack of IT knowledge among the entrepreneurs and due to non-availability of easy market accessibility.

Mukherjee (2017) identifies E-commerce or electronic commerce as trading goods and services through an electronic medium, i.e. internet or phone. Elia, Lefebvre and Lefebvre (2007) found the benefits of e-commerce initiatives includes the reduction in delivery time and overall costs with commensurate decline in the product manufacturing cycle time along with an increase in market share, revenues and in customer service quality. With the development of E-commerce, there has been significant costs reduction; in terms of transactional and advertisement costs for the producer (Elia, Lefebvre & Lefebvre, 2007; Jahanshahi, Zhang &Brem, 2013; Santarelli&D’Altri, 2003; Shemi& Proctor, 2018). The empirical findings by Gregory, Karavdic& Zou (2007) signifies that e-commerce assets directly increases a firm’s degree of promotion adaptation, enhances communication and distribution efficiency, facilitates greater distribution support, and improves price competitiveness for export ventures. So, in today’s global market, a company will be able to gain if it invests further in e-commerce and simplifies its online product transferability. Internet-based technology provides an avenue to small market firms to expand their customer reach barring the limitations due to cost and market inaccessibility. While small firms achieve better improvements in the case of marketing, the

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larger firms are likely to observe greater operational effects. However, some studies have pointed out that small organizations are less likely to adapt to modern technology as compared to large organizations (Ein-Dor&Segev, 1978). There are a number of factors that influence this decision. Lefebvre and Lefebvre (1996) categorized these factors into internal and external factors.

Internal factors refer to firms' organizational characteristics. past experience with technology. Studies have shown that a firm's past experience with technology in terms of exposure and organizational learning affects a firm's future choices in adopting technology (Burgelman& Rosenbloom, 1989). Lefebvre and Lefebvre (1996) found components like time-since first acquisition, the number of technologies adopted, types of technologies adopted, the current level of assimilation of technologies and personnel familiarized with technology. Firm's size, availability of financial resources and centralization are key components to firm adopting e-commerce (Upadhyaya, Mohan &Karantha, 2017). Other important factors influencing a firm's decision to adopt e-commerce involves firm's pursued strategy including a firm's strategic orientation, technological awareness and technological policy (Lefebvre & Lefebvre, 1996). One of the main driving forces of a SMEs decision to adopt e-commerce is its management. The management's willingness is a key component that drives an industry's decision to adopt e-commerce (Lefebvre & Lefebvre, 1996). Ramanathan, Ramanathan& Hsiao (2012), indicates that this willingness is nowhere independent of the macro-economic and firm-level characteristics.

External factors viz. industrial and macro-economic characteristics as well as the government policies also influence firm decision to adopt e-commerce. Industrial characteristics includes competition level - number, type and proximity of competitors along with demand-level for goods, play an important role along with the degree of diffusion with technology (Sin et al, 2015). Strong competition within the industry works as a motivating factor for firms to stay ahead in the competition. As the competitors adopt E-Commerce, MSMEs have more inclination towards adopting E-Commerce for strengthening their position in the market (Yanmei, 2008).

The current e-commerce policy of India is likely to bring in more investment in e-commerce. Similarly, tax policies such as investment tax credits aimed at making adoption of e-commerce easier or more accessible to specific groups of industries. In addition, industry regulation and government buying practices are crucial determinants of a firm's judgment on whether to adopt e-commerce or not.

Literature on highlighting the factors which play an important role in influencing a firm's decision to sell online is not exhaustive. Moreover, there exists hardly any literature on the adoption of e-commerce factors influencing it in the case of rubber MSMEs. The paper focuses on understanding the rate and determinants of adoption of e-commerce of the MSMEs in the manufacturing and processing of rubber products in Pune.

This paper is divided into four sections, including introduction. Section two presents the data sources and methodology adopted to fulfil the objectives of the paper. Results are presented and discussed in section three and section four concludes with policy suggestions.

2. Data and Methodology

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This study is based on regional analysis of primary data collected from the rubber industries of Pune. The study adopts a cross-sectional research design with data collected in March 2018. Sampling frame of the respondents was prepared from the UdyogAadhar registration directory of Ministry of MSME for the Pune city with Around a thousand registered MSMEs dealing in the manufacturing and processing of rubber products in Pune. Around 220 randomly selected respondents were reached out of which 50 respondents agreed to give the interview. Out of the 50 firms, 10 were adopters of e-commerce and 40 were non-adopters. The sample includes both tyre and non-tyre enterprises (refer Table 2) .

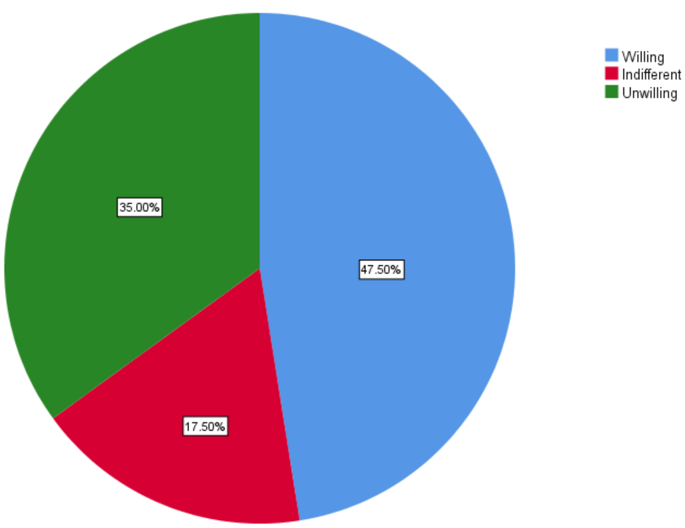
Primary data was collected through structured interviews. To elicit the response of reasons for not adopting of e-commerce by the MSMEs, likert scale was used on certain parameters identified from literature review. The interview schedule has questions on internal and external factors and the adoption of e-commerce by the firms. For internal factors, the paper considers availability of inventory and technical know-how of owner. Macro-economic factors including transactional risks and availability of resources, both capital, and human resource, have been considered but also industry level characteristics like type of customers and market accessibility have been focused upon.

3. Results and Discussion

a. Non Adopters

Out of the industries who have been non-adopters of E-commerce, it has been observed that only 35% of the managers areunwilling to adopt E-Commerce while 47.50% are willing to adopt and 17.50% are indifferent about the same (Figure 1).

Figure 1: Management'swillingness to adopt E-commerce (among Non-adopters)



Source: Primary Survey

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Table 1: Factors influencing managers' unwillingness to adopt E-commerce technology

Factors	Response	Disagree	Indifferent	Agree	Chi-Square
Fear of fraud	Disagree	12	1	7	Chi-square = 17.406
	Indifferent	5	5	0	df = 4
	Agree	2	1	7	p = .002
Competition fear	Disagree	8	1	7	Chi-square = 5.009
	Indifferent	7	4	2	df = 4
	Agree	4	2	5	p = .286
Changing Govt. regulations	Disagree	13	3	5	Chi-square = 3.840
	Indifferent	3	2	4	df = 4
	Agree	3	2	5	p = .428
Nearby Market availability for manufacturers	Disagree	11	1	1	Chi-square = 21.364
	Indifferent	0	4	2	df = 4
	Agree	8	2	11	p = .000
Low inventory available	Disagree	13	3	10	Chi-square = 3.042
	Indifferent	1	1	0	df = 4
	Agree	5	3	4	p = .551
Technical know-how of owner/manager	Disagree	3	0	5	Chi-square = 12.706
	Indifferent	1	4	4	df = 4
	Agree	15	3	5	p = .013
Lack of Funds	Disagree	14	4	8	Chi-square = 4.457
	Indifferent	1	2	1	df = 4
	Agree	4	1	5	p = .348

Source: Primary Survey

Table 2: Products manufactured by Adopters and Non-Adopters

Type of Products	**Adopters**	**Non-Adopters**	**Total**
Tyre	70.0%	30.0%	100% (n=10)
Non-Tyre	7.50%	92.5%	100% (n=30)

Source: Primary Survey

Note: Units are presented as row sum

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Past literature has indicated that some of the factors which influence a manager to not adopt latest technology apart from lack of funds include technical know-how of the owner, availability of inventory space, easy market accessibility, changes in national policies and fear of global competition due to lower comparative advantage (Lefebvre & Lefebvre, 1996). One of the main driving forces of a SMEs decision to adopt e-commerce is its management. Table 1 lists the factors which influence managers willingness to adopt E-commerce technology.Considering 5% significance level for the chi-square test, Table 1 highlights that the fear of fraud and management's willingness to adopt e-commerce are not independent of each other as the p-value (0.002) is less than the level of significance (0.05). This confirms the contemporary thought of dependence of lack of funds is a significant driver influencing a manager's decision to adopt e-commerce in sample MSMEs. This is in line with the findings of Dholakia and Kshetri (2004). Various other factors including inventory availability, competitive pressure and changing government regulations are independent of e-commerce adoption strategy. Similarly, Table 1 also indicates that the current state of market accessibility as well as manager's technical know-how has a significant clout on management's unwillingness to adopt B2B E-commerce. Thus, majority of the non-adopters find two major issues as posing a challenge to their strategy oriented towards their adoption of e-commerce—Lack of technical know-how and market inaccessibility. Most rubber industries refute the strategy to adopt E-commerce due to the easy availability of market in the neighborhood. Interviews signify that adopting B2B E-commerce would not significantly add to their market base. These challenges are faced by the tyre as well as the non-tyre sector.

Managers of small scale enterprises, during the phase of integration with new technology are not inclined to take huge risk (Rao &Metts, 2003) and particularly this is true when they are themselves not much aware of the technology (Ein-Dor&Segev, 1978). Another component significantly influencing managers' unwillingness includes their current state of market accessibility.

b. Adopters

The adopters constitute 20% of our sample. Interview questions included some of the factors that are actually a result of a firm's adoption strategy (refer Table 3). Majority of the industries who have adopted E-Commerce agree to the fact that contracts have increased due to the adoption of this platform. This is primarily because of increased market reach (Shemi& Proctor, 2017). The same can be seen particularly among tyre industries. They see reduction in cost and competitive advantage as primary reasons behind adopting E-Commerce. 50% of them have disregarded partner pressure as a reason behind adoption.

Table 3: Summary of Results from survey on factors that led to E-Commerce adoption

Factors	**Agree**	**Indifferent**	**Disagree**
Cost Reduction	8	1	1
Competitive Advantage	8	2	0

Source: Primary Survey

As shown in Table 4, around 80% of the adopters agree that competitive advantage and cost

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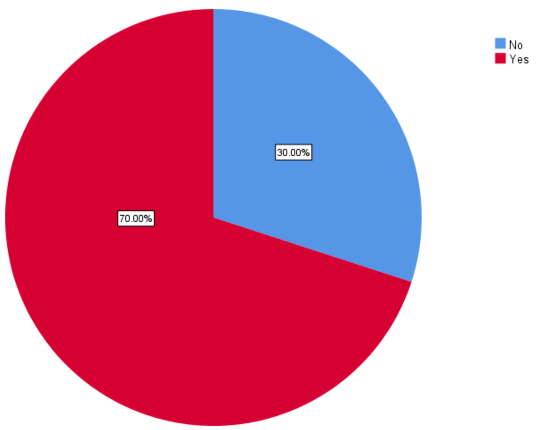
reduction have been the major factors for them to get incentivized to adopt E-Commerce. Willingness of firms to try new technology has been another factor. However, it is interesting to note that the adopters have disregarded partner pressure as a factor that motivates them to adopt E-Commerce.

Post-adoption, research indicated, 60% of the adopters have felt the impact of E-Commerce in terms of both, extended market reach and easy customer availability. As per cost reduction, firms specifically feel advertisement cost has reduced significantly. While 50% of them also feel labor cost has reduced. Industries equally believe that there is either an increase or no impact on competition. 70% of the adopters agree that the risks have decreased significantly.

Figure 2: Adopters feelings that E-Commerce will make GST and TCS more feasible



Source: Primary Survey

Figure 2 indicates that there has been a tremendous impact of tax rate on adoption. 70% of the adopters feel that “Tax Collected at Source (TCS)” and “same tax rate across states” provision for E-Commerce sale under GST, has made E-Commerce adoption more feasible. Internet banking has been agreed to be one of the most convenient modes of collecting payment by the adopters of E-Commerce. These findings are parallel to the findings of a study by Raghavan, Wani, and Abraham (2018).

c. Testing for Factor Dependence

Past Literature, indicates two crucial factors (have been considered) which deter a firm to adopt e-marketplace. One is the lack of information among the management regarding technology. Interviews indicated many of the micro and small firms were resistant to adopt e-commerce because they lack economies of scale, unlike medium and large business houses. Since small firms are not well-versed with the technology and its advancements, therefore they were not ready to adopt e-commerce. Hence IT awareness, which is an internal factor, is investigated for its dependency. When it comes to technical know-how, the non-adopters feel that, lack of technical knowledge of owners is one of the biggest obstacles in adoption. Adopters, on the other hand, agree that their technical know-how has been one of the greatest strengths that led them to adopt e-commerce.

Another factor that has been determined crucial in past results is market accessibility. Lefebvre and Lefebvre (1996) have highlighted that such industry level factors mainly comprise of competitive pressure in the industry along with the type of buyers. So the study will be focusing on two of these factors.

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Moreover, studies have shown firm-level characteristics including the scale of business operation, centralization and firm's structure play an influential role in determining a firm's decision to adopt e-commerce (Dholakia &Kshetri, 2004; Gregory, Karavdic& Zou, 2007). This part of the study draws out empirically testing the dependence of a firm's compliance to sell online. Chi-square tests were carried out to decide whether there were any significant differences among adopters and non-adopters of E-Commerce in terms of factors such as competitive pressure, technical know-how of Owner/Manager, the scale of operation, having IT department. Table 5 indicates every firm's degree of acceptance to some of the aforementioned variables.

Table 4: Factors affecting manufacturers in Non-Adoption and Adoption of E-commerce

Factors	**Response**	**Non Adopters (n = 40)**	**Adopters (n = 10)**	**Chi-Square**
Competitive Pressure	Disagree Indifferent Agree	16 13 11	0 5 5	Chi-square = 5.946 df = 2 p = .051
Scale of Operation	Micro Small Medium Large	13 19 7 1	0 5 3 2	Chi-square = 7.969 df = 3 p = .047
Technical Know-how of owner	No IT knowledge Indifferent IT knowledge	25 9 6	1 0 9	Chi-square = 21.490 df = 2 p = .000
Departments	IT department Non-IT department	10 30	6 4	Chi-square = 4.504 df = 1 p = .034
Primary Buyers	Industries Normal Consumers Retailers	23 12 5	6 3 1	Chi-square = 0.050 df = 2 p = .975

Source: Primary Survey

The results indicated in Table 4, show that there is no significant difference between adopters and non-adopters in terms of competitive pressure. This is due to the fact that with increasing E-Commerce space every firm is facing competition in the product sale whether it is adopter or non-adopter—particularly when in Pune most of the rubber industries are clustered in Chakan and Bhosari regions. When contrasted between the adopters and non-adopters of E-Commerce, it is interesting to note that majority of the non-adopters do not feel competitive factor as a reason for adoption. However, the adopters mostly agree or are indifferent on the competitive factor as a driver to adopt E-

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Commerce.

In terms of the scale of operation, there is a significant difference among the firms. Interestingly, as the scale of operation went on increasing the proportion of firms adopting E-Commerce also increased. Earlier research has generally found that larger firms tend to adopt new technologies more rapidly than smaller firms (Teo and Tan, 1998; Ein-Dor&Segev, 1978). A common explanation is that larger firms have more resources and may have a greater need to stay at the forefront when it comes to integration with the technology.

Similarly, there is a significant difference among owners with IT knowledge, those without IT knowledge and those who have so little that leaves them in the indifferent zone. The owners with IT knowledge are more willing to accept change in structure, workforce, and skills that may result in the adoption of E-Commerce. On the other hand, the proportion of owners with no or little IT knowledge adopting the E-Commerce is very less which can be the fear of accepting changes in work structure, high fixed costs, and acquiring relevant skills etc. Another reason is that non-adopters are inclined to adopt a "wait and watch" approach as they are unsure of its benefits in relation to its cost.

In the study having an IT department implies ownership of computer(s) and skilled personnel. In terms of accessibility to or not having an IT department, there is a significant difference among adopters and non-adopters of E-Commerce. Firms having IT departments tend towards adopting E-Commerce whereas firms not having IT departments are skeptical about the decision. This is due to the fact that firms without IT departments are likely to feel that the cost is quite substantial despite the potential benefits. In this way, Adopters and Non-Adopters differ from each other.

Primary buyers of products, as an industry level factor influencing a firm's strategy in terms of adoption of E-Commerce is insignificant. The basic reason is that, as most of the rubber products are demanded as ancillary product by some other industries, the proportion of direct consumers and retailers for the products is less. The sale of products to other industries is based on orders made by these industries for the rubber products. Although the proportion of industry buyers is higher than consumers and retailers, the kind of buyer of product does not make any significant difference in adoption of E-Commerce.Although, larger firms are more likely to adopt the E-Commerce technique, it is not only the scale of operation but also the technical know-how of owner and competitive pressure that determines whether firm adopts E-Commerce or not.

4. Conclusion

Paper found that scale of operations has a positive impact on the adoption of E-Commerce, market competitiveness individually does not impact adoption, but does so positively with the technical know-how of the owner/manager. Favorable government policies boost E-Commerce adoption by firms. The results from the research provide the end system users, i.e, the manufacturers of rubber products, with a more vivid understanding of the factors associated with the adoption of E-Commerce. The paper has some limitations. The sample size of the study was very small to generalize the results for Pune as a whole. The financial and time constraints did not allow the researcher to cover a larger sample size. This research was conducted to study the factors responsible for the adoption of E-Commerce by rubber manufacturing firms and SMEs, but the technical aspect of E-Commerce could not be covered properly. Lower sample size is one of the limitation of this paper. However, the paper helps in

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identifying the importance of particular factors influencing the rubber industry's marketing strategy and the primary reasons behind adopting and not adopting E-Commerce.

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"Study on Dryng Characteristics of Grape Raisins By Using Different Drying Methods"

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Abstract

Grape is one of the most important fruit crop in the world due to its nutritional and therapeutic value. Grapes are good source of dietary sugars, organic acids and some vitamins. The seedless raisins are called as Kishmish. Raisin not only provides sweetness but also is excellent source of dietary fibres, some amount of minerals and vitamins. The study on making grape raisins was carried by. Open drying (Sun drying) is widely used due to its low initial and running costs but depend mainly on weather conditions, which can induce microbial and insect contamination and hence, lower their quality. Drying rate and drying time was faster in tray drying compare to others three drying methods but the disadvantage of tray drying was it is batch process and cannot be used for mass production and the consumption of power is more. The quality of raisins from sensory evaluation were highly accepted in controlled shade drying where temperature and humidity is maintain as per the requirement and least accepted in open drying. Controlled shade drying is better drying method compare to other methods as it is a continuous process and less chances of contamination and high quality of product is obtained. The mean score for colour/appearance, texture, taste, flavour and acceptability of the raisins prepared by different drying methods ranged from 6.1 to 8.4, 6.3 to 8.1, 6.2 to 8.3, 6.3 to 8.0 and 6.2 to 8.3 respectively.

Keywords: Grapes, raisins, shade drying, controlled shade drying, tray drying, sensory evaluation.

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INTRODUCTION

Agriculture is the most important sector of the Indian economy from the perspective of poverty alleviation and employment generation. While half of our population still dependent on agriculture for most of their incomes, we cannot expect inclusive growth if we do not revitalize our agriculture. India's comparative advantage in agriculture does not lie in land intensive crops but in labour intensive high value crops like fruits, vegetables and organically produced cereals.

Globalization of world trade has opened up immense opportunities for multifold increase in export of Indian products. Agriculture, which forms more than one-third of the economic activity, of the country, undoubtedly stands in a resultant advantage for tapping this potential in the field of agriculture is because of the varying climatic conditions and production of a variety of vegetables and fruits with annual production of 1.88 million tonnes from 79.6 thousands hectares of land.

Grape is a fruit, botanically a berry, of the deciduous woody vines of the flowering plant genus *Vitis*. Grapes are cultivated since prehistoric times. The global grape production currently amounts to more than 75.8 million tons (Mt) according to Food and Agriculture Organization and International Organization of Vine and Wine (OIV) data for 2016. The world's five largest grape producers are: China (about 14.5 Mt), Italy (about 7.9 Mt), United States of America (about 7.1 Mt), France (about 6.4 Mt) and Spain (about 6.0 Mt). Around 71% of this production is destined for wine making, while the remainder is consumed fresh as table grapes and juice or dried as raisins (Zemni *et al.* 2017).

Grape is an important commercial fruit crop of India, which contributes to the maximum share among the fresh fruits and vegetables exported to Europe and other parts of the world. According to the estimate of NHB, the total area and production of grapes in the year 2016-17 was 136.0 thousand hectares and 2.6833 million tonnes, respectively. Major grape growing states are Maharashtra, Karnataka, Andhra Pradesh, Tamil Nadu and the North-Western region covering Punjab, Haryana, western Uttar Pradesh, Rajasthan and Madhya Pradesh. In India, raisins are mainly produced in Sangli, Solapur and Nasik districts of Maharashtra and Vijayapur district of Karnataka state (Venkatram, 2017).

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Due to their high moisture and sugar contents, grapes are very perishable, even if stored under the best refrigerated conditions, they still remain highly susceptible to contamination with spoilage by pathogenic microorganisms. That is why these fruits should be consumed fresh or converted to other derived products within few weeks after harvest otherwise, their marketability would be jeopardized, which could result in conspicuous economic losses (Bhat *et al.* 2012). The improvement of grape management, processing and marketing is required which, in turn, emphasizes the need for the adoption of more effective preserving approaches. In this respect, drying, as the oldest food-preservation method, should be one of techniques that may fulfill this need by enhancing derived grapes product quality, widening their availability and diversifying their trade (Zemni *et al.* 2017).

Drying basically removes the excess of water until an appropriate moisture level is reached that inhibits the growth of bacteria, molds, and yeasts, slows down the enzyme degradation and inactivates the majority of the physical and biochemical reactions (Araya and Ratti, 2008). It is believed that the first raisins were produced in the near east by simply burying the grapes in the sand. The aim of grape drying was to extend their shelf life and, due to their high sugar content, to provide excellent sources of energy for workers executing hard tasks (Carughi *et al.* 2008).Preserving grapes in the form of raisins has other advantages including reduction of weight and bulk, which contribute to the lessening of packing, storage and transportation costs, as well (**Wang** *et al.* 2016).

World production of dried grapes (Raisins, Sultanas and Currants) reached 1.24 million tons during 2016–2017. Turkey was the major producer, accounting for 310,000 tons (25%), followed by the US with 297,738 tons (24%), China with 185,000 tons (15%) and Iran with 170,000 tons (14%).The four countries together account for 78% of the world production, according to the latest report of the United States Department of Agriculture (USDA) 2016.

Commonly, dried grapes are used as an ingredient in baking, snacks, breakfast cereals and confectionery industry (USDA). In 2016, about 1.2 million tons of raisins were consumed in the world, an increase of 17% from 2000. With more than 250,000 tons consumed, the United States and Turkey are the leading domestic markets, accounting for 25% of global consumption. China, with 203,100 tons of dried grape consumed in 2016, was in third place (FAO-OIV).

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World raisin consumption is in fact is steadily increasing due to its nutritional quality recognized by consumers (USDA).

Sun and solar drying are the two methods traditionally used for drying of commercial raisins. However, these processes are very slow and depend mainly on weather conditions, which can induce microbial and insect contamination of the resulting dried fruits and hence, lower their quality (Pangavhane and Sawhney, 2002). More recently, advanced drying techniques such as oven drying, microwave drying, vacuum pulsed drying, infrared drying and many others have been employed in order to enhance the dehydration rate and guarantee a better quality of the raisins (Wang *et al.* 2016). Natural drying of grapes includes the open sun drying (with or without cover) and shade drying (Pangavhane and Sawhney, 2002). As a traditional method, natural drying of grape can be dated to 1490 BC in Greece and even today it is still widely applied, especially in developing countries due to its low initial and running costs (Jairaj *et al.* 2009; Esmaiili *et al.* 2007).

The main purpose of sensory evaluation is to determine the food quality characteristics and the degree of compliance with the legal requirements and consumer habits. The first and most essential parameter of food is the sensory characteristics. It is complex property, and it is an opinion about the product itself, which cannot be replaced by any other method. The colour, taste, and texture (i.e. organoleptic qualities) of the raisins produced are important attributes for consumer acceptance and are judged by sensory evaluation (Ranganna, 1977). The quality of product may deteriorate during storage due to effect of various treatments and processing methods and also due to physico-chemical changes in the product as influenced by storage environment.

MATERIAL AND METHODS

The present experiment on **"Study on drying characteristics of grape raisins by using different drying methods"** was carried out at two locations simultaneously in MIT College of Food Technology and ICAR- National Research Centre for Grapes, Manjiri Farm, P B No 3, Solapur Road,

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1. Details of Experiment

1. Location- MIT College of Food Technology and ICAR- National Research Centre for Grapes, Loni Kalbhor, Pune.
2. Year and season of experiment- Summer 2019
3. Name of crop- Grape (*Vitis vinifera* L.)
4. Variety- Thompson seedless
5. No. of drying methods- 4
6. Total weight of grapes- 100 kg
7. Weight of grapes/drying methods- 6.25 kg

2. Preparation of sample

2.1 Sample selection

Variety: Fresh Thompson seedless grapes will be used due to its good variety.
Moisture content: The moisture content of Thompson seedless grapes is between 75 to 85%.
Availability: February to May

2.2 Procurement of grapes

All cracked, diseased, malformed and discoloured berries were sorted out and discarded. The berries were washed with water for removal of adhering dust and foreign matter. The average diameter, total soluble solids, skin thickness, moisture content, acidity, pH were determined from the fresh grapes.

2.3 Preparation of dipping solution

Grapes were taken and were placed in 20kg plastic carat. Dipping solutions were prepared in water by dissolving ethyl oleate (1 liter) and Potassium carbonate anhydrous (250 g) in 50 liter of water. These carat containing grapes were dipped in the solution for 2 minutes and it was removed.

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2.4 Flow sheet of raisins making process

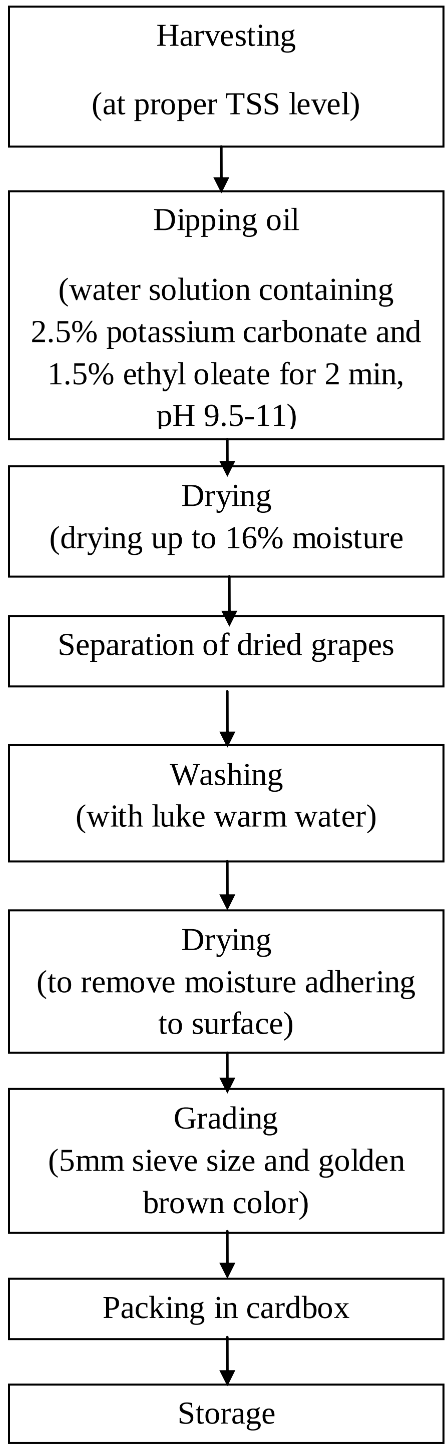

Fig 2.1 Flow chart of raisins preparation

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2.5 Drying methods

2.5.1 Open drying

Grapes pre-treated are spread on a platform in a thin layer directly exposed to the sun. During sun drying process, part of the solar radiation penetrate the material and be absorbed within the grape itself, thus generating heat in the interior of the material as well as at its surface, therefore, increasing the heat transfer and enhances moisture evaporation. Usually time required in open drying is between 6 to 9 days depending on the weather conditions. The drying of grape was stopped when it reaches to desired state of dryness that is 15-16% moisture content.

2.5.2 Shade drying

Shade drying is also a kind of natural method and extensively used for grape drying. It is also known as natural rack dryer. Pre-treated grapes were placed on the rack of dimension of 250*150*30 cm^3 and capacity of 500kg. The ambient air is the principal source of heat required for drying. Raisin of shade drying obtained better colour than sun drying, avoid the directly contact with sun rays. Time required in shade drying is between 12 to 15 days depending on the weather conditions. The drying of grape was stopped when it reaches to desired state of dryness that is 15-16% moisture content.

Fig 2.2 Open shade drying

2.5.3 Controlled shade drying

It is same as a shade drying where temperature and humidity are controlled as per the requirement. In controlled shade drying, the sensors are placed with heater and air blower. The sensors starts on low temperature range and stops when it reaches to higher temperature set as per the requirement. The temperature and humidity were set in the range of 30-42ºC and 6-

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20%.The dimensions of controlled shade drying cabinet were 250*150*30 cm^3 and capacity of 500kg. Time required in controlled shade drying is between 10 to 13 days depending on the inner cabinet conditions. The drying of grape was stopped when it reaches to desired state of dryness that is 15-16% moisture content.

Fig 2.3 Controlled shade drying

2.5.4 Tray drying

In this type of drying tray drier were used, which consisted of three basic section- an air blowing section, air heating section, and a drying chamber. The drying compartment consisted of trays, placed perpendicularly to the airflow. The grapes were placed in a single layer over the tray and inserted into the dryer cabinet, after operating conditions had been achieved. The tray containing samples was weighted at regular interval time drying runs were carried out at a constant temperature and air velocity. The temperature kept in tray drying was $35^{\circ}C$ The dimension of tray was 80*40 cm^2 and capacity of 25kg. Time required in tray drying is between 3 to 5 days. The drying of grape was stopped when it reaches to desired state of dryness that is 15-16% moisture content.

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Fig 2.4 Tray drying

2.6 Different drying parameters of drying system

2.6.1 Dry bulb temperature

It is the temperature of air recorded by the thermometer with a dry bulb and denoted by T. It indicates the amount of heat in the air and is directly proportional to the mean kinetic energy of the air molecules.

2.6.2 Wet bulb temperature

It is the temperature of air recorded by the thermometer with the bulb covered by a piece of wet cloth. Wet bulb temperature is less than dry bulb temperature.

2.6.3 Relative humidity

RH is the ratio of the partial pressure of water vapour in the mixture to the partial pressure of water vapour in saturated air at same dry bulb temperature and pressure. Hygrometer was used to determine the relative humidity.

$$RH = p_{wv} / p_s * 100$$

2.6.4 Air flow rate

Air flow is the movement of air from one area to another. Anemometer was used for measuring the speed of wind.

2.6.5 Bed thickness

Bed thickness is the distance between the top and base berries measured perpendicular to the top. Bed thickness was calculated with the help of a scale. The average of five points were taken.

2.7 Drying characteristics of raisin process

2.7.1 Drying rate

Drying rate is either the mass of water removed per unit time per unit mass of dry matter (denoted as Φ) or the mass of water removed per unit time per unit area (water flux denoted by N).

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2.7.2 Drying time

The time required to achieve a desired state of dryness can be found by integrating the expressions for drying rate with respect to time. The time required to achieve a desired state of dryness can be found by integrating the expressions for drying rate with respect to time.

2.7.3 Dehydration ratio

It is the ratio of fresh grape berries to the final dried raisins. Moreover, the ratio of the product has been calculated by dividing the fresh weight of grape berries with weight of final dried berries.

Dehydration ratio was determined by using following equation.

$$\text{Dehydration ratio} = \frac{Weight\ of\ raw\ material\ \ (g)}{Weight\ of\ dehydrated\ \ material\ \ (g)}$$

2.7.4 Physiological loss in weight

Physiological loss weight is determined by using equation.

$$\text{PLW} = \frac{Intial\ \ weight - Final\ \ weight}{Intial\ \ weight} \times 100$$

2.8. Sensory evaluation

The sensory evaluation of different organoleptic properties namely colour, taste, texture and overall acceptability were carried out by panel members. The 9 point hedonic scale was used for sensory evaluation of dried grapes (raisins).Samples were coded using random one digit numbers. Panelists were provided with a glass of water and instructed to rinse and swallow water in between the samples to break the monotony in taste of the dried grapes. Mean sensory scores for quality attributes colour, taste, texture and overall acceptability were recorded. The ranks were determined from the scores given by the judges. The sensory evaluation score sheets were provided to panellist. The results obtained from the sensory evaluation of the dried grapes are depicted in plate 3.7.

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Fig 2.5 Sensory evaluation of raisins

2.9. Statistical Analysis

The sensory evaluation results obtained were statistically analyzed by Completely Randomized Design (CRD) for different treatments as per the method given by Panse and Sukhatme (1987). The analysis of variance revealed at significance of $P<0.05$ level, S.E. and C.D at 5% is mentioned whenever required.

RESULTS AND DISCUSSION

The results of the present study entitled “Study on drying characteristics of grape raisins by using different drying methods” are presented and discussed in this chapter.

3.1 Drying parameters

3.1.1 Moisture content v/s Time

Fig 3.1 shows the drying curve for grapes in the open drying. It was observed that the removal of moisture increased due to increase in temperature between 10.00h and 17.00h but decreased thereafter, which shows the earlier and faster removal of moisture from the dried item.

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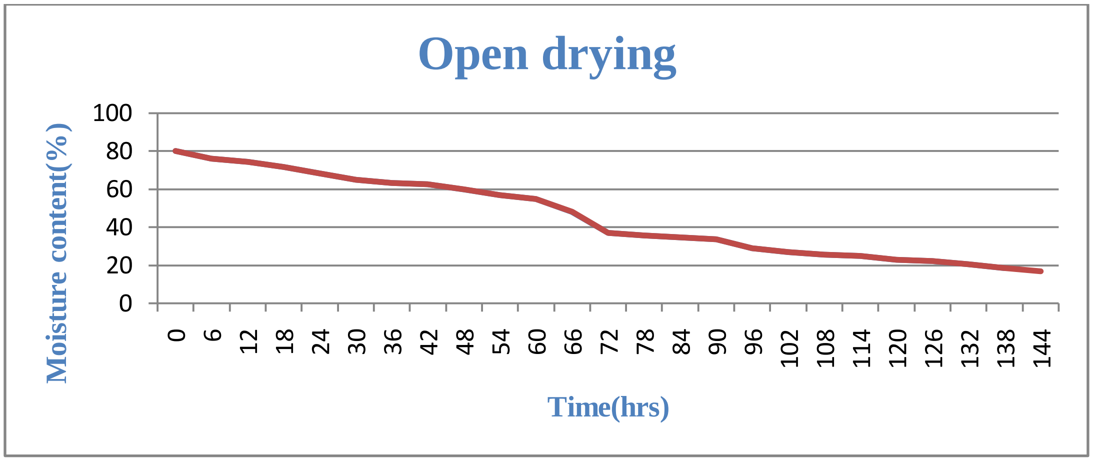

Fig 3.1 Moisture Content(%) v/s Time(hrs) in open drying

Fig 3.2 shows the drying curve for grapes in the open shade drying. It was observed that the removal of moisture increased due to increase in temperature between 11.00h and 16.00h but decreased thereafter, which shows the earlier and faster removal of moisture from the dried item.

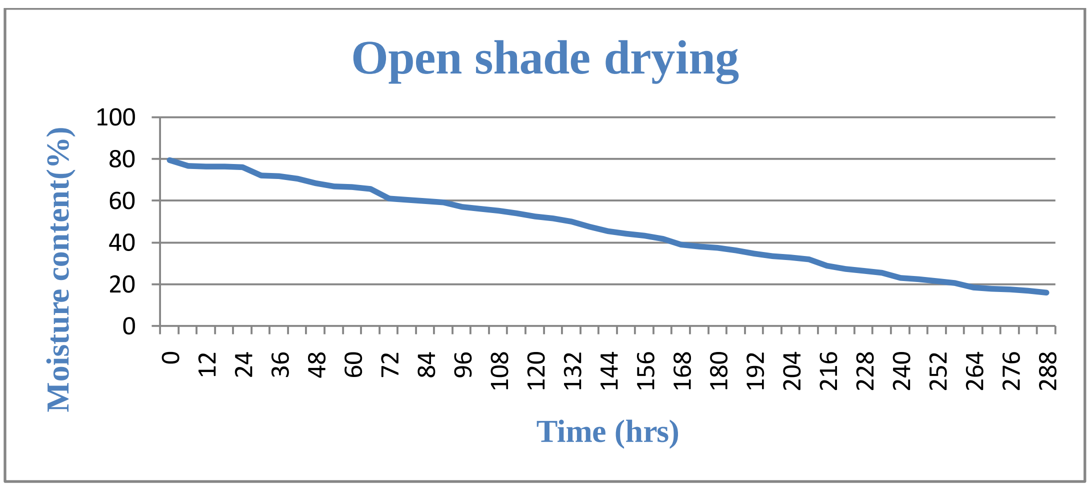

Fig 3.2 Moisture Content(%) v/s Time(hrs) in open shade drying

Fig 3.3 shows the drying curve for grapes in the controlled shade drying. It was observed that the removal of moisture was constant as the temperature (30ºC to 40ºC) and relative humidity (5% to 20%) was constant in the particular range.

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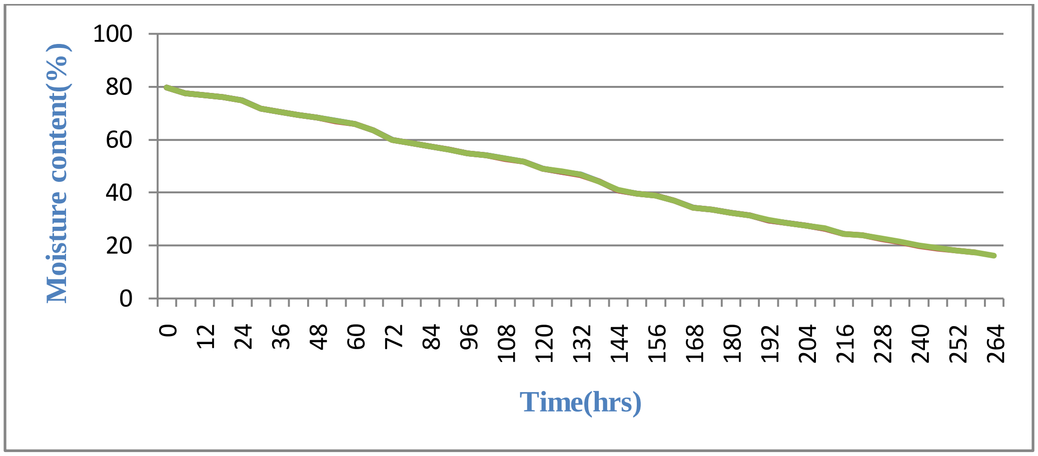

Fig 3.3 Moisture Content(%) v/s Time(hrs) in Controlled shade drying

Fig 3.4 shows the drying curve for grapes in the tray drying. It was observed that the removal of moisture increased as the time increases due to constant temperature (35ºC), which shows the earlier and faster removal of moisture from the dried item.

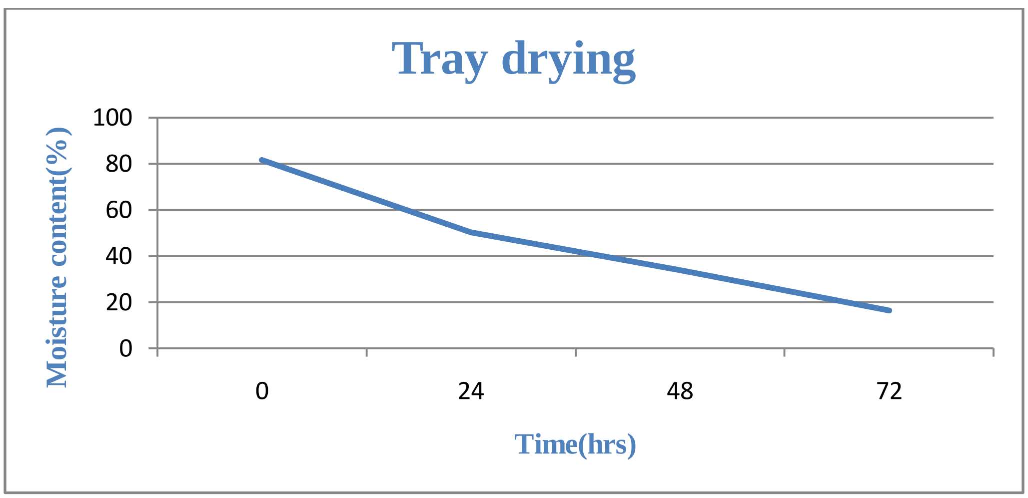

Fig 3.4 Moisture Content(%) v/s Time(hrs) in tray drying

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3.2 Physico-chemical properties of raisin

Table 3.1 Comparison of Physico-Chemical properties of raisins in different drying methods

Sr. No.	Parameters	Fresh grapes	Raisins			
			Open drying	Open shade drying	Controlled shade drying	Tray drying
1	Moisture content (%)	79.89	15.97	16.02	16.19	16.34
2	T.S.S. (ºBrix)	23.90	69.30	68.70	68.50	68.20
3	Acidity (%)	0.33	0.31	0.30	0.30	0.31
4	pH	3.29	4.10	3.98	3.90	3.86
5	Average length (cm)	0.64	0.45	0.45	0.47	0.46
6	Average diameter(cm)	0.52	0.28	0.27	0.29	0.28
7	Surface area(cm^2)	0.33	0.12	0.12	0.10	0.13
8	Surface volume(cm^3)	0.21	0.06	0.06	0.05	0.21
9	Skin thickness(mm)	0.644	0.302	0.303	0.302	0.301
10	Bulk density(kg/m^3)	517	626	629	628	620
11	True density (kg/m^3)	1104	1241	1255	1248	1235
12	Porosity (%)	53.17	49.52	49.89	49.64	49.79

3.3 Comparison of drying characteristics

Table 3.2 Comparison of drying characteristics

Sr. No.	Parameters	Open drying	Open shade drying	Controlled shade drying	Tray drying
1	Drying time (Days)	7- 8	13-14	11-12	3(at 35ºC)
2	Dehydration ratio	3.30	3.03	2.94	2.91
3	PLW (%)	69.70	67.00	66.00	65.60
4	Bed thickness (cm)	6.50	6.80	7.60	4.20
5	Diameter(cm)	0.277	0.279	0.300	0.284
6	Length(cm)	0.458	0.458	0.481	0.472
7	Bulk density(kg/m^3)	626	631	631	619
8	True density(kg/m^3)	1241	1259	1247	1227
9	Porosity(%)	49.52	49.88	49.40	49.55

The drying time required for preparation of raisins by different drying methods was 7-8 days in open drying, 13-14 days in open shade drying, 11-12 in controlled shade drying and 3 days in tray drying. The dehydration ratio was in the range of 2.91 to 3.30. Physiological loss in weight (PLW) during raisins process was found in the range of 65.60 to 69.70 percent in

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'Thompson seedless'. The bed thickness varied in different drying methods measured by scale. It was 6.50cm in open drying, 6.80cm in open shade drying, 7.60cm in controlled shade drying and 4.20cm in tray drying

3.4 Sensory Evaluation of Raisins

Table 3.3 Sensory evaluation of raisins

Samples	Colour/Appearance	Texture	Taste	Flavour	Acceptability	Avg.
C	8.4	8.1	8.3	8.0	8.3	8.22
A1	6.1	6.3	6.2	6.4	6.2	6.24
A2	6.2	6.4	6.4	6.3	6.5	6.36
A3	7.3	7.4	7.4	7.3	7.6	7.4
A4	7.8	7.1	7.3	7.1	7.3	7.32
SE ±	0.24198	0.20858	0.21061	0.20786	0.20084	-
CD @ 5%	0.72844	0.62788	0.63399	0.62571	0.60459	-

***Each value is an average of 10 responses**

Where,

C- Control sample

A1- Open drying sample

A2-Open shade drying sample

A3- Controlled shade drying sample

A4-Tray drying sample

The mean score for colour/appearance of the raisins prepared by different drying methods ranged from 6.1 to 8.4 in 'Thompson seedless'. The highest score was obtained in sample A4 and lowest in sample A1 when compared to control sample. The mean score for texture of the raisins prepared by different drying methods ranged from 6.3 to 8.1 in 'Thompson seedless'. The highest score was obtained in sample A3 and lowest in sample A1 when compared to control sample. The mean score for taste of the raisins prepared by different drying methods ranged from 6.2 to 8.3 in 'Thompson seedless'. The highest score was obtained in sample A3 and lowest in sample A1 when compared to control sample. The mean score for flavour of the raisins prepared by different drying methods ranged from 6.3 to 8.0 in 'Thompson seedless'. The highest score was obtained in sample A3 and lowest in sample A1 when compared to control sample. The mean score for acceptability of the raisins prepared by different drying methods ranged from 6.2

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to 8.3 in 'Thompson seedless'. The highest score was obtained in sample A3 and lowest in sample A1 when compared to control sample.

CONCLUSIONS Grape is one of the most important fruit crop in the world due to its nutritional and therapeutic value. It is a good source of dietary sugars, organic acids, excellent source of dietary fibres, some amount of minerals and vitamins.

The moisture content of fresh fruits of 'Thompson seedless' was 79.89 percent measured by hot air oven method. The moisture content of raisins decreased to 15.97 percent in open drying, 16.02 percent in open shade drying, 16.19 percent in controlled shade drying and 16.34 percent in tray drying. The total soluble solids content of fresh fruits of 'Thompson seedless' was 23.9 ºBrix measured by Erna hand refractometer. The total soluble solids of raisins increased to 69.3ºBrix in open drying, 68.7ºBrix in open shade drying, 68.5ºBrix in controlled shade drying and 68.2ºBrix in tray drying. The acidity of fresh fruits of 'Thompson seedless' was 0.3264 percent measured by titrable acidity. The titrable acidity of raisins decreased to 0.300 percent in open drying, 0.302 percent in open shade drying, 0.309 percent in controlled shade drying and 0.310 percent in tray drying.

The pH content of fresh fruits of 'Thompson seedless' was 3.29 measured by pH meter. The pH of raisins increased to 4.1 in open drying, 3.98 in open shade drying, 3.9 in controlled shade drying and 3.86 in tray drying. The average length of fresh fruits of 'Thompson seedless' was 0.637 cm measured by vernier calliper. The average length of raisins decreased to 0.457cm in open drying, 0.458 cm in open shade drying, 0.471 cm in controlled shade drying and 0.459 cm in tray drying.

The mean score for colour/appearance, texture, taste, flavour and acceptability of the raisins prepared by different drying methods ranged from 6.1 to 8.4, 6.3 to 8.1, 6.2 to 8.3, 6.3 to 8.0 and 6.2 to 8.3 respectively. From the different drying methods carried out, the following conclusions were made. Open drying (Sun drying) is widely used due to its low initial and running costs but depend mainly on weather conditions, which can induce microbial and insect contamination and hence, lower their quality. Drying rate and drying time was faster in tray drying compare to others three drying methods but the disadvantage of tray drying was it is batch process and cannot be used for mass production and the consumption of power is more. The quality of raisins from sensory evaluation were highly accepted in controlled shade drying

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where temperature and humidity was maintain as per the requirement and least accepted in open drying. Controlled shade drying found better drying method compared to other methods as it is a continuous process and less chances of contamination and high quality of product is obtained.

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Design and Development of Bullock Drawn Traction Sprayer

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Abstracts:

A bullock drawn traction sprayer was designed and the field performance was evaluated at 16 and 17 kg/cm^2 pressure. The average boom discharge was observed at 9.0 & 9.26 and 9.01 & 9.12 l/min for laboratory and field conditions, respectively. The spray distribution pattern was uniform for all the nozzles at pressure of 17 kg/cm^2 and 75 cm crop height. The effective field capacity was recorded 1.20 ha/hr considering total time of operation, whereas theoretical field capacity was 1.55 ha/hr with field efficiency 77 %. The average power required to operate the sprayer was 0.69 hp, at the operating cost of Rs. 35 per ha. It is simple in construction and can be fabricated in small workshops with locally available materials

Keyword: Bullock; Traction; Sprayer; Boom discharge; Field Capacity;

Introduction:

Every year 20 to 30% of the farm produce is lost due to severe crop pests and diseases, which can be estimate over 100 million rupees. (Sastry, 1993). Agricultural production depend on quality and quantity of product for which control of crops pests is important, to achieve maximum genetic potential of the particular crop.

Proper selection of pesticides and application of correct dose at proper time are not the only attributes of good performance in pest control, but in order to obtain maximum returns from their use, it is necessary to select most efficient equipment for securing a uniform deposit of the pesticide on the target without any wastage of the material in least time with minimum labour and fatigue (Reddy and Joshi, 1976). Hence selection and use of equipment is of utmost importance and deserves more emphasis while considering pesticide application.

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To accomplish effective, economic spraying of pesticides, considerable improvements have been made in both the equipment and application technology. Modern spraying techniques are also introduced in Plant Protection through aerial spraying and ground drive equipments.

At present manually operated knapsack sprayer and engine operated power sprayers are widely used by the farmers for spraying pesticides and insecticides. A farmer has to walk 25 km while spraying one-hectare area having 40 cm spraying coverage. In case of power sprayer there is jerking on shoulders and also the flumes coming through sprayer is harmful to farmer. This drudgery can be eliminated with the help of a bullock drawn traction type sprayer (Singh, 1989). Hence, there is a great need to reduce drudgery involved in spraying operations and to increase the output by timely control of insects and pests.

In agriculture, the contribution of draught animals is significant and leading one and therefore utilization and economical management of animal power by way of research work is of prime importance. Bullocks are used only for land preparation, sowing and transportation operations. Hence small and marginal farmers are required to have a pair of bullocks instead of their limited use and high maintenance cost in slack season. Hence there is need to increase the use bullocks in agriculture by performing more farm operation using available bullock power. Animal drawn sprayer is technically immidiate between the hand operated knapsack sprayer and completely mechanized sprayers and can be suited to wide range of conditions.

The spatial scenario of draught animal population in Maharashtra has been different compared to overall situation of country. The trend of draught animal power, draught animal population in Maharashtra is increased consistently over time at a growth rate of 0.36 per cent and still very important source of farm power for most of agricultural operation. The population increased 1.07 times between 1971 and 1991. The expected increase between 1991 and 2005 being 1.05 times to magnitude of 7.2 million. The population density of draught animals was 0.19 animal pair/ha (or 5.2 ha /animal pair) in 1971 and is likely to 0.2 animal pair/ha (or 5.0 ha / animal pair) in 2005. The growth of draught animal populations and net sown area over the period has thus been consistent. With net cropped area increasing draught animal power availability between 1971 and 1981 increased merely from 0.101 to 0.103 kw/ha at rate of 0.20 per cent. The overall

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trends suggest that 0.113-kw/ha draught animal power would be available in 2005 with an overall growth of 0.33 per cent (Nadre, 2003).

Bullocks are used only for land preparation, sowing and transportation operations. Hence there is need to increase the use bullocks in agriculture by performing more farm operation using available bullock power. Animal drawn sprayer is technically immediate between the hand operated knapsack sprayer and completely mechanized sprayers and can be suited to wide range of conditions. Hence looking to these facts a bullock drawn traction sprayer was designed and fabricated to avoid the problems involved in spraying operation and provide a simple, economical and spraying equipment suitable for farming systems of small and marginal farmers with following objectives:

1) To design and develop a bullock drawn traction sprayer.
2) To evaluate performance of developed bullock drawn traction sprayer.

Materials and Methods:

Design consideration:

Bullock drawn traction sprayer was designed considering agronomical, functional, physical and economical requirements. Agronomical requirement includes row spacing and height of crop. Functional requirement includes draft, pulling capacity of bullocks, pressure in nozzles and could be operate in different soil conditions with minimum of wheel slippage. Physical and economical considerations include simplicity in design, durability, low cost and locally available materials and low operational and maintenance cost.

Power transmission unit:

The power to the sprayer is taken from pneumatic type wheels (P_1) of cart, having diameter 72 cm fixed on hub to suit the different crops as per the plant height without damaging the plants. The power was given to pump by means of V- belt and pulley arrangement to maintain the number of strokes required to develop the pressure of 1.0 to 1.5 kg/cm^2 for operating fourteen nozzles simultaneously at normal bullock speed. The power transmission is as shown in Fig. 1. For calculating rpm of ground wheel, the standard speed of bullocks as 2.5 km/hr is considered.

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Component details of the Sprayer:

A cylindrical tank of 200 litres (105 cm x 60 cm x 40 cm) capacity made of corrosion resistant synthetic plastic material with round corners was used. A double piston horizontal triple action pump was mounted on the frame of the machine. The pump develops 28 kg/cm^2 pressure, at 950 rpm having suction capacity of 24 lit/min. A flexible PVC hose pipe of 14 and 9 mm outer and inner diameter respectively was used to carry a high pressure fluid. The driven shaft of 2.54 cm diameter, 25 cm in length was used for mounting the intermediate pulleys (P_2 & P_3). Two pedestals with ball bearings of 2.54 diameter were used. Fourteen hollow cone nozzles of discharge 650 ml/min and having pressure 1 to 1.5 kg/cm^2 made by ASPEE were selected for spraying the variety of crops. These nozzles were mounted on the boom frame of length 600 cm. Cut off lever made of brass and mounted in front of pump was provided for controlling flow of liquid. The frame made of strong and sturdy MS channel available with the Department of Farm Power and Machinery, MAU was used to support and hold different components.

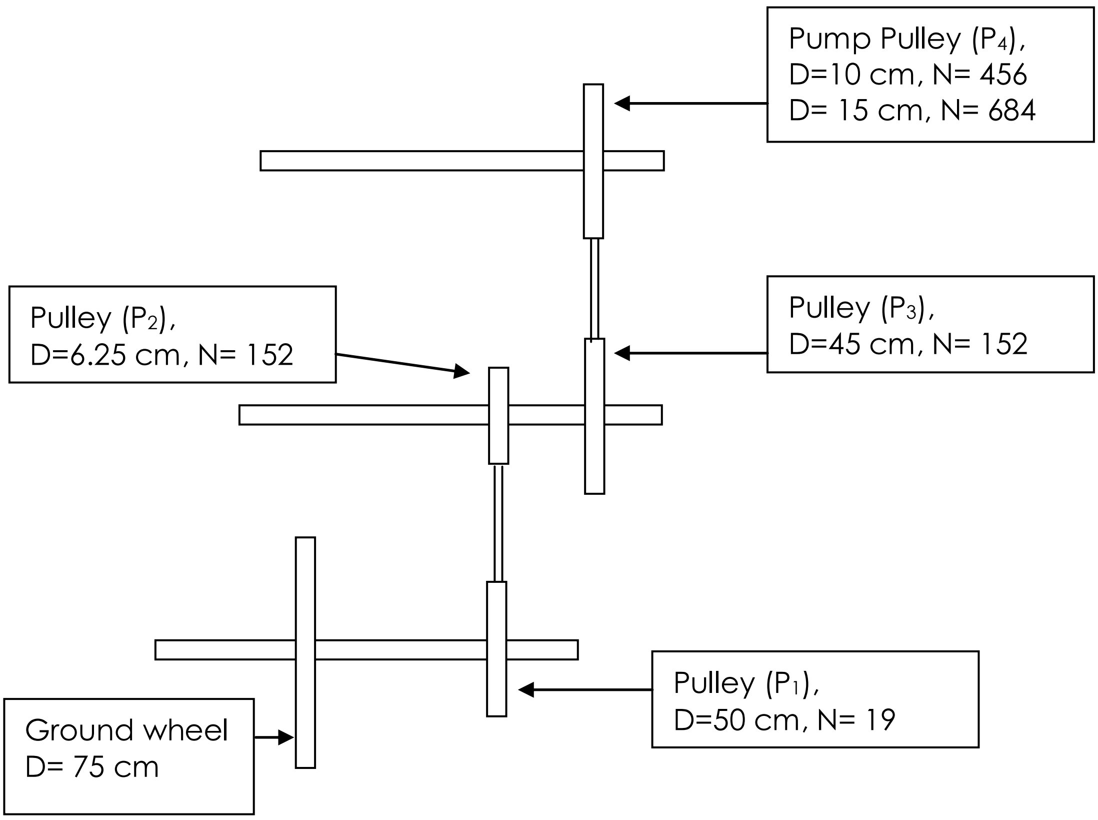

Fig. 1: Power Transmission System on Bullock Drawn Traction Sprayer

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Testing of bullock drawn traction sprayer:

Performance of the machine was evaluated both in laboratory and field as per RNAM (1983) and IS Test codes (IS: 8548-1977 & IS: 10134, 1994). The height of the boom and position of the nozzles was adjusted so that the boom does not damage the crop and the spray covers the plant completely and uniformly. The pressure was maintained by continuous rotation of the ground wheel.

Laboratory Testing:

In laboratory testing, the sprayer was jacked up and fixed on the supports to make the ground wheel free to rotate. The power was supplied by an electric motor through V-belt and pulley arrangement to drive the ground wheel at the speed of bullocks. Red colour clean water was used as a spray fluid.

For measurement of discharge and spray distribution pattern, the sprayer was operated at 2.5 km/h and at three different pressure 16, 17 and 18 kg/cm^2 obtained by changing pump pulleys as 7.5 cm, 10 cm and 15 cm. The graduated cylinders of 1 lit capacity were kept under each nozzle and spray fluid was collected for one minute for three pressures, then the cylinders were taken out from the nozzle and volume of spray fluid collected in each graduated cylinder was measured and recorded. In the same manner, three observation of discharge from each nozzle was taken at constant pressure and average value of discharge was taken as representative values. The spray distribution pattern and swath width of the nozzle were calculated by using the galvanized iron corrugated sheet of (68 x 65) cm size having 11 corrugations and kept at 20^o inclined plane. The liquid sprayed in test set up was collected at the lower end of corrugated sheet in plastic beakers immediately after the test run. The width of each individual corrugation was 5 cm. Each corrugated channel was exposed to an equal surface area for collecting spray droplets.

Field testing:

The field tests were carried out as per Indian standard (IS: 10134-1994) and RNAM test codes to study the field performance of the sprayer under actual field conditions at Dry land and Organic Farming Research Center, Marathwada Agricultural University, Parbhani. Nozzles were placed at 45 cm spacing on the boom. The pressure gauge was connected between pump and nozzles. The performance of the sprayer was evaluated in

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terms of discharge and spray distribution pattern. The speed of the ground wheel of the sprayer was kept at 2.5 kmph during the laboratory testing whereas it was operated at 2.53 kmph during the field testing.

Results and Discussion:

Discharge Rate:

The results indicate that the average discharge of individual nozzle varied from 645.34 to 649.34 ml/min with average boom discharge of 9.046 l/min at 16 kg/cm^2 pressure. Whereas it varies from 659.67 to 662.67 ml/min with average boom discharge of 9.26 l/min at pressure of 17 kg/cm^2. It is clear that the discharge rate for each nozzle is more or less same and is in the range of standard discharge of nozzle (650 ml/min). There was no significant difference observed in discharge rate among all nozzles at 16 kg/cm^2 (10 cm pump pulley) as well as 17 kg/cm^2 (15 cm pump pulley) pressures.

During field testing average discharge of individual nozzle at pressure 16 kg/cm^2 varied from 640.33 to 645.67 ml/min with total boom discharge 9.00 lit/min. At 17 kg/cm^2 pressure, discharge of individual nozzle varied from 649.67 to 654.67 ml/min with total boom discharge of 9.13 lit/min which is closer to recommended discharge of nozzle i.e. 650 ml/min. It is concluded that the discharge rate for each nozzle was more or less same at both pressures. But slight difference in discharge rate of laboratory and field condition was observed; it is due to variation in speed of the sprayer under field conditions.

The swath width for nozzle N_1 to N_{14} varied from 40-43 cm and 52 to 53.5 cm at pressure of 16 kg/cm^2 for the height of 45 cm and 75 cm respectively. Whereas, the swath width for nozzle N_1 to N_{14} varied from 42 to 43.5 and 55 to 57 cm at pressure of 17 kg/cm^2 for the height of 45 cm and 75 cm above the ground level respectively. It is also observed that the spray angle varied from 47.9^o to 51.07^o and 38.23 to 38.90^o for all fourteen nozzles at pressure 16 kg/cm^2 for the height of 45 cm and 75 cm respectively. Where as spray angle for the pressure 17kg/cm^2 at 45cm and 75 cm height for all fourteen nozzles varied from 50^o to 52.10^o and 40.270^o to 41.27^o respectively. It is concluded that swath width increases with increase in height of nozzle but spray angle decreases. The swath width depends upon the pressure, as the pressure increases, the swath width also increases and decreases with the decrease in pressure. Height of nozzle also affected the swath width. As the height of nozzle was increased, swath width also increased but at lower rate up to certain limit. This was only due to more contact area. The spray distribution pattern was

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found uniform for all the nozzles at pressure of 17 kg/cm^2. The spray pattern obtained was wider at 75 cm height for all nozzles.

Field capacity and field efficiency:

The effective field capacity was recorded 1.20 ha/hr considering total time of operation. Where as theoretical field capacity was recorded 1.55 ha/hr. Efficiency of sprayer was recorded as 77 %.

Power requirement:

The pull required for operating the sprayer varied from 85 to 90 kg with an average pull of 86.6 kg at 38^0 angle of pull. The draft required for operating the sprayer varied 65.4 to 70.9 kg with an average draft of 68.24 kg and was well within the work capacity of the bullocks at an average speed of 2.53 kmph. The average power required to operate the sprayer was 0.62 hp. An average pair of bullocks can produce about 0.8 to 1.5 hp (Mourya, 1985). Hence, a pair of bullocks can easily operate the traction sprayer.

Labor requirement:

The man hours required for spraying one ha area with the developed sprayer varied from 0.8 – 1.0, whereas the knapsack sprayer requires 14 man-hours/ha (Awadhwal *et al*., 1993).

Economics of the sprayer:

The cost of operation per hectare was worked out as Rs. 35, which was very low due to its higher field capacity 1.2 ha/h.

Conclusions:

From the results presented and discussion made in following conclusions could be drawn:

- The average discharge of fourteen nozzles at 16 and 17 kg/cm^2 was found 643.38 and 652.24 ml/min respectively under field condition, which is closer to standard nozzle discharge.
- Uniform spray distribution pattern and maximum swath width was observed at pressure 16 and 17 kg/cm^2 at 75 cm nozzle height from test setup.
- The average power required to operate the sprayer was 0.69 hp, which was well within the working capacity of a pair of bullock.

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- The average effective field capacity of the sprayer was 1.20 ha/h for a bullock speed of 2.5 km/hr.
- It requires considerable less time and labour than the conventional knapsack sprayer and the sprayer applies pesticides behind the operator, due to which chances of operator's exposure to pesticides are minimized.
- The operating cost of bullock drawn traction sprayer was Rs. 35/ha.
- It is simple in construction, inexpensive and can be fabricated in small workshops with locally available components.
- The overall performance of the bullock drawn traction sprayer was satisfactory at 16kg/cm^2 as well as at 17kg/cm^2 pressure for all medium height crops.
- It was difficult to create pressure above 19 kg/cm^2 continuously and spontaneously.
- There is slight fluctuation in pressure in laboratory and field condition due to variation in speed of operation.
- The actual & theoretical field capacity and field efficiency of this sprayer was found to be 1.20 ha/h, 1.55 ha/h and 77 per cent respectively.
- From calibration of sprayer, it was found that sprayer was medium volume sprayer and one man can operate it effectively.

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Table 1: Discharge rate of individual nozzle for 16 kg/cm^2 pressure and 15 cm diameter pump pulley

Test No.	discharge rate (ml/min)														Average (ml/min)	Total* (l/min)
	N1	N2	N3	N4	N5	N6	N7	N8	N9	N10	N11	N12	N13	N14		
	Laboratory testing															
1	645	645	647	647	649	649	650	650	649	649	647	647	646	645	647.5	9.065
2	645	645	648	647	649	649	649	649	648	648	647	646	647	645	647.28	9.062
3	646	646	648	648	648	649	649	649	648	647	648	647	647	646	647.57	9.066
Avg	645.33	645.33	647.66	647.33	648.66	649	649.33	649.33	648.33	648	647.33	646.66	646.66	645.33		9.064
	Field testing															
1	640	641	643	644	644	643	645	645	646	645	644	644	641	642	643.35	9.007
2	640	641	643	644	645	643	645	646	646	645	644	643	642	642	643.5	9.009
3	641	640	643	644	644	645	646	645	645	645	643	642	642	641	643.28	9.006
Avg	640.33	640.67	643	644	644.33	643.66	645.33	645.33	645.66	645	643.66	643	641.66	641.66		9.007

Total discharge of boom (l/min)

Table 2: Discharge rate of individual nozzle at 17 kg/cm^2 pressure and 10 cm diameter pump pulley

Test No.	discharge rate (ml/min)														Average (ml/min)	Total* (l/min)
	N1	N2	N3	N4	N5	N6	N7	N8	N9	N10	N11	N12	N13	N14		
	Laboratory testing															
1	659	660	660	661	661	661	663	662	664	663	663	662	660	660	661.35	9.259
2	660	660	661	661	661	662	663	663	662	662	662	662	660	660	661.35	9.259
3	660	661	661	661	662	662	662	662	662	663	663	662	661	661	661.64	9.263
Avg	659.67	660.33	660.66	661	661.33	661.66	662.66	662.33	662.66	662.66	662.66	662	660.33	660.33		9.2603
	Field testing															

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1	650	652	653	652	653	653	654	656	652	657	649	650	650	649	652.14	9.13
2	649	652	651	652	653	652	654	654	652	651	651	650	650	651	651.57	9.122
3	650	651	651	650	652	652	653	654	657	652	651	651	651	652	651.92	9.127
Avg	649.67	651.66	651.66	651.33	652.66	652.33	653.66	654.66	653.66	653.33	650.33	650.33	650.33	650.66		9.1263

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Biodegradable Edible Packaging Film is the Main Source of Packaging Material and is Use to Packaging the Food Products

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Abstract

Nanocomposites are a new generation of polymers emerging into every aspect of our lives. They show great promise for potential applications as high-performance biodegradable materials, which are entirely new types of materials based on plant, animal, and other natural materials. When disposed of in compost, these are safely decomposed into CO2, water, and humus through the activity of microorganisms. The CO2 and water could become corn or sugar cane again through plant photosynthesis. Many consumer plastic products may be replaced by the natural bio-polymer-based plastics, which may be used for disposal plastic bag, cup, plates, contains and utensils, and others plastic products. These biodegradable plastics can be treated like food waste, which also gets in the plastics stream, so whatever is used to handle or separate food waste will be effective for biodegradable plastics. Also most biodegradable plastics will dissolve in warm water. Therefore, biodegradable materials offer a possible alternative to the traditional non-biodegradable polymers, especially in short life-time application and when their recycling is difficult and/or not economical. Thus, there is a considerable interest in replacing some or all of the synthetic plastics by biodegradable materials in many applications. Although these materials have strong future prospects, their present low level of production and high costs restrict them from a wide range of applications. The most important factors to the formation of renewable plastics-based industries include cost reduction of biodegradable polymers, the improvement of mechanical strength and water resistance, as well as public and political acceptance. In order for renewable polymer-based bio-nanocomposites to meet a wide range of applications, bionanocomposite formulation must be further researched and modified so that mechanical and other properties can be easily manipulated, depending on the end-users' requirements.

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We believe that the next generation of packaging materials will be to fit the requirements of preserving fruit, vegetable, beverage, wine, chocolate, and other foods. By adding appropriate nano-particles, it will be possible to produce packages with stronger mechanical, barrier and thermal performance.

Keywords: Nano-composites, biodegradable, photosynthesis, packaging, polymers.

Introduction

In last 20 years, non-biodegradable petroleum based film dominates food packaging sector, because of their high strength, light weight, low cost, easy processing and easy water barrier properties. However it is becoming more evident that the ecosystem is considerably disturbed and damaged as a result limited and alternate methods of disposal. The present methods of disposing of the non-biodegradable packaging material are land filling, mechanical/biological waste treatment and thermal waste management. But these methods of disposal ultimately cause problems of odour, production of large amount of carbon dioxides and toxic gases and leaching of toxic monomers and oligomers, which again contributes to global pollution causing health problems in human and animals. On the other hand, satisfactory landfills are limited and the petroleum resources are also finite and becoming limited (Davis and Song, 2006; Ray and Okamoto, 2003). Concern on environmental waste problems caused by non-biodegradable plastic packaging material as well as consumer's demand for high quality food products has caused increasing interest in developing biodegradable/edible packaging material using annually renewable natural polymers.

Renewable biodegradable polymers can be classified according to their sources:

1. Polymers directly extracted or removed from biomass i.e. polysaccharides, proteins and lipids.
2. Polymers produced by classical chemical synthesis using renewable bio-based monomers of biomass i.e. Poly lactic acid (PLA).
3. Polymers produced by classical chemical synthesis using monomers or polymers from petroleum i.e. Polycaprolactones (PCL), Polyesteramides (PEA).
4. Polymers produced by micro-organism or genetically modified bacteria i.e. Xanthan, Curdian, Pullan, Bacterial cellulose. (Bordes et al., 2009; Jahn and Thomas, 2008; Sorrentino et al., 2007; Weber, 2000).

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But renewable biopolymers such as polysaccharides, proteins, lipids and their composites, derived from plant and animal resources has been widely using for development of biodegradable/edible packaging materials with suitable additives (Thunwall et al., 2008; Peressini et al., 2003; Weber, 2000; Chandra and Rustgi, 1998). Different plasticizers and functional ingredients like antimicrobials, antioxidants, flavour, colourants, vitamins etc. are used as additives with film forming material to modify physical properties or to add functionality to film (Nobile, 2009; Lee et al., 2008; Swain et al., 2004). Renewable biopolymers are abundant, renewable, inexpensive, environmentally-friendly, biodegradable and have also some beneficial properties as packaging materials in improving food quality and extending shelf-life by incorporating different functional ingredients (Sothomvit et al., 2009). They are also excellent barrier to fats and oils and have a good gas selective permeability as compared to synthetic films (Gontard et al., 1996). Natural biopolymer films are classified as polysaccharide film, protein film, lipid film and composite film, according to their film forming materials (Rhim and Ng Perry, 2007; Weber, 2000; Chandra and Rustgi, 1998).

Polysaccharide films are hydrophilic polymers and therefore exhibit very low moisture barrier properties (Lee et al., 2008). A variety of polysaccharides and their derivatives have been used as biodegradable film materials including starch (Namazi et al., 2009; Davis and Song, 2006), cellulose derivatives (Angls and Dufresne, 2000; Chandra and Rustgi, 1998), pectin, alginate, chitosan (Wang et al., 2004), pullulan (Chandra and Rustgi, 1998) and natural gums. (Sozer and Kokini, 2009; Weber, 2000). Among them starch, chitosan and cellulose polymers are of prime interest because of their availability and rather low cost, but they having poor mechanical and water barrier properties when compared to synthetic polymers. (Bae et al., 2009; Muller, 2009; Namazi et al., 2009; Sothomvit et al., 2009; Sozer and Kokini, 2009; Lee et al., 2008; Wang et al., 2005; Chandra and Rustgi, 1998).

Protein films are formed through the partial denaturation of polypeptide chains by addition of solvent, alteration of pH, addition of an electrolyte to cause cross-linking, and/or application of heat. Protein film forming materials derived from animal sources such as casein, whey protein, gelatin (Sothomvit et al., 2009; Zheng et al., 2001), collagen, egg white, fish myofibrillar protein, keratin and that from plant origin are zein (Sozer and Kokini, 2009),

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soya protein (Swain et al., 2004; Zhang et al., 2001), gluten etc (Rhim and Ng Perry, 2007; Weber, 2000; Chandra and Rustgi, 1998). These film forming materials are also using for microencapsulation and coating due to their water resistance properties (Weber, 2000).

Lipid are not polymers, so do not form cohesive stand-alone film but used as coating material with high barrier properties to moisture. Lipid materials such as wax, fatty acids, acylglycerols and resins are generally used as film forming material. Waxes are commonly used for coating fruits and vegetables to retard respiration and lessen moisture loss (Sorrentino et al., 2007). Films based on protein and polysaccharides are efficient oxygen and carbon dioxide barriers, whereas their resistance to water vapour transmission is limited due to their hydrophilic nature. On the contrary, lipid films are moisture resistant but their mechanical properties are inferior to those of protein and polysaccharide film, so composite films are formed by using protein or carbohydrates films coated with lipids. But lipid coated films have limited oxygen barrier properties and coveting of food can have disadvantages, such as onset of rancidity in fats as well as greasy surface coating (Rhim and Ng Perry, 2007).

Polysaccharide and protein form film of sufficient strength and stiffness, but having poor water resistance than synthetic polymers and thus absorb more moisture and results in swelling with loss of mechanical properties (Azeredo, 2009; Bae et al., 2009; Sothomvit et al., 2009; Rhim and Ng Perry, 2007). Now days many researchers have focused on effect of various chemical, physical and enzymatic treatments like solvent concentration, pH change (Bae et al., 2009; Wang et al., 2004; Shu et al., 2001), different heat treatments, ultrasound treatment (Bae et al., 2009), UV radiation, enzymatic cross linking, addition of fillers like fibres (Muller, 2009) and mineral particles to improve physical properties of biodegradable films.

Traditionally, one of the widely used methods of improving water vapour barrier of biodegradable film is addition of mineral salts with specific properties. Different mineral salts such as silica, talc, Zn, calcium carbonate (Wan et al., 2003) and synthetic polymers are incorporated in the range of 10-50%, without interfering properties of biodegradability of film. Different fibres like flax, jute, ramie, oil palm fibre, and regenerated cellulose fibres (Muller, 2009), glass fibres (Fischer, 2003; Wollerdorfer and Bader, 1998), disturbed starch granules (Angls and Dufresne, 2000) and carbon fibres (Fischer, 2003; Zheng et al., 2001) are

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also used as fillers in film preparation (Mondragon et al., 2008). But it is often reported that these filler content is limited by insufficient compatibility or high viscosity. On the other hand, they impart high weight, opacity and brittleness to film (Pavlidou and Papasprides, 2008; Fischer, 2003; Wollerdorfer and Bader, 1998). These limitations of mineral salts and fibres can be improved by decreasing filler dimensions. In last a few years, nano-scale clay fillers/nanocomposite have received much attention as an alternative to conventional fillers because of their extraordinary possibility to improve barrier properties, thermal stability, mechanical properties as well as to decrease flammability of thin films (Sothomvit et al., 2009; Zhao et al., 2008; Avella et al., 2005; Zeng et al., 2005; Fischer, 2003).

Basic Concept of Nanocomposite

Polymer clay nanocomposites are a class of hybrid materials composed of organic polymer materials and nano-scale clay fillers (Wang et al., 2001). Nano-scale clay fillers used for synthesis of nanocomposites are natural or synthetic minerals, consisting of very thin layers that are usually bound together with counter-ions.

1. **Structure of nano-scale clay**

Nano-scale clay minerals are made of mostly three elements: silicon, oxygen and aluminium. They are having platy or layered structure with some water molecules and cations in their structure so called as hydrated layered silicates or aluminosilicates (Lal, 2005). These layered silicates are fundamentally built of tetrahedral sheets in which silicon is surrounded by four oxygen atoms and octahedral sheet in which a metal like aluminium is surrounded by eight oxygen atoms. Kaolinite, mica, montmorillonite (MMT), hectorite, saporite, rectorite and talc are frequently used layered silicates, which are combined with polymeric material for formation of nanocomposite (Wang et al., 2007; Sozer and Kokini, 2009). These frequently used nano-scale clays in preparation of polymer clay nanocomposite are classified as 1:1 or 2:1 (Harpstead et al., 2005).

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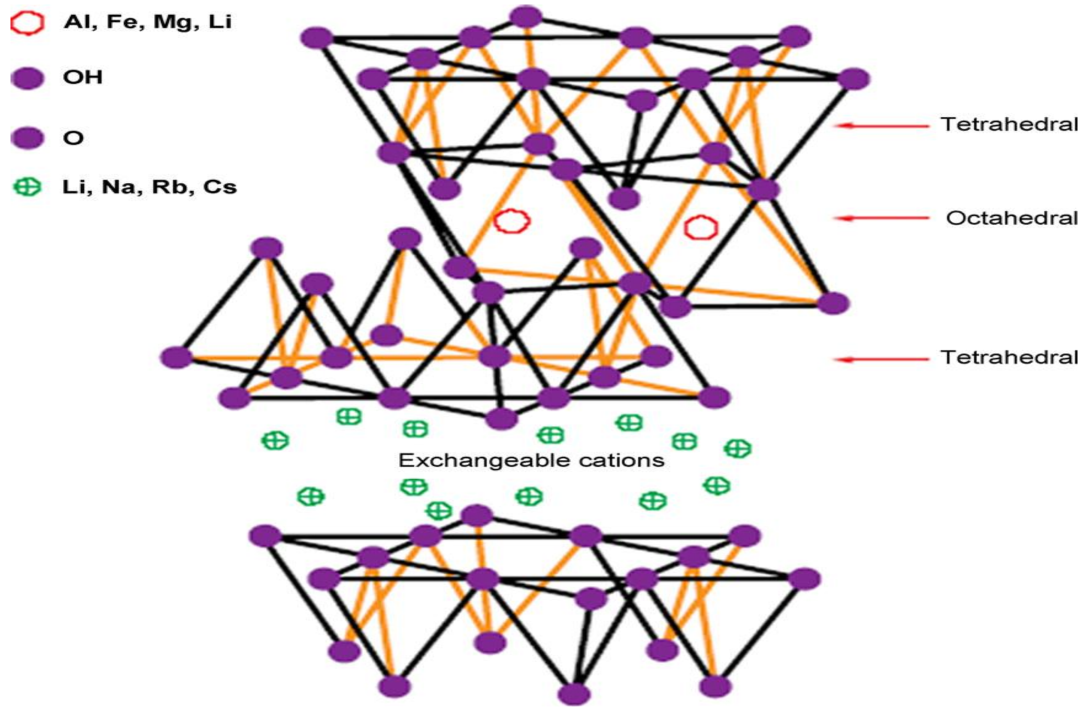

Fig. 1. The structure of a 2:1 layered silicate (Pavlidou and Papasprides, 2008)

In 1:1 layered structures a tetrahedral sheet is fused with an octahedral sheet, whereby the oxygen atom is shared e.g. kaolinite (Pavlidou and Papasprides, 2008; Chen and Evans, 2005). First, silica layer develops a negative charge from the oxygen ions along the edge of crystal. Only one of the oxygen's two negative charges is combined with a silicon ion, so at the plane where the crystal ends, there are oxygen ions with one negative charge unsatisfied. But this negative charge is low and not permanent as well as pH dependant; as H^+ can nullify the negative charge (Lee et al., 2008; Lal, 2005). Kaolinite form nonexpansive structure with less external surface area than other clay minerals, and less capacity for holding of water and cations (Miranda-Trevino and Coles, 2003; http://soils.missouri.edu/tutorial/page8.asp#)

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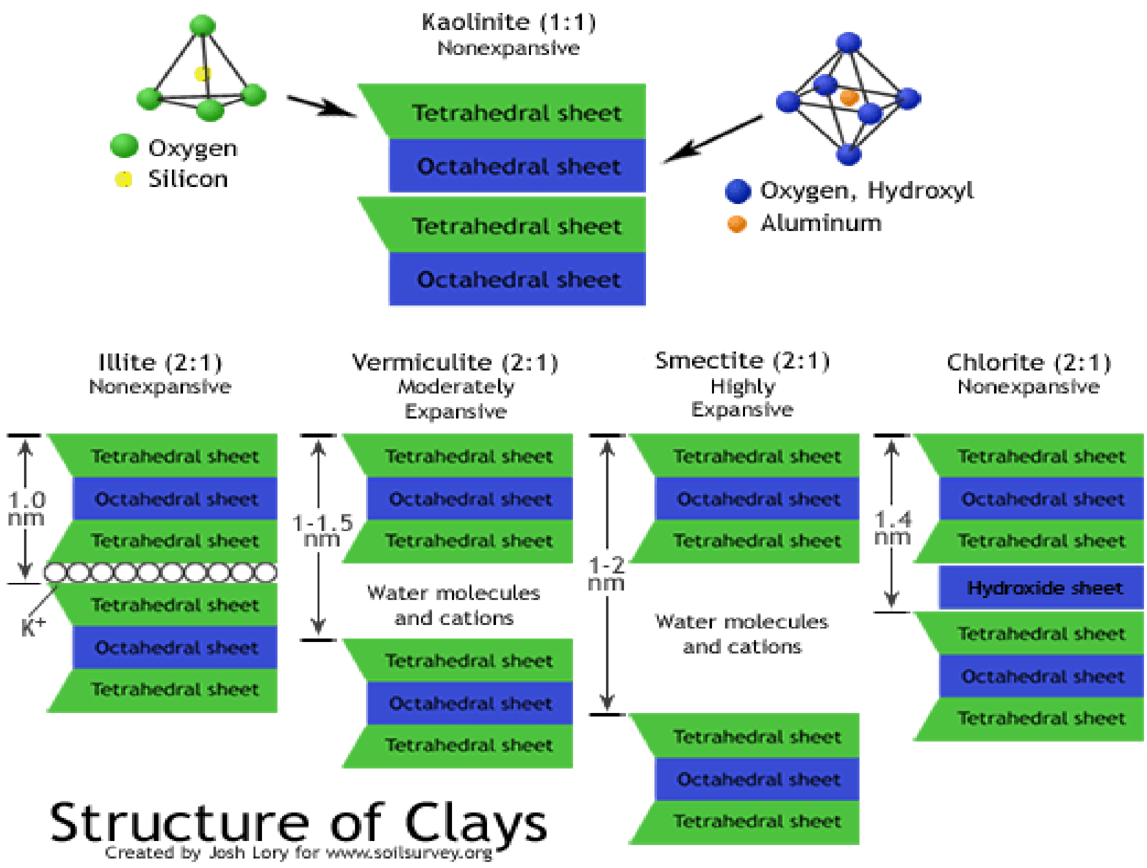

Fig. 2. Structure and arrangement of nano-scale clays.

(Source: http://soils.missouri.edu/tutorial/page8.asp#)

2:1 layered silicates, consisting of two-dimensional layers where a central octahedral sheet of alumina is fused with two external silica tetrahedral sheets by a tip, so that the oxygen ions of the octahedral sheet also belong to the tetrahedral sheets (Pavlidou and Papasprides, 2008). The permanent negative charge arises when one ion is substituted for another during formation of silicate clay. In some clay an aluminium ion (Al^{3+}) is substitutes for silicon ion (Si^{4+}), where as in other clay a magnesium ion (Mg^{2+}) may substitute for Al^{3+} (Sorrentino et al., 2007). These clays are divided into four groups like illite, vermiculite, smectite and chlorite. (Pavlidou and Papasprides, 2008; Lal, 2005).

Illite is non-expanding, clay sized, micaceous mineral in which silicon in tetrahedral sheet is substituted by aluminium. Due to this substitution, negative charge of mineral is balance by potassium cations present in interlayer. However, because of size of potassium ions matches the hexagonal hole created by Si/Al tetrahedral layer, it is able to fit very tightly

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between the layers. The sheets are held together with van der Waals bonds between the basal oxygen of the tetrahedral sheet and the hydroxyl of the octahedral sheet. Layers are held together tightly by hydrogen bonding, which restrict expansion and limits reactive area. e.g. Mica (Lee et al., 2008; Pavlidou and Papasprides, 2008; Lal, 2005).

Vermiculites results from replacement of inter layer K^+ with hydrated exchangeable cations of Illite. Water molecules and exchangeable cations like Mg^{2+}, Fe^{2+} and Ca^{2+} are strongly adsorbed within interlayer space results in limited expansion of basal spacing to 1.5 mm (Lal, 2005).

Smectite generally refers to a group of expandable dioctahedral 2:1 minerals like Montmorillonite, saponite and hectorite etc. Montmorillonite is the most common member of this group, derived its charge from the octahedral substitution of Mg^{2+} and Fe^{2+} for Al^{3+} in alumina layer. In this case the overall negative charge is balanced by hydrated Na^+ and Ca^{2+} of the interlayer. These layers are held together by van der Waals bonds and weak cation-to-oxygen linkages. The presence of hydrated exchangeable cations between layers results in expansion (basal spacing 2 nm) of crystal lattice, when minerals are saturated with water, while under dry conditions, the basal spacing may be reduced to less than 1 nm (Chen and Evans, 2005; Lal, 2005; Wang et al., 2005; Manias et al. 2001).

Chlorites are a group of minerals similar to talc, but with an interlayer hydroxide sheet form 2:1:1 structure. There is water absorption within the interlayer space; thus are considered as nonexpansive e.g. rectorite.

Table 1. Properties of clay mineral groups used in polymer clay nanocomposite.

Characteristic	Kaolinite	Smectite	Illite	Vermiculite	Chlorite
Layer Type*	1:1	2:1	2:1	2:1	2:1:1
Specific Surface area m^2g^{-1}*	10-30	600-800	70-100	550-700	70-100
Shrink/swell potential #	Nonexpans-ive	Highly expansive	Nonexpans-ive	Moderately expansive	nonexpansive
Cation-exchange capacity, meq/100g$	3-15	80-120	10-40	100-150	10-40
Interlayer (d) spacing, nm*	0.7	1-2	1	1-1.5	1.4

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Data obtained from: * (Lal, 2005); # (Harpstead et al., 2005); $ {clay rock (book)}

Although kaolinite, mica, montmorillonite (MMT), hectorite, saporite, rectorite and talc are most commonly used layered silicates in nanocomposite materials, but smectites like Montmorillonite (MMT), hectorite and saporite have received a great attention recently, as a reinforcing materials for polymers owing to their high aspect ratio and unique intercalation/exfoliation characteristics, which are discussed later (Magalhaes and Andrade, 2009; Pavlidou and Papasprides, 2008; Cho and Paul, 2001). The high aspect ratio of layered silicate is ratio of length to the thickness of sheets which plays an important role for enhancement of mechanical and physical properties of composite material. Among the nano-scale clays, MMT is of particular interest and studied widely because of their high specific surface area, high aspect ratio (50-1000) (Wang, N. et al. 2009; Zhao et al., 2009) and plate thickness of 1nm, however the other remaining clays are smaller in size with low specific surface area has tendency to agglomerate rather than to disperse homogeneously in a matrix (Pavlidou and Papasprides, 2008; Rhim and Ng Perry, 2007; Fischer, 2003). MMT is also environmentally friendly, naturally abundant and economic; it has been applied in numerous industrial fields due to its good performance-cost ratio (Chivrac et al., 2008; Cyras et al., 2008; Wang X., et al., 2007; Wan et al., 2003).

MMT is hydrophilic clay contain Na^+ and Ca^{2+} in the interlayer with some water molecules (Cyras et al., 2008; Harpstead et al., 2005; Wang et al., 2005; Manias et al., 2001). In this state silicates are only miscible only with hydrophilic natural biopolymers such as starches and proteins (Pavlidou and Papasprides, 2008). However this hydrophilic nature of MMT surface impedes its homogeneous dispersion in an organic polymers phase. Therefore it is crucial to convert hydrophilic clay into organophilic before reinforcing into organic polymers (Mondragon, 2009; Chiou et al. 205; Zheng et al., 2001).

2. Organic modification of layered silicates

In the interlayer of MMT there exists hydrated exchangeable Na^+ and Ca^{2+}. These alkali counter-ions must be exchange with a cationic-organic surfactant, in order to achieve into organic nature of MMT. Organic modification of layered silicate is having two main objectives are: (1) to expand the interlayer space, allowing large polymer molecules to enter into the clay galleries, and (2) to improve the miscibility of montmorillonite with the polymer

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to achieve a good dispersion of layered structure within the polymer matrix (Mondragon, 2009). As polyhedral oligomeric silsesquioxane (POSS) possesses high thermal stability (>300 ºC), good biocompatibility, and recyclability, as well as nonflammability, it has been used as organic surfactant for MMT in recent years (Zhao et al., 2009; Rhim and Ng Perry, 2007; Sorrentino et al., 2007). Other onium salts such as alkylammonium ions, sulfonium, alkyphosphonium (Naveau et al., 2009) and octadecylamine (Wang et al., 2001) can also be used as organic surfactant (Pavlidou and Papasprides, 2008).

Proportionally, even if a small part of the charge balancing sodium and calcium ions is located on the external crystalline surface, the majority of these exchangeable cations are located inside the galleries. In order to exchange of the onium ions with the cations in the interlayer, water swelling of MMT is needed. But presence of divalent calcium ions prevent swelling of clay in water, so it require exchange procedures with sodium prior to further treatment with onium salt (Pavlidou and Papasprides, 2008; Fischer, 2003). Heating of MMT in hot water at 80ºC with organic surfactant results in, swelling of clay followed by ion exchange reactions. The inorganic, relatively small sodium ions are exchanged against more voluminous organic onium cations results in more d-spacing is shown in fig. 3 (Pavlidou and Papasprides, 2008; Wang et al., 2007; Fischer, 2003). Also the surface properties of each single sheet are changed from being hydrophilic to hydrophobic (Fischer, 2003).

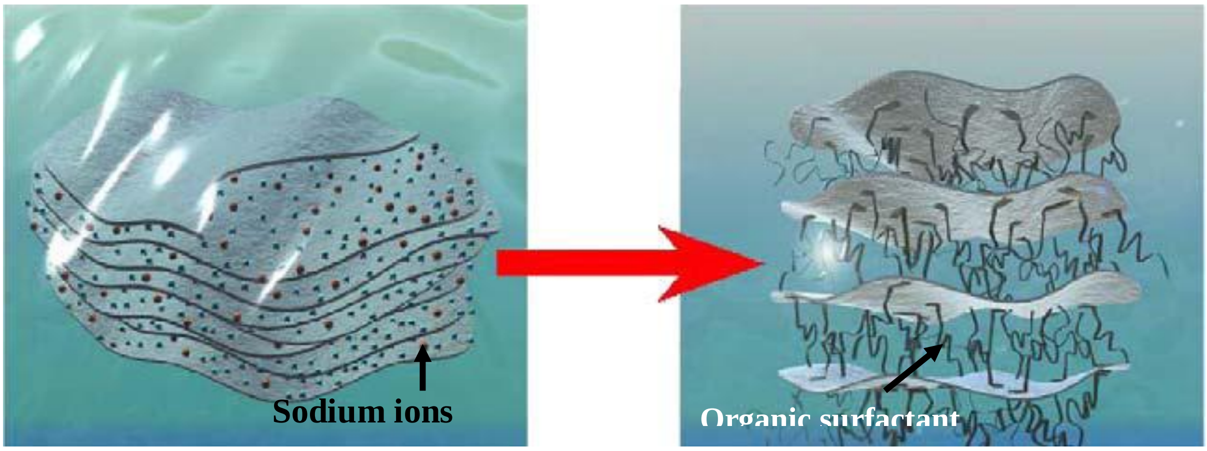

Fig.3. Schematic picture showing organic modification of layered silicate (Fischer, 2003).

The organic modifier plays an important role for producing the nanocomposite (Wang et al., 2009; Rhim and Ng Perry, 2007). The organic cations lower the surface energy of the silicate surface and improve wetting with the polymer matrix depends on length of organic chain of surfactants. Figure 4 shows arrangement of alkyl chain aggregation and basal

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spacing in layered silicate with different chain length. In general, the longer the surfactant chain length, the further apart layers will be forced. Surfactants with positively charged heads are resides negative charged layer surface, leaving the organic tail radiating away from the surface for polymer head (Naveau et al., 2009; Pavlidou and Papasprides, 2008). Depending on the functionality, packaging density and length of the organic modifiers, the organic modified layered silicates may be engineered to optimize their compatibility with a given polymers.

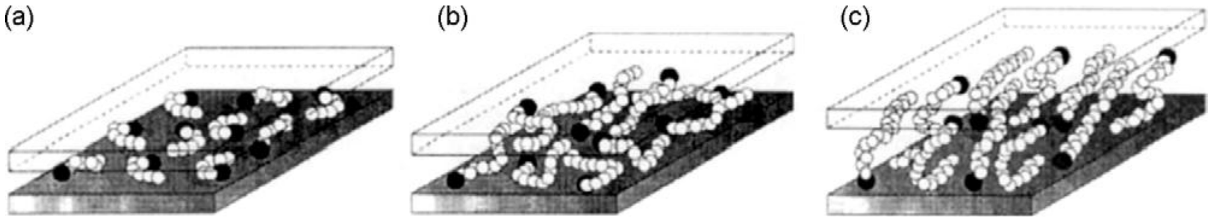

Fig. 4. Arrangement of alkyl chain aggregation and basal spacing in layered silicate with different chain length (....)

3. **Nanocomposite structures**

When organic modified clay mixed with a polymer, three types of composites are commonly obtained as phase separated, intercalated and exfoliated structures (Fig. 5) (Ray and Okamoto, 2003). Formation of particular structure depends on the preparation method and nature of components used, including polymer matrix, layered silicate and organic cation.

In phase separation, the mixture of polymer and organoclays is resemblance to immiscible systems where clay particles are dispersed within the polymer matrix without separation of layers results in micro-scale composite [fig. 5 (a)]. In this system, the poor physical attraction and intercalation of the organic clay and polymers, leads to relatively poor mechanical and barrier properties. Furthermore, particles agglomeration tends to reduce strength and produces weaker material. Here the clay only serves as conventional fillers.

Intercalated structure formed when a single (or sometimes more) extended polymer chain is driven between the clay silicate layers, but the system still remains quite well ordered in a stacked type arrangement (Chivrac et al., 2008). On the other hand, in an exfoliated

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nanocomposite the silicate layers are completely delaminated from each other and are well dispersed. The exfoliated nanocomposites are of great interest because it maximizes the polymer clay interactions making the entire surface of layers available for the polymers. This leads to the most significant changes in mechanical and physical properties than intercalated one. (Chivrac et al., 2008; Beyer, 2002). The complete exfoliation of clay is not easy to achieve, but the majority of polymer nanocomposites were found to have intercalated or mixed intercalated-exfoliated (Cyras et al., 2008).

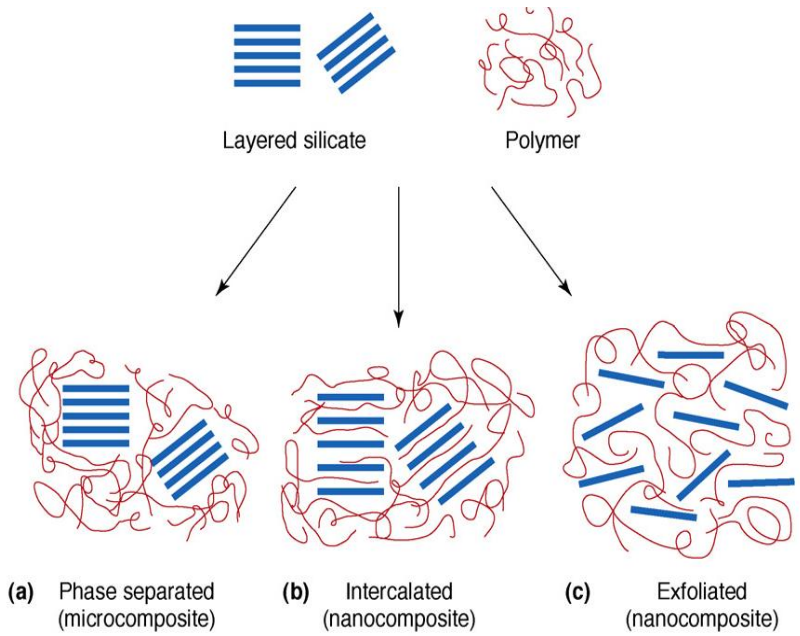

Fig. 5. Different types of composite that can arise from the interaction between layered silicates and polymers. (a) Phase-separated composite (microcomposite). (b) Intercalated composite (nanocomposite). (c) Exfoliated composite (nanocomposite) (Sozer and Kokini, 2009).

Characterisation of Nanocomposite Structure

X-ray diffraction (XRD), Scanning Electron Microscopy (SEM) and Transmission Electron Microscopy (TEM) techniques are widely used for characterization of structure of nanocomposite (Magalhaes and Andrade, 2009; Pavlidou and Papasprides, 2008; Wan et al., 2003). XRD technique is used to probe the structure of phase separated and intercalated nanocomposites and to study the kinetics of polymer melt intercalation due to its ease of use and availability. It is used to determine space between the structural layers of silicate by using

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Bragg's law: sin θ = $n\lambda/2d$, where λ corresponds to the wave length of the X-ray radiation used in the diffraction experiment, *d* the spacing between diffraction lattice planes and θ is the measured diffraction angle or glancing angle (Mondragon, 2009; Ray and Okamto, 2003). While the structure of nanocomposite may be identified by monitoring the position, shape and intensity of reflections of X-ray from distributed silicate layers (Pavlidou and Papasprides, 2008). The intercalation of the polymer chains usually increases the interlayer spacing, in comparison with the spacing of the organoclays used leading to a shift of the diffraction peak towards lower angle values. On the other hand, in exfoliated (delaminated) nanocomposites silicate layers are extensively distributed throughout the matrix, so results in featureless diffraction pattern (Fig. 6). Conversely, SEM and TEM are complementary technique to XRD wherein an image of the dispersion of the silicate within a polymer matrix can be quantified and analyzed (Wang et al., 2009).

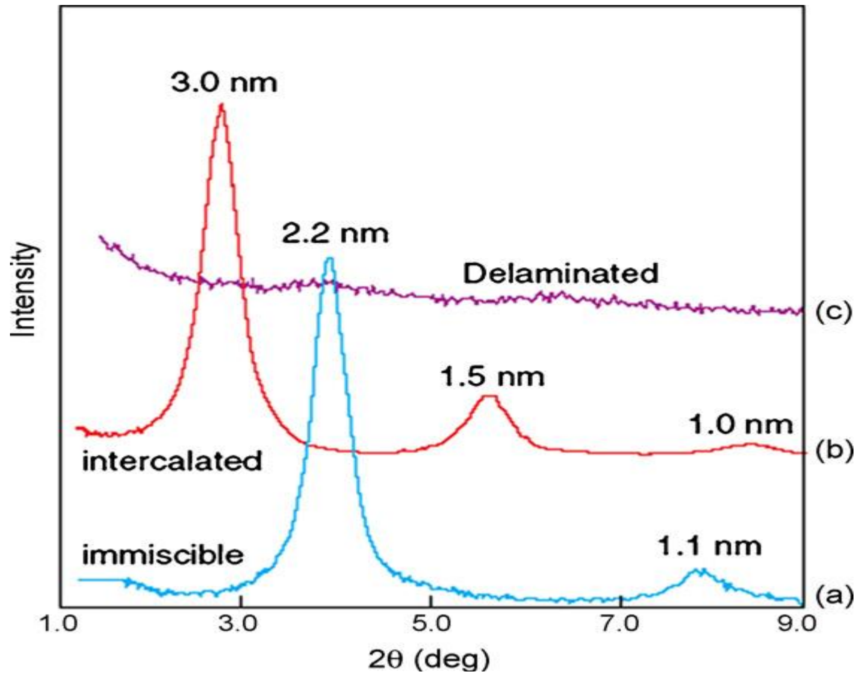

Fig. 6. Typical XRD patterns from polymer/layered silicate: (a) for immiscible (Phase separated) nanocomposite, (b) for intercalated nanocomposite, (c) for delaminated (exfoliated) nanocomposite.

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Preparation of Polymer-layered Silicate Nanocomposite

Various methods have been used for preparation of polymer clay nanocomposite, and their properties have been found out dependent on preparation procedures (Tang et al., 2008; Dean et al., 2007; Sorrentino et al., 2007). At present there are four principle methods of preparation of polymer-layered silicate nanocomposite: (1) template synthesis method, (2) intercalation of polymer from solution, (3) in situ polimerization and (4) polymer melt intercalation.

1. **Template synthesis method**

This technique is widely used for the synthesis of double-layered hydroxide based nanocomposite material. The double-layered hydroxide containing interlayer carbonate, with precursors as metal nitrate and NaOH solution were simultaneously added with continuous stirring to a basic solution of the polymer under nitrogen. Nitrogen is used to create inert atmosphere was essential to prevent preferential intercalation of carbonate in presence of CO_2. During the process, the polymer aids the nucleation and growth of inorganic double-layered hydroxide and polymer get trapped within the layers as they grow (Pavlidou and Papasprides, 2008; Wilson Jr. et al., 1999).

2. **Intercalation of polymer from solution**

In this method, the organically modified layered silicate is exfoliated using a solvent in which the bio-polymers such as starches and proteins are soluble. The layered silicate is first swollen in a solvent such as water, chloroform or toluene. When the biopolymer and solution of swollen layered silicates are mixed, the polymer chains intercalate and displace the solvent within the interlayer of the silicate. Then in final step solvent is removed, either by vapourization, usually under vacuum or by precipitation. After solvent removal the sheets reassemble, sandwiching the polymer to form a nanocomposite structure. The main advantage of this method is that intercalated nanocomposites can be synthesized that are base on polymers with low of even no polarity. However, this method of intercalation is difficult to apply in industry due to use of large quantity of solvents (Zhao et al., 2008; Beyer, 2002).

3. **In situ intercalation polymerization**

In situ intercalation involves the combination of clay and monomer, followed by the polymerization of monomer. First the modified layered silicate is swollen in the liquid or a monomer solution. They enter the interlayer space of the layered silicates followed by

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polymerization. Polymerization reaction can be initiated either by application of heat or radiation, by the diffusion of a suitable initiator, or by an organic initiator or catalyst fixed through cation exchange inside the interlayer before the swelling step by the monomers. Polymerization produces long-chain-polymers within the clay interlayer. Under this condition clay layers are delaminated and form polymer clay nanocomposite. (Pavlidou and Papasprides, 2008; Zhao et al., 2008; Beyer, 2002).

4. **Polymer melt intercalation**

Recently, polymer melt intercalation technique has become the standard method for the preparation of polymer/layered silicate bio-nanocomposites. There are many advantages compared when compared with other method of preparation of nanocomposite. For example, from a waste perspective, the absence of organic solvents makes direct melt intercalation an environmentally sound (Magalhaes and Andrade, 2009). In addition, it is compatible with current industrial processes such as extrusion (Tang et al., 2008) and injection moulding (Wang et al., 2009). It consists of blending of layered silicate with the polymer in the molten state. First the modified layered silicates and polymer mixed, followed by annealing the mixture above the softening point of the polymer. While annealing, the polymer chains crawl into the interlayer space and form a range of nanocomposite with a structure from intercalated to exfoliated (Pavlidou and Papasprides, 2008; Zao et al., 2008).

Polymer Nanocomposite Films:

Wilhelm et al. (2003) prepared nanocomposite films with glycerol-plasticized Cara starch reinforced with Ca^{2+}-hectorite clay by the solution casting method. Clay mineral was filled with 5, 10, 15, 20, and 30% concentration of the plasticized starch. The degree of intercalation was found to be dependent on the clay content in the starch/clay hybrid. XRD spectra revealed the decrease in the interplanar distance with increase in clay content and the increase in d-space was inversely proportional to the amount of clay added. Dynamic mechanical analysis (DMA) results showed that the storage modulus with the starch/clay hybrid films increased considerably at temperatures greater than 25^0C, which is further evidence for the reinforcing effect of clay particles. Tensile test results showed that Young’s modulus for the starch/clay hybrids increased with the clay content, while maximum strain at break decreased. However, a significant reinforcing effect was not observed below 20% clay content in the starch matrix. When the clay content was increased to 30%, Young’s modulus

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for the films increased significantly, being 72% higher than for non-filled films, but the maximum strain at break decreased to 5%. Though resilience of the starch/clay hybrid with 30% clay increased, it seemed to be too brittle for packaging applications.

Avella et al. (2005) prepared potato starch/clay nanocomposite by uniform dispersion of various amount of montmorillonite clay and biodegradable polyester via polymer melt processing techniques. The Magic angle spinning nuclear magnetic resonance (MAS NMR) and SEM used to evaluate dispersion of clay into starch matrix showed intercalated structure for starch/clay samples without biodegradable polyester. They observed that the addition of polyester negatively affect the reinforcing effect of clay particles resulted in decreased Young's modulus and increase in strain at break. They also verifies above prepared materials with actual regulations and European directives for use in food packaging sector owing to their low overall migration limits.

Chen and Evan (2005) prepared three types starch-clay nanocomposite film with hectorite, kaolinete and montmorillonite clay by melt intercalation technique. They observed slightly greater improvement in the mechanical properties for montmorillonite clay.

Cyras *et al.* (2008) prepared glycerol plasticized potato starch/natural montmorillonite nanocomposite films with three concentration (0, 1, 3, 5% w/w of starch) of the clay by polymer melt intercalation to study the effect of nanoclay in the properties of starch. The clay dispersion was analysed by XRD and observed that the clay nanolayers formed an interlayer structure but not complete exfoliation. They also observed the effect of clay addition on thermal resistance, water absorption and tensile properties of the film. The nanocomposite film containing 5 wt% of clay showed maximum improved thermal resistance, hydrophilic character and Young modulus up to 500%.. Addition of clay in the nanocomposite also attributed to the tortuous pathways between the molecules of starch and the MMT influenced the rate of water uptake.

Dean *et. al*. (2008) developed starch/poly vinyl alcohol (PVOH)/montmorillonite micro- and nanocomposite films using extrusion technology. They studied the effect of addition of PVOH and dispersion technique on mechanical performance in starch-montmorillonite nanocomposite film. Forier transform infrared (FTIR) spectra of the thermoplastic starch nanocomposite showed small concentration of PVOH could be directly correlated to changes in intergallery spacing of the clay platelets which resulted in improved

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mechanical properties as result of strong H-bonding between the starch and PVOH. They also used XRD and Transmission electron microscopy (TEM) and concluded that the mechanical properties of film depend on uniform distribution of clay. Uniform dispersion of clay was obtained by the use of ultrasound.

Bae et al. (2009) investigated the effect of clay content, homogenization RPM and pH on mechanical and barrier properties of fish gelatine/natural montmorillonite nanocomposite. They reported improved mechanical and barrier properties for ultrasonically treated nanocomposite film exhibited an exfoliated type structure. While difference in homogenization RPM and pH did not result in substantial changes in properties of film. Addition of 5% nanoclay (w/w) showed maximum tensile strength.

Casariego et al. (2009) prepared the chitosan/clay film by solution intercalation method with varied amount of chitosan (1.0, 1.5 or 2.0%w/v) and clay (in 1 and 3%w/w chitosan). They characterized prepared films in terms of water solubility, water vapour, oxygen and carbon dioxide permeability, optical, mechanical and thermal properties using Instron universal testing machine, differential scanning calorimetry, thermogravimetric analyses and SEM and found improvement in water barrier properties, water solubility and tensile strength with increased concentration of clay. While the values of elongation decreased slightly for high values of chitosan concentration. The value of crystallization temperature (T_m) increased with the increase of chitosan concentration, but no significant changes in T_m were detected with the addition of clay.

Conclusions

Nanocomposites are a new generation of polymers emerging into every aspect of our lives. They show great promise for potential applications as high-performance biodegradable materials, which are entirely new types of materials based on plant, animal, and other natural materials. When disposed of in compost, these are safely decomposed into CO2, water, and humus through the activity of microorganisms. The CO2 and water could become corn or sugar cane again through plant photosynthesis. Many consumer plastic products may be replaced by the natural bio-polymer-based plastics, which may be used for disposal plastic bag, cup, plates, contains and utensils, and others plastic products. These biodegradable plastics can be treated like food waste, which also gets in the plastics stream, so whatever is

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used to handle or separate food waste will be effective for biodegradable plastics. Also most biodegradable plastics will dissolve in warm water. Therefore, biodegradable materials offer a possible alternative to the traditional non-biodegradable polymers, especially in short life-time application and when their recycling is difficult and/or not economical. Thus, there is a considerable interest in replacing some or all of the synthetic plastics by biodegradable materials in many applications. Although these materials have strong future prospects, their present low level of production and high costs restrict them from a wide range of applications. The most important factors to the formation of renewable plastics-based industries include cost reduction of biodegradable polymers, the improvement of mechanical strength and water resistance, as well as public and political acceptance. In order for renewable polymer-based bio-nanocomposites to meet a wide range of applications, bionanocomposite formulation must be further researched and modified so that mechanical and other properties can be easily manipulated, depending on the end-users' requirements. We believe that the next generation of packaging materials will be to fit the requirements of preserving fruit, vegetable, beverage, wine, chocolate, and other foods. By adding appropriate nano-particles, it will be possible to produce packages with stronger mechanical, barrier and thermal performance. To food safety, nano-structured materials will prevent the invasion of bacteria and microorganisms. Embedded nano-sensors in the packaging will alert the consumer if a food has gone bad. To the agriculture, the use of biodegradable materials can promote sustainable and environmentally friendly cultivation and reduce the contamination of the soil and pollution of landscape in rural areas. In all, natural polymer-based film materials originating in controlled bio-nanocomposites pave the way to a much broader range of applications, and open a new dimension for plastics and composites in the future.

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DEVELOPMENT OF FLAVOUR ENRICHED JAGGERY CUBES

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Abstract: Sugar industry is the second largest agro-base industry and contributes significantly to the socio-economic development of the nation. In the present investigation blend of ginger lemongrass oleoresin was taken to provide health benefits with taste to satisfy the consumer need and demand. In the present investigation the different concentration (0.6, 0.8 and 1.0%) of blend of ginger lemongrass oleoresin was used to optimize flavor enriched jaggery cubes. Among all 0.8 % concentration of flavor was selected and evaluated for its antimicrobial studies. The result of antimicrobial studies revealed that the selected concentration of oleoresin enriched sugarcubes are most effective for gram positive bacteria like *Bacillus Substilus* followed by *E.coli* and gram negative bacteria. Storage studies of developed cubes were carried out at different conditions like, storage temperature (20-25˚C, 40-45˚C) and packaging material (HDPE,LDPE). Further bioactive compounds were checked and observed slight degradation in phenolic compounds and antioxidant activity during storage with respect to time. The present study indicated that the development of flavor jaggery cubes will be boon for sugar producer and processing industries.

***IndexTerms* - Jaggery Cubes, Antioxidant Activity, Total Phenolic Content, Ginger lemongrass flavour**

I. INTRODUCTION

Sugar industry is plays a leading role in global market after Brazil, produces nearly 15 and 25 per cent of sugar and sugarcane respectively. Worldwide India produces more than 70% sugarcane, out of which 53% is processed into white sugar, 36% processed into jaggery and khandsari, 3% for chewing as cane juice, and 8% as seed cane to full fill the need as a sweeteners. Sugar industries are providing livelihood to more than 50 million farmers and their families. Therefore sugar cane industries are economic backbone of the nation (Kshirsagar, 2012).

As mention above, sugar cane is processed into many products, among them jaggery is a natural sweetener made by the concentrating a sugarcane juice to a certain level. It is a rich source of iron and therefore consumption increases the level of hemoglobin in the blood. Along with iron, jaggery is a prominent source of minerals and vitamins. Therefore jaggery is the healthiest sugar in the world (Kshirsagar, 2012). Due to its high nutritional value jaggery industries occupy a prominent place in the sugar economy and it consumes 20.36% of the total sugarcane grown in India. To develop light colored jaggery, herbal clarificant (deola extract @ 45 g/100 kg juice) is use to eliminate impurities from colloidal suspension and coloring compound from accumulation process. The structure of jaggery is more complex than sugar, and made up from longer chains of sucrose. Jaggery digest slowly as compare to sugar and it releases energy gradually to keeps body energetic for longer time. Therefore utilization of jaggery in any product will be achievement for processing industries.

Flavoured sugar cubes like orange, blossom, rosewater, lemon and cardamom are available in the market, can be used in the beverages to sweeten the drinks but does not provide health benefits and appealing taste to the consumer. Scanty of literature is available on the utilization of herbs and spices for preparation of flavoured cubes. Similarlly no reports are available on the utilization of jaggery, hence scientists are looking for innovation. Consumers are also in quest of natural foods and natural preservatives for healthier lifestyles and natural ways of preventing ailments. Indian herbs posses multifarious properties and provide tons of health benefits if you consume. The hypothesis behind this work was to prepare flavoured jaggery cubes for beverages like tea and coffee, as they are most favourite beverage and fulfill the thirst quenching properties of the consumer. It can be instant energy source for hot (tea and coffee) and cold (Ice tea) beverages. This product will be boon to the processing industry. Ginger and lemongrass are the important tea ingredients posseses huge benefits to the consumer.

Ginger (*Zingiber officinale* Rosco), member of *Zingiberaceae*, it has been used for over 2000 years (Stoilova *et al.* 2007; Hasan *et al.* 2012). The distinct yellow, pungent, aromatic rhizome is the plant's organ that confers its value to the spice and the source of oleoresin and the essential oil. The chemical studied of ginger found that it has over 400 different constituents. The major pungent compounds from thelipophilic rhizome extract have yielded potentially active gingerols, which can be converted to shogaols, zingerone and paradol. Gingerols known as phenolic ketones can be converted to shogaols, zingerone, and paradol (Rahmani *et al.* 2014) which produce the "hot" sensation in the mouth (Aly *et al.* 2013). The important compounds are carbohydrates (50–70%), lipids (3–8%), phenolic acids, and terpenes in ginger rhizomes **(**Mele, 2019). Gingerol is responsible for its characteristic aroma and taste.

Lemongrass is known as *Cymbopogon citratus* belongs to the family *Poaceae*, contains several important bioactive compounds which are useful in many health diseases. Essential oil is one of the important components of lemon grass extracts and its applications include co-ingredients for perfumes and cosmetics. Lemongrass oil has been found to contain up to 75-85% citral, borneol, estragole, methyl eugenol, geranyl acetate (3,7-dimethyl-2,6-octadiene-1-ol acetate), geraniol (some species higher in this compound than citral) (Anggraeni *et al.* 2017). The different compound in lemongrass possesses various pharmacological activities such as anti-amoebic, anti-bacterial, anti-diarrheal, anti-fungal and anti-inflammatory properties (Hasim *et al.* 2015).

As discussed, ginger and lemongrass are having tons of health benefiting properties. Hence small attempt was taken to provide health benefits with taste to satisfy the consumer need and demand. Tea without ginger and lemongrass can't imagine. Therefore the development of flavor cubes using blend of ginger and lemongrass oleoresin will be the good idea to prepare instant product.

II. MATERIAL AND METHODOLOGY:

2.1. Raw Materials

Organic jaggery was procured as per the requirement of product characteristics from the local market of loni kalbhor. The **b**lend of ginger-lemongrass oleoresin was purchased from International flavor and fragrances (IFF) India pvt.ltd, Chennai.

2.2 Packaging material

Low density polyethylene and high density polyethylene bags were selected to stored flavoured cubes during storage. Packaging material was purchased from local market of Pune.

2.3 Chemicals

Analytical grade chemicals i.e sodium bicarbonate ($Na_2CO_{3)}$, Sodium hydroxide (NAOH), Hexane, Folin-Ciocalteu reagent (Sigma-Aldrich pvt.ltd, Pune), DPPH (2,2-diphenyl-1-picrylhydrazyl) (Sigma – Aldrich pvt.ltd,) reagent was purchase from marshal Laboratories Private Limited, pune.

2.4 Strains of microorganisms

To check the antimicrobial activity of samples most common gram positive and gram negative strains like *Bacillus cereus (B. cereus)*, *Escherichia coli (E. coli)* and fungal strain *Aspergillus Niger (A.niger)*, were obtained from microbiology lab of MIT College of Food Technology, Pune.

2.5 Chemical analysis

2.5.1 Total phenolic content

Total phenolic contents of all sample extracts were determined using Folin-Ciocalteu reagent as described by Singlaton and Rossi (1965) with slight modification. Extracted 100 µl samples were inserted into different test tube and mixed thoroughly into 900 µl Folin-Ciocalteu reagent (Pre-dilute with distilled water, 10 times) and makeup the volume up to 5 ml with water. After 5 mins, 750 µl of NA_2CO_3 of 7.5% sodium carbonate (NA_2CO_3) was added and allowed to react for 90 min at room temperature (20-25˚C). The absorbance was measure at 765 nm using spectrophotometers. Standard curve of gallic acid solution (20, 40, 60, 80, 100 and 120µl) was prepared using the similar procedure. Total phenolic contents were expressed as mg gallic acid equivalents (GAE)/g of crude extract from the gallic acid calibration curve using the equation y=0.0012x-0.007 (R^2=0.995). All samples were analyzed in triplicate.

2.5.2 Antioxidant analysis

Free radical scavenging activity of sample was determined by 2,2-Diphenyl-1-picrylhydrazil radical (DPPH) and expressed % radical scavenging activity. DPPH solution (1 mg/ml) was made by dissolving DPPH in methanol. DPPH solution (100 µl) was diluted to 5 ml and absorbance was taken at 517 in UV-Spectrophotometer. Five different concentrations (0, 20, 40, 60, 80, 100**µl**) of ascorbic acid were taken and plotted standard curve against absorbance. The extract (100µl) was made by dissolving required oleoresin in methanol then it was added with 100µl of 1mg/ml of DPPH solution and was incubated at room temperature for 30 min. The absorbance of extract was measured at 517 nm in UV spectrophotometer. Following formula was used to calculate the antioxidant activity (Rongshan *et al.*, 2012).

$$\frac{(A\ blank - A\ sample)}{A\ blank} \times 100 = \%\ DPPH\ scavenging\ activity$$

A blank represents the absorbance of the control reaction (containing all reagents except the tested compound) and A sample represents the absorbance of the tested compound. Ascorbic acid is used as a standard for antioxidant activity and results were expressed as % inhibition. The regression equation for this is y=0.392x+4.339 (R^2=0.999), all experiments were carried out in triplicate.

2.6 Antimicrobial studies

2.6.1 Antibacterial activity

The antibacterial activity of essential oil was determined using disc diffusion method as described by Bellik, (2014) with slight modification. Bacterial inocula was prepared in 10 mL of Müller-Hinton broth (Bioxon) and incubated at 37˚C for 24 hr. The inoculums were adjusted with sterile saline to obtain turbidity of the McFarland standard No. 0.5 (10^8 cfu/mL). Bacterial inocula were planted on Muller-Hinton agar plates, filter paper disc (5 mm diameter) impregnated with 100 µL of essential oil was placed on the plate. The plates were incubated at 37˚C for 24h. The inhibition zones were reported in mm. Three concentration of oleoresin (0.6, 0.8 and 1.0%) was used for this study.

2.6.2 Antifungal activity

The antifungal activity of essential oil was determined using disc diffusion method as described by Bellik, 2014 with slight modification. Fungal inocula were prepared in 10 mL of Müller-Hinton broth (Bioxon) and incubated at 37˚C for 24 hr. The inoculums were adjusted with sterile saline to obtain turbidity of the McFarland standard No. 0.5 (10^8 cfu/mL). Fungal inocula were planted on potato dextrose agar plates. On the surface of potato dextrose agar, impregnated (100 µl) filter paper discs (5 mm diameter) was placed.

The plates were incubated at 28˚C for 48 hr and the zone of inhibition was calculated, reported in mm. Three different concentration of oleoresin (0.6, 0.8 and 1.0%) were prepared in triplicate.

2.7 Formulation and optimization of product

After all prelimary analysis of oleoresign, three different concentration were selected initially to check the acceptability of concentration within the product. Further the cubes were analyzed for sensory evaluation and finalize the acceptable concentration of the raw ingredient.

Table 2.1 Formulation of flavor jaggery cubes

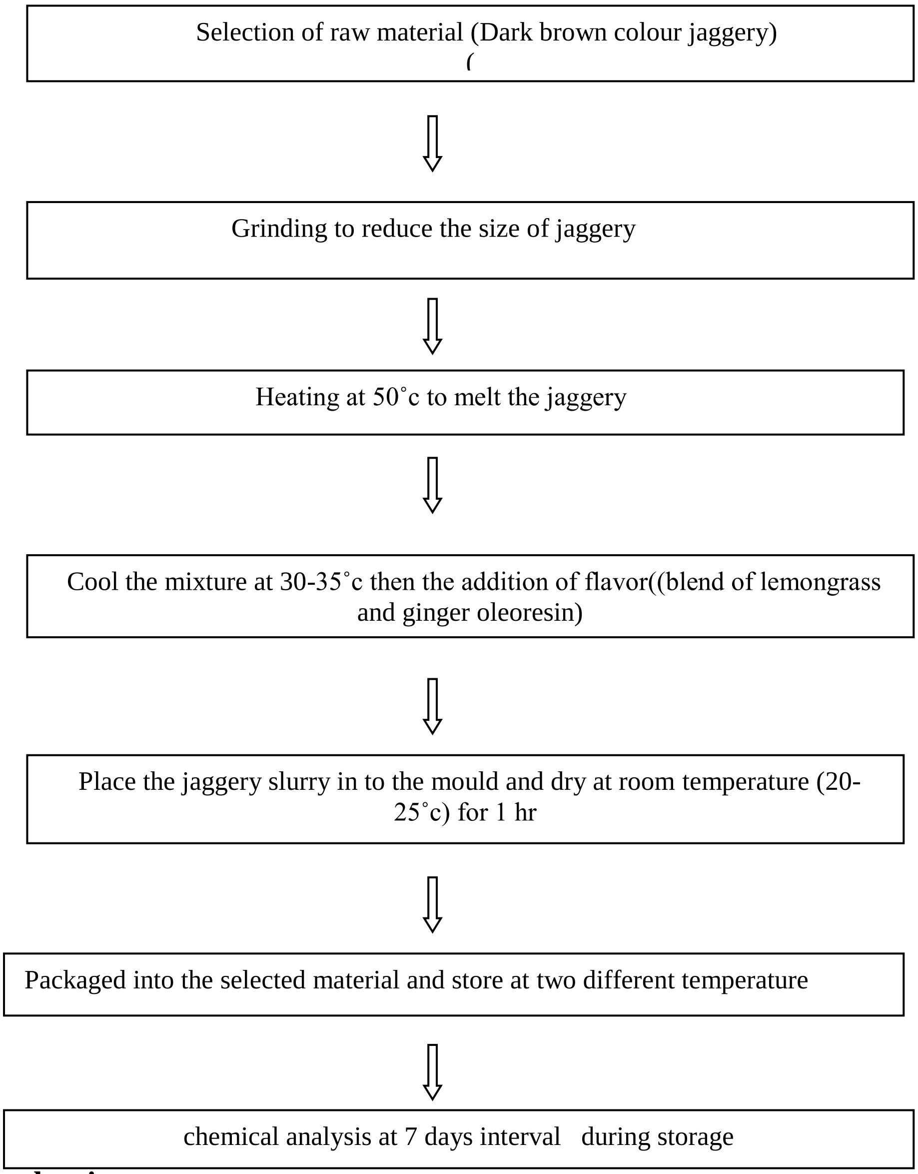
Ingredients	Control	J1	J2	J3
Jaggery (gm)	50	50	50	50
Oleoresin (BGL)(ml)	-	0.3	0.4	0.5

J0- Control

J1- Experimental sample (Jaggery 50 gm + oleoresin 0.3 ml)

J2- Experimental sample (Jaggery 50gm + oleoresin 0.4 ml)

J3- Experimental sample (Jaggery 50gm +oleoresin 0.5 ml)



2.8 Sensory evaluation

Sensory evaluation of flavor enriched jaggery cube was done by panel of semi trained judges on 9 point hedonic scale.

2.9 Storage study of flavor jaggery cubes

Optimized flavor sugar cubes was packed in two different packaging material [LDPE (low density polyethylene) and HDPE (high density polyethylene)] stored at two different temperature [(20-25˚) and elevated temperature (40-45˚)] to analyze the effect of external conditions on the samples. During storage, samples were analyzed for its bioactivity after every 7 days.

2.11 Statistical analysis:

Critical difference (CD) at 5% level of significance was recorded for comparison.

Result and conclusion

3.1 Formulation for flavor jaggery cubes by using blend of ginger and lemongrass oleoresin (BGL)

The study was carried out to optimize the concentration of BGL oleoresin for the better acceptability of the product. For this study different concentration of BGL were taken and analyzed for sensory evaluation. Semi trained panel of 10 members was developed for the study. The calculated results of obtained samples were reported in fig 3.1 According to the all panelists, sample J2 was selected because it has given the good taste and mouth feel to the product. From this study we can observed that 0.8 % concentration of J2 sample is acceptable, beyond this concentration (0.8%) strong flavour and mouth feel were observed which is not accepted by the panel. As mentioned above the reports of lemongrass oleoresin suggests that the high concentration of oleoresin provide strong aroma and taste due to the presence of aromatic compound i.e. citral (Baratta *et al*. 1998*;* Kasali *et al*. 2001; Nur Ain *et al*. 2011). Similarly, GO also contains bioactive compound which are responsible for taste and flavour . As a result, at highest concentration response of panelist has declined.

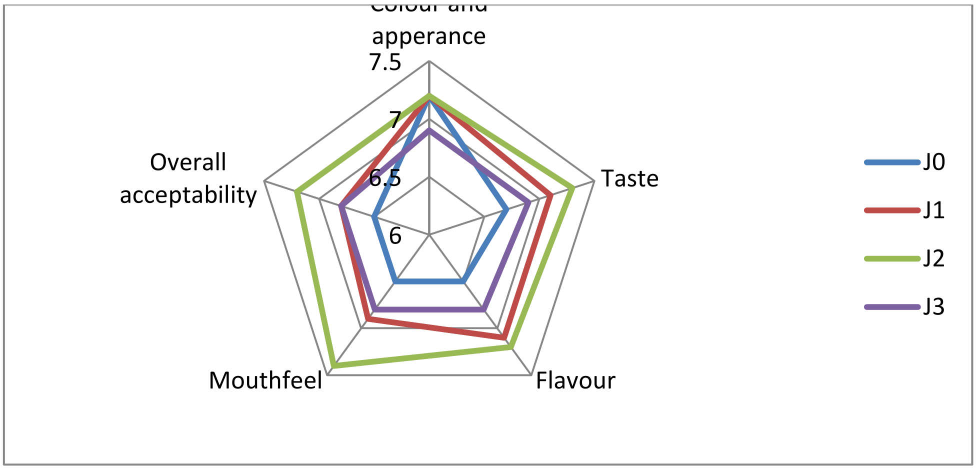


Fig 3.1 Organoleptic evaluation of BGL Jaggery cube

J0- Control

J1- Experimental sample (Jaggery 50 gm + oleoresin 0.3 ml)

J2- Experimental sample (Jaggery 50gm + oleoresin 0.4 ml)

J3- Experimental sample (Jaggery 50gm +oleoresin 0.5 ml)

3.2 Biochemical analysis of raw and finished product

Biochemical analysis of raw material (BGL oleoresin), BGL jaggery cube was carried out and presented in table3.1. The total phenolic content in BGL is 143.55mg/GAE/100gm, BGL jaggery cube is 104.23 mg /GAE/100 gm. Obtained results of oleoresin phenolic content are in agreement with Briones *et.al* (2014), Bellik et.al (2013) and Murad *et.al* (2011). The small change is due to the seasonal conditions and extraction procedures used for the experiment.

Antioxidant activity of samples was studied to check the efficacy of product against oxidation during storage. Scavenging activity of BGL oleoresin at optimized concentration (0.8%) is 50.72%,BGL jaggery cube is 39.41 %. Obtained results are in agreement with Elizabeth (2013) and Briones *et al*. (2015). The small change in antioxidant activity may be due to the presence of various types of compounds in them. Silva et al. (2000) also reported significant scavenging effects of phenolic compounds against the DPPH free radical. Hence, the presence of phenolic compounds such as eugenol, shogaols, zingerone, gingerdiols, gingerols in ginger oil responsible for their antioxidant properties. The solubility index of BGL jaggery cube was recorded as 1 min 30 sec.

Parameter	**BGL**	**BGL Jaggery cube**
Total phenolic content (mg/GAE/ 100gm)	143.55±0.17	104.23±0.12
Antioxidant activity (%)	50.72±0.24	39.41±0.11
Solubility index	-	1 min 30 sec

Values are represented as mean ± SD of three determinants

3.3 Antimicrobial activity of experimental samples

Three different concentrations of BGL were taken against gram positive and gram negative samples. BGL showed best activity against *B. Substilis* with increase in concentration. Maximum zone of inhibition were observed at higher concentration i.e. 1.0% ml followed by 0.8% and 0.6% ml shown in table 3.2 Therefore prepared BGL jaggery cube was analyzed at its optimized concentration (0.8%) and zone of respective samples was 7mm. Also the gram negative bacteria i.e. *E.Coli* was also shown activity with increase in concentration of BGL. The maximum zone of inhibition against *E.coli* was observed at higher concentration i.e 1.0% ml followed by 0.8% and 0.6% ml. As mentioned above jaggery cube was analyzed as its optimum concentration (0.8%) and it was 5mm. It can be seen that with increase in concentration of oleoresin antimicrobial activity increases while taste of product is decreases in terms on bitterness and provide burning sensation in throght. This may be due to the presence of phenolic compound i.e. **shogaols, zingerone and paradol** which are responsible for its activity. Antifungal activity of *A. niger* was found to be completely resistant towards the tested samples i.e oleoresin and BGL Jaggery cube. Obtained results are in agreement with Singh *et al.* (2008) and Bellik (2014). The antimicrobial activity of essential oils and oleoresins from spices and herbs is believed to be due to the phenolic compounds present in the oleoresin.

Table 3.2 Antimicrobial activity of raw and developed flavoured cubes

Microorganism	Zone of inhibition (mm) Oleoresin concentration			Flavour jaggery cube (0.4 ml)
	0.3 ml	0.4 ml	0.5 ml	
Bacteria				
B.substilis	7	10	12	7
E.Coli	6	8	10	5

3.4 Storage study of flavoured BGL jaggery cubes

Storage study of the developed samples was carried out at different factors to check the shelf life of the product at different storage condition. For this study two different storage temperatures [room temperature (20-25˚C) and elevated temperature (40-45˚C)] and two different packaging material (HDPE, LDPE) selected as a dependent variables for the responses. Sample were kept for 42 days and analyzed for its chemical activity

3.5 Chemical analysis of product

3.5.1 Effect of storage temperatures and Packaging material on phenolic content

The degradation curve is shown in graph fig 3.2, fig 3.3, fig 3.4 and fig 3.5 respectively The slight decrease in total phenolic content of BGL jaggery cubes was observed in both of temperature and packaging material during storage but the rate of degradation is less as compared to control This may be due to the oxidation of phenolic compounds and the stability of the compounds can be influence by the external factors like exposure to light, air, or different storage temperatures. Plant bioactive compounds are highly sensitive to the said factors as reported by **Moldovan *et.al* (2016).** Another logical reason behind this is volatility of oleoresin during storage which we have added into the sample. They are correlated with its activity as well.

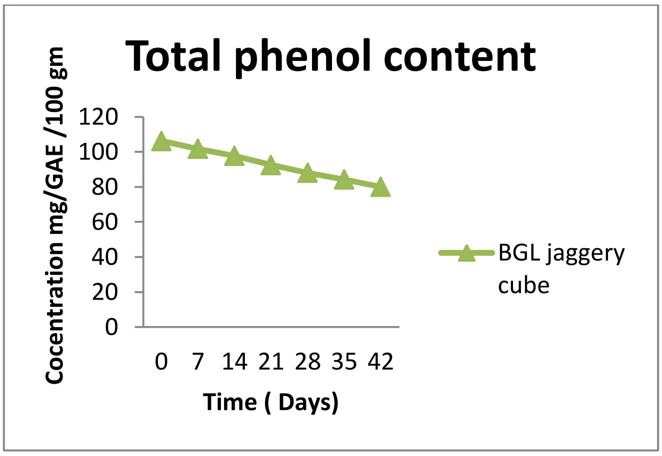


Fig 3.2 Effect of 20-25˚C temperature with HDPE packaging material on phenolic compounds

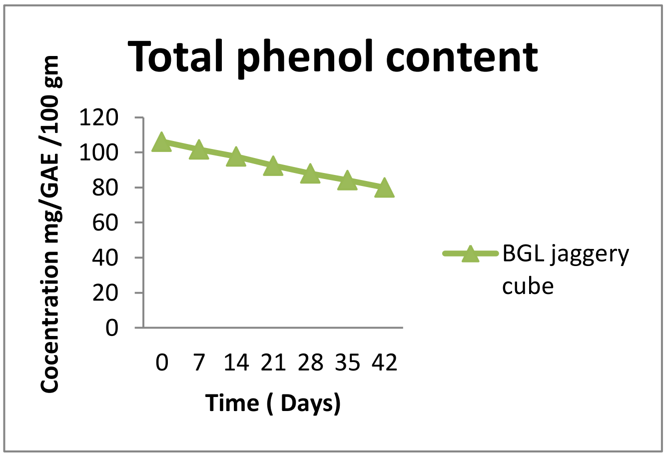
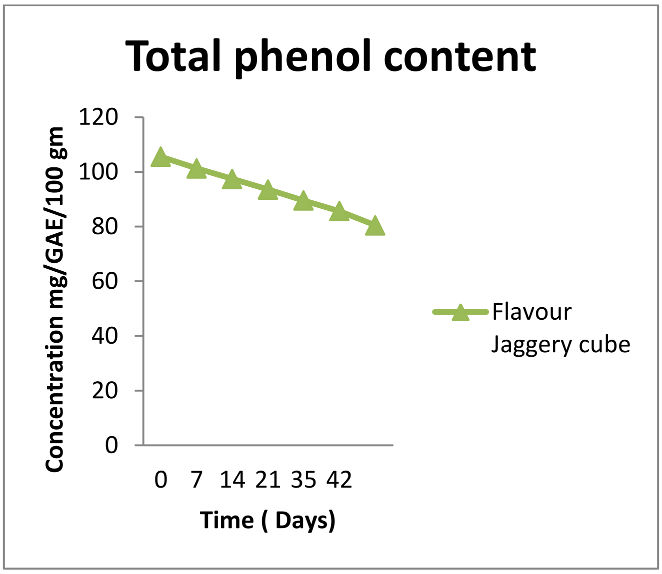


Fig 3.3 Effect of 20-25˚C temperature with LDPE packaging material on phenolic compound



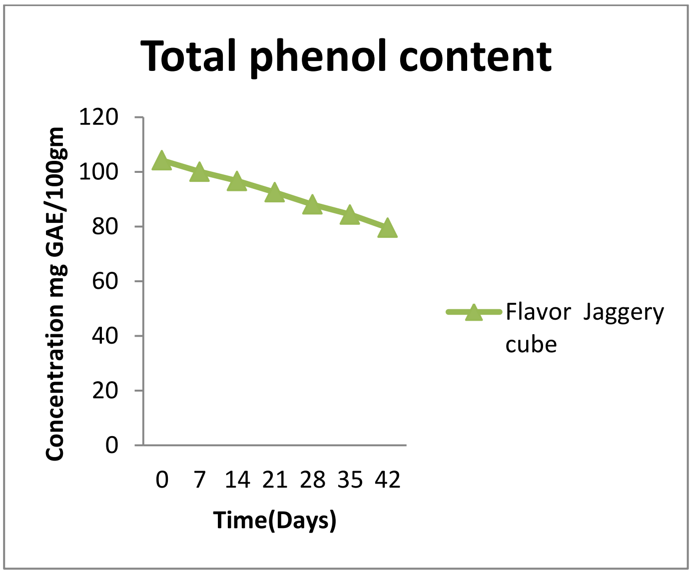
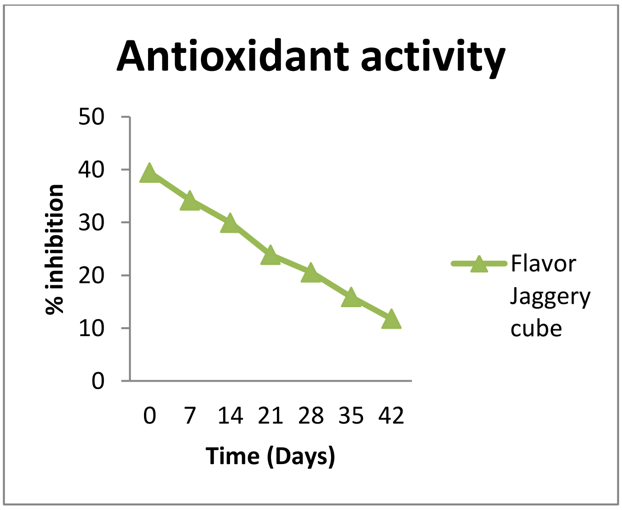


Fig 3.4 Effect of 40-45˚C with HDPE packaging packaging material on material on phenolic compound compound

Fig 3.5 Effect of 40-45˚C with LDPE phenolic

3.5.1 Effect of storage temperatures and Packaging material on antioxidant content

The changes were observed in antioxidant activity are reported in fig 3.6, fig 3.7, fig 3.8 and fig 3.9. it is observed that antioxidant activity of blended flavor jaggery cube was decreased with increase in time. Degradation rate of both the samples can be observe from the graph that slight degradation in antioxidant activity of BGL jaggery cubes was observed in both the packaging material during storage. As per the literature review, total phenolic content and antioxidant activity possesses positive correlation between each other. Degradation in antioxidant activity was observed due to the change in phenolic content with respective to the temperature.



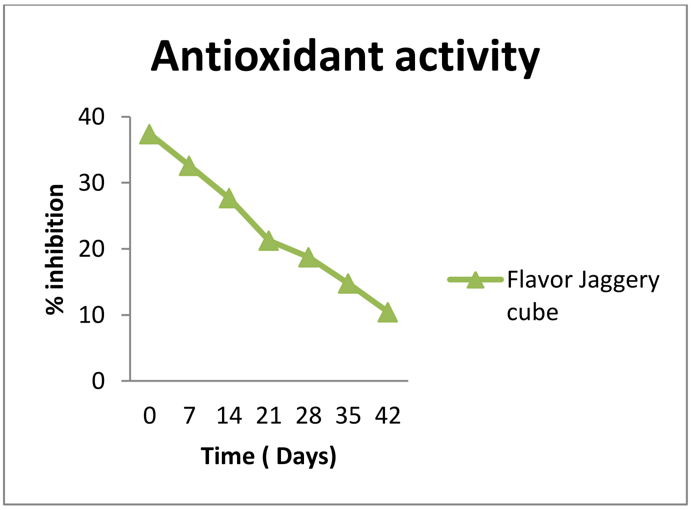


Fig 3.6 Effect of 20-25˚C temperature with HDPE with LDPE packaging material on antioxidant activity antioxidant activity

Fig 3.7 Effect of 20-25˚C temperature packaging material on

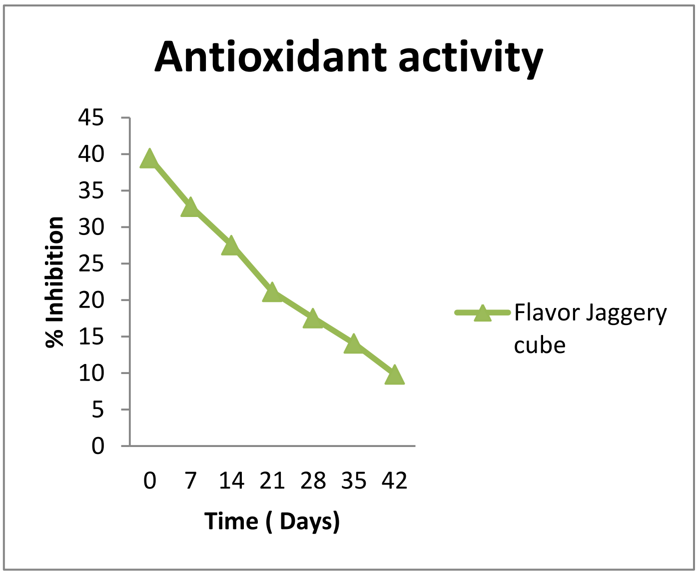


Fig 3.8 Effect of 40-45˚C temperature with HDPE packaging material on antioxidant activity

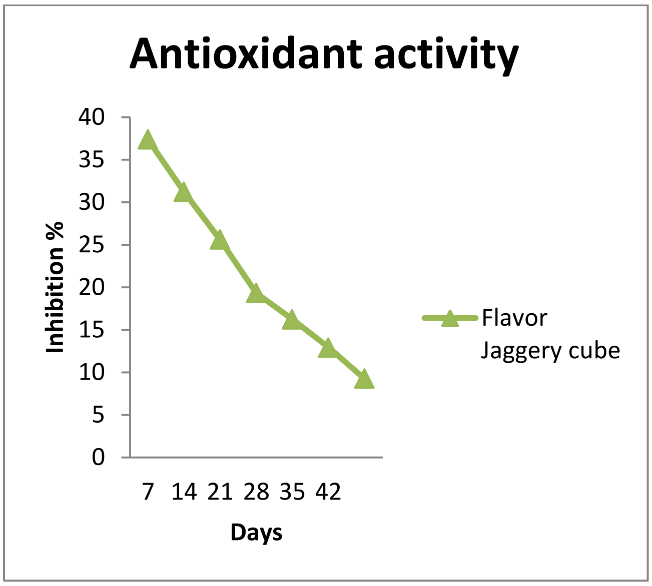


Fig 3.9 Effect of 40-45˚C temperature with LDPE packaging material on antioxidant activity

3.5.3 Effect of storage temperatures and Packaging material on moisture content

Effect of temperatures and packaging material on moisture content of BGL jaggery cubes was presented in figure 3.10,3.11,3.12 and 3.13. As evident from storage study, it can be seen that slight degradation in moisture content was observed at 0^{th} and 42 days respectively for both of temperature and packaging material This may due to the change in environmental conditions.

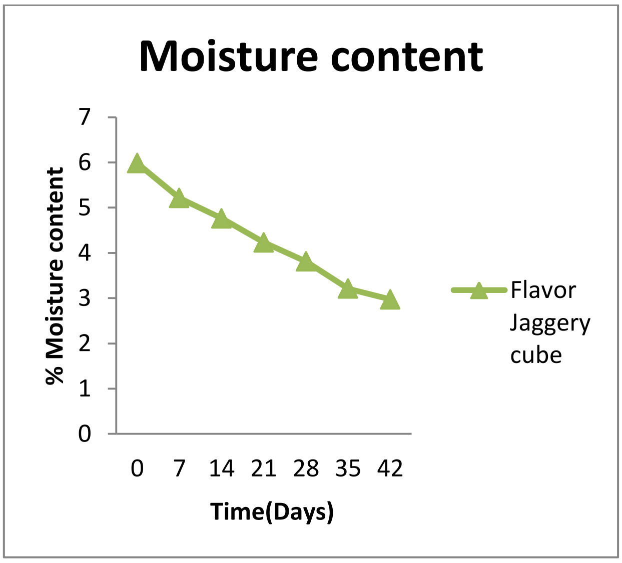


Fig 3.10 Effect of 20-25˚C temperature with HDPE packaging material on moisture content

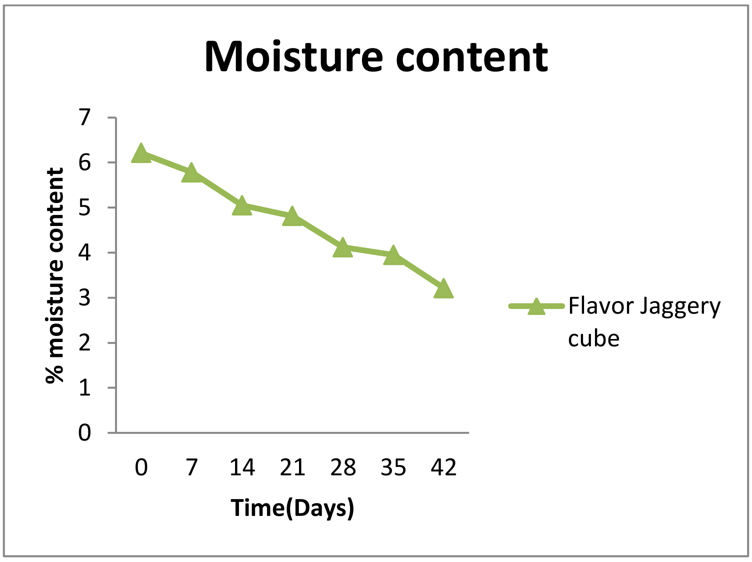
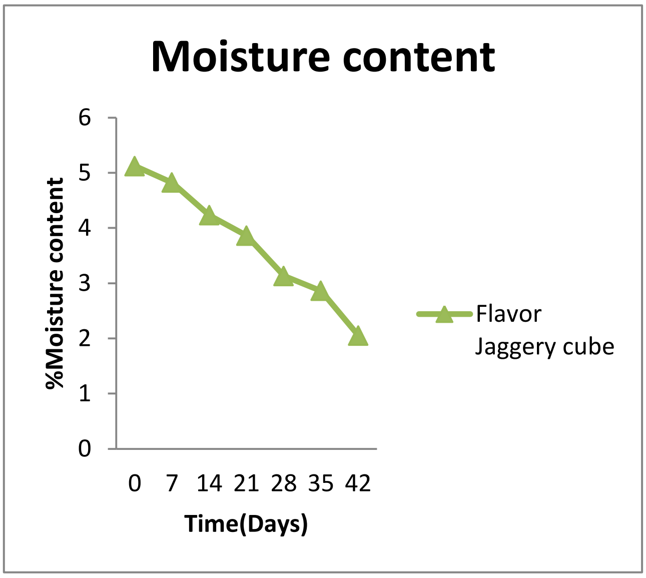


Fig 3.11 Effect of 20-25˚C temperature with LDPE packaging material on moisture content



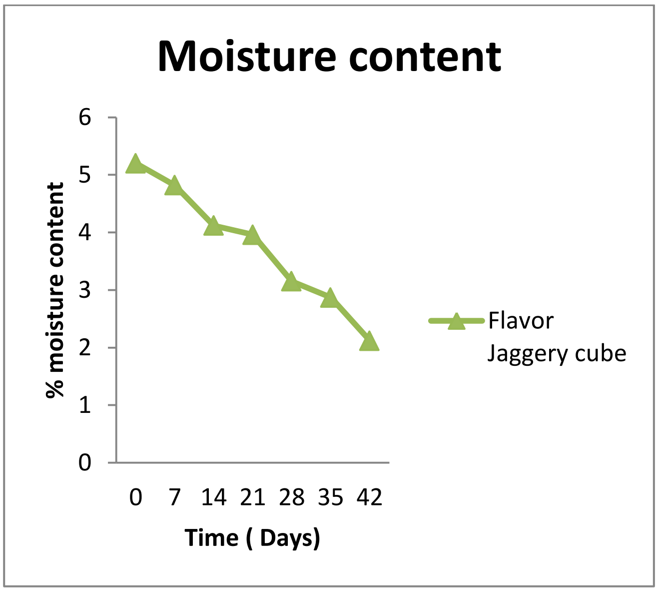


Fig 3.12 Effect of 40-45˚C temperature with HDPE packaging material on moisture content

Fig 3.13 Effect of 40-45˚C temperature with LDPE packaging material on moisture content

SUMMARY AND CONCLUSION

The present investigation was carried out on "Development of flavour enriched jaggery cubes" as a source of instant energy to the beverages instead of sugar. The different concentration (0.6,0.8 and 1.0%) of raw material like blend of ginger lemongrass oleoresin was used for the flavor jaggery cube and as per the sensory evaluation score, 0.8% concentration of sample was selected for further antimicrobial and chemical studies. BGL and BGL jaggery cubes shows highest antimicrobial activity against *B. substilis* followed *E.coli* at optimized concentration (0.8%). During storage, bioactive compounds of flavor jaggery cubes and its antioxidant activity decreased slightly with respect to temperature and storage time.

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Development of health drink by blending of fruit and vegetables

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Abstract: India is the largest producer of fruits and vegetable but the processing and utilization rate of it is very less. Apart from this fruits and vegetables are recognized as one of the cornerstone of the healthy diet and contain benefiting component which provides essential nutrition for promoting and maintaining healthy life. Therefore the investigation focused on the blending of different ingredient for development of health drink to increase its utilization. Screening of ingredients was done on the basis of taste and nutritional parameters. Bioactivity of selected ingredients like beetroot, *moringa* leaves and pineapple were evaluated and optimize the concentration ratio (25:15:60) of ingredient on the basis of sensory parameters. Further the behavior of developed drink were studied at 28 ± 2°C and 4 ± 2°C temperatures with different preservatives and found that drink can be stored satisfactorily for a period of 10 weeks at refrigeration temperature (4 ± 2°C) and 6 weeks at (28 ± 2°C) with addition of sodium benzoate. Developed drink will open newer vistas to food processing industries and producers.

Keywords: Antioxidant, Bioactivity, Health Drink, Pineapple, Beetroot and Moringa leaves

INTRODUCTION

India is the world's largest producer of many fresh fruits and vegetables. India's vast geographical area coupled with varied climate conditions facilitates to grow a variety of fruits and vegetables. India produced around 81.285 MT fruits and 162.187 MTs of vegetables which accounts for nearly 14.0% of country's share in the world production of vegetables (Rais and Sheoran, 2015). Although It has been found that 30 – 40 percent of fruits and vegetables are wasted due to post harvest losses. Waste percentages in each step of the food supply chain in India which is the cause of low availability of fruits and vegetables for consumers and the need for import of them in spite of India being second largest producer. India, the world's second largest fruit and vegetable producer encounters a waste of close to 25% worth of produce (Rais and Sheoran, 2015).

The beetroot (*Beta vulgaris*) is the taproot portion of the beet plant, also known as the table beet, garden beet, red or golden beet or informally simply as the beet. In recent years increased attention has been focused on utilization of healthy foods. The beetroot (*Beta vulgaris*) being an alkaline food with pH from 7.5 to 8.0 has been acclaimed for its health benefits, in particular for its disease fighting antioxidant potential, significant amount of vitamin C and vitamins B1, B2, niacin, B6, B12 and excellent source of vitamin A . The claimed therapeutic use of beetroot includes its antitumor, carminative, emmenagogue and hemostatic and renal protective properties and is a potential herb used in cardiovascular conditions . Beetroot is known to be a powerful antioxidant. Consumption of natural produce beetroot juice which is rich in antioxidant compounds may help to redress the balance between RONS production and endogenous protection when the body is under oxidative stress. Beetroot is an excellent source of folate and a good source of manganese. Betaine has several noted effects related to human health and function, including acting as an osmolyte (protecting cells against dehydration), as an antioxidant agent (protecting cells against free radicals), as a methyl group donor (lowering potentially harmful levels of homocysteine), and as a vascular protectant . (Dambalkar V. S. *et al*.,2013).

Pineapple is one of the most popular tropical fruit that is well known for its juicy sweet taste. This fruit is rich in nutrition and contains high amount of vitamins, minerals, fibers and enzymes. Pineapples are a good source of vitamin-C and free from cholesterol. This healthy nutritious fruit can be eaten raw as well as can be used in preparing various tasty recipes. The sodium content of the fruit is also very low. The micro nutrients content of this fruit helps to protect us from many diseases like cancer, stroke and other heart problems. Pineapple juice also helps to kill intestinal worms and helps to relieve intestinal disorders. The chemicals that this fruit contain stimulate the kidneys and aids in removing toxic elements in the body (Petronella.2011).

Moringa oleifera belonging to the family of *Moringa*ceae is an effective remedy for malnutrition. Every part of *Moringa oleifera* is a store house of important nutrients and antinutrients. The leaves of *Moringa Oleifera* are rich in minerals like calcium, potassium, zinc, magnesium, iron and copper. Vitamins like beta-carotene of vitamin A, vitamin B such as folic acid,pyridoxine and nicotinic acid, vitamin C, D and E; are present. In fact, *moringa* is said to provide 7 times more vitamin C than oranges, 10 times more vitamin A than carrots, 17 times more calcium than milk, 9 times more protein than yoghurt, 15 times more potassium than bananas and 25 times more iron than spinach. *Moringa* is rich in phytosterols like stigmasterol, sitosterol and kampesterol which are precursors for hormones. The phytochemicals such as tannins, sterols, terpenoids, flavonoids, saponins, anthraquinones, alkaloids and reducing sugar are present along with anti-cancerous agents like glucosinolates, isothiocyanates. The fact that *moringa* is easily cultivable makes it a sustainable remedy for malnutrition. Children It is used to treat malnutrition in children younger than 3 years. About 6 spoonfuls of leaf powder can meet a woman's daily iron and calcium requirements, during pregnancy reported by Gopalakrishnan *et al*.,(2016).

MATERIALS AND METHODS

Raw material: Beetroot, Pineapple will be purchased from the local market and necessary pre-treatments such as washing, grading, sorting etc., will be carried out. *Moringa* leaves will be collected from department of botany Shivaji University Kolhapur and further Beetroot, Pineapple and *Moringa* leaves would be use for preparation of juice for blending purpose.

Physicochemical analysis of raw material: *Moringa* leaves, Beetroot and Pineapple was analyzed for their physical and physico-chemical analysis i.e. moisture, crude fat, ash, crude fiber and crude protein, etc. contents following standard methods (Ranganna 1986).

Total Phenolic Content

TPC was determined using the calorimetric Folin–Ciocalteu method (Chavan et al., 2013).0.2mL of diluted extracts were mixed with 1 mL of 1:10 diluted Folin–Ciocalteu reagent and reacted for 5 min. 0.8 mL of 7.5% sodium carbonate was added to the mixture, and incubated for 30 min in the dark at 27 ± 2 ° C. Absorbance was measured at 765 nm on the spectrophotometer. Gallic acid was used as a standard. The standard graph was prepared by using gallic acid in the range with different concentrations gave a regression equation $Y = 0.002X + 0.039$ ($R^2 = 0.999$).

Determination of % radical scavenging activity (Antioxidant Activity).

The beetroot powders and beetroot concentrate, amaranth extract was analyzed for free radical scavenging activity. The total antioxidant property of beetroot powder was determined by 2, 2-Diphenyl-1-picrylhydrazil radical (DPPH) in terms of % radical scavenging activity. DPPH solution (1 mg/ml) was made by dissolving DPPH in methanol. DPPH solution (100 µl) was diluted to 5 ml and absorbance was taken at 535 in UV-Spectrophotometer. The absorbance was taken as control absorbance. The extract (100µl) was made by dissolving required beetroot powder in methanol; then it was added with 100µl of

1mg/ml of DPPH solution. Then it was diluted to 5 ml by methanol then it was incubated at room temperature for 30 min. Then absorbance was measured at 535 nm in UV spectrophotometer. The absorbance was taken as sample absorbance. Following formula was used to calculate the antioxidant activity.

$$\% \text{ Antioxintant activity} = \frac{\text{Absorbance of controle} - \text{Absorbance of sample}}{\text{Absorbance of controle}} \times 100$$

Determination of Total Betalain

The concentrated red beet was diluted with distilled water and measurement was carried out at wavelength of 535 nm and the quantification was expressed as mg betalains/ 100g using the following equation as determined by Castellar et al., (2003)

Total betalain content (mg/100g) = A×DF×MW×1000/€L

Where:

A	:	Absorption value at 535 nm density.
DF	:	Dilution volume.
L	:	Path length of cuvette.
MW	:	Molecular weight of betalain (550g/mol).
€	:	The extinction coefficient for betalain 60000L/ mol

Ascorbic Acid

Ascorbic acid content was determined by the titration method using 2,6-dichlorophenol endophenol dye (C12H7NCl2) as recommended by Ranganna (1986).

Determination of reducing sugar by DNSA method

The pipette out 0.2,0.4,0.6,0.8 and 1ml standard glucose solution in a clean dry test tube. Adjust the volume by 1ml distilled water. Add 2.5ml DNSA reagent. keep the test tube in a boiling water bath for 5min and cool under tap water. Read the optical density at 530nm.

Mineral determination

The minerals such as calcium, iron, magnesium and sodium content of sample's determination by using the Atomic Absorption Spectroscopy in Common Facility Centre, Shivaji University, Kolhapur.

Preparation of Juice:

1) Beetroot was peeled out and sliced, crushed in a grinder, then juice extract by using hydraulic press and the extracted juice was again filtered by using a four layer muslin cloth to remove remaining pomace(Ashurst, 1995).

2) Pineapple was peeled out, remove feves and sliced crushed in a grinder, then juice extract by using hydraulic press and the extracted juice was again filtered by using a four layer muslin cloth to remove remaining pomace (Ashurst, 1995)

3) Moringa leaves was washed, blanched to remove flavour and bitterness, crushed in a grinder, then juice extract by using hydraulic press and the extracted juice was again filtered by using a four layer muslin cloth to remove remaining pomace(Ashurst, 1995).

Preparation of blended drink:

Blended drink were prepared using 15% of blended juice extracts of pineapple juice beetroot juice, and moringa leaves juice, 15% of total soluble solid (TSS) and 0.3% of acidity at the time of preparation in all the formulated blends. The blended juice of different ratio of pineapple, juice beetroot juice, and moringa leaves juice 75:20:05(T1), 75:15:10(T2), 75:10:15(T3), 70:20:05(T4), 65:25:10(T5), 60:25:15(T6) and 55:25:20(T7) respectively with 15% of sugar, 0.3% of acidity as % of anhydrous citric acid and 100 ppm of sodium benzoate one liter of treated water. The controlled RTS beverage having 100 per cent pineapple juice without beetroot juice and moringa leaves juice(Control).

Beetroot Juice | Pineapple Juice | *Moringa* Leaves Juice

↓

Mixing with strained syrup
(Sugar + Citric acid + Water as per requirement)

↓

Homogenization(1800-2000psi at 65°C)

↓

Pasteurization

↓

Bottling

↓

Crown corking

↓

Pasteurization

↓

Cooling at room temperature

↓

Packing and Labelling

↓

Storage

Fig.4: Preparation of blended health drink.

Standardization of Beetroot, Pineapple and Moringa leaves blended Health drink

In the present investigation samples were prepared, firstly optimized blended juice prepared from pineapple juice and beetroot juice i.e. sample T1 using 100:00, sample T2 using 95:05 proportion, sample T3 using 90:10 proportion, sample T4 using 85:15 proportion, sample T5 using 80:25 proportion, sample T6 using 75:25 proportion, sample T7 using 70:30 proportion, sample T8 using 65:35 proportion (as shown in table no. 4) respectively. Then secondly optimized blended juice prepared from pineapple juice, beetroot juice juice and *moringa* leaves juice i.e. sample T1 using 75:25:00, sample T2 using 75:20:05 proportion, sample T3 using 75:15:10 proportion, sample T4 using 75:10:15 proportion, sample T5 using 70:25:05 proportion, sample T6 using 65:25:10 proportion, sample T7 using 60:25:15 proportion, sample T8 using 55:25:20 proportion (as shown in table no. 5) respectively.

Sensory quality evaluation: The beverage samples were evaluated for their sensory characteristics namely appearance colour, taste, flavor and overall acceptability by a trained panels comprising of 20 panelists drawn from faculty members and post graduate students of the Department. The panelists were asked to record their observations on the sensory sheet based on a 9 point hedonic scale (9 and 1 points showing like extremely and dislike).

Storage studies: The blended health drink (RTS) beverage with best blending combination and their ratio (on the basis of sensory evaluation) were packed in glass bottles and kept at refrigerated temperature as well as room temperature and changes were determined during storage at 8says intervals up to 2 months. TSS, pH, acidity,Vit.C, %total sugar,%reducing sugar,%non reducing sugar,total phenolic compound,antioxidant activity during storage was measured by standard method and overall acceptability was measured on 9 Point Hedonic Scale by 20 semi-trained panel members.

RESULTS AND DISCUSSION:

The results obtained during present investigation are presented and discussed under suitable headings in view of available relevant scientific literature.

Physical and chemical properties analysis of Beetroot, pineapple and *Moringa* leaves

Table:1 Physical properties of Beetroot, pineapple and *moringa* leaves

Parameter	Beetroot	Pineapple	*Moringa* leaves
Color (exterior)	Reddish purple	Yellowish green	Green
Weight of fruit (g)	250	1000	250
Height of fruit (cm)	9.0±0.40	19.0±0.80	1.0±0.20
Length of fruit (cm)	11.0±1.10	18.0±1.50	1.50±0.20
Juice obtained (ml)	156	278	36

*Each value represents the average of three determinations

A range of physical properties of Beetroot, pineapple and *moringa* leaves were determined. The average color, weight, height, width and length of fruits were determined and given in the table 1. Digital Vernier caliper with the sensitivity of 0.01 mm was used to measure the axial dimensions of randomly selected beetroot, pineapple ; diameter, length etc as given in the above table. The quantity of beetroot, pineapple and moringa leaves per kg was measured using an electronic digital balance with 0.01 gm sensitivity. The results of the physical analysis were resembled with values of Mccance and Widdowson's (2002), Tejendra Bhakta *et al.(*2012) Gopalakrishnan, L. *et al*.(2016) respectively.

Physicochemical Analysis of Beetroot, pineaaple and *moringa* leaves

Table 2 : Proximate Analysis of Beetrrot, pineapple and *moringa* leaves

Sr.no	Parameter (%)	beetroot	Pineapple	*Moringa* leaves
1.	Moisture (%)	89.2±0.45	87.1±0.55	72.26±1.67
2.	Ash (%)	2.26±0.30	2.1±0.25	3.26±0.30
3.	Protein (%)	1.56±0.06	0.39±0.03	8.1±0.12
4.	Fat (%)	0.2±0.011	0.45±0.07	1.7±0.10

5.	Crude fiber (%)	1.87±0.02	1.37±0.24	7.05±0.32

Data are expressed as mean ± standard deviation of triplicate experiments (n=3)

The chemical composition of the red beetroot, revealed that it was a poor source of crude fat (0.20 per cent) and protein (1.57per cent). Fiber and ash content was 1.37 and 2.1 percent respectively. The results obtained in present investigation are in close agreement with the results reported in the scientific literature Mccance and Widdowson's (2002), Ayyavoo and Ramasamy D. (2013).

The chemical composition of the pineapple revealed that it was a poor source of crude fat (0.45 per cent) and protein (0.39per cent). Fiber and ash content was 1.87 and 2.26 percent respectively. The results obtained in present investigation are in close agreement with the results reported in the scientific literature Tejendra Bhakta *et al.*2012.

The chemical composition of the *moringa* leaves revealed that it was a rich source of crude protein (8.1 percent) and fiber (7.0 percent). Fat and ash content was 1.7 and 3.26 percent respectively. The results obtained in present investigation are in close agreement with the results reported in the scientific literature of Gopalakrishnan, L. *et al.*(2016).

Physicochemical Analysis of Beetrrot juice, pineapple juice and *moringa* juice

Table 3: physicochemical Analysis of Beetrrot juice, pineapple juice and *moringa* leaves juice

Sr.no	Parameters	beetroot juice	Pineapple juice	*Moringa* leaves juice
1.	Moisture (%)	92.13±0.90	91.26±0.11	91.80±20
2.	Ash (%)	0.53±0.11	0.83±0.03	1.2±0.20
3.	Protein (%)	0.22±0.04	0.13±0.02	4.65±0.15
4.	Fat (%)	0.11±0.01	0.02	0.5±0.11
5.	Crude fiber (%)	0.48±0.017	0.50±0.04	1.29±0.05
6.	Vit.c(mg/100gm)	4.20±0.60	17.60±0.69	88±0.85
7.	Betalain(mg/100gm)	180±2.03	-	-
8.	T.S.S (Brix)	6.0±0.70	12.0±0.90	5.0±0.30
9.	Acidity (%)	0.05±0.003	0.66±0.01	0.11±0.004
10.	pH	6.50±0.32	4.50±0.50	5.50±0.42
11.	Total sugar(%)	7.20±0.23	13.0±0.38	2.62±0.13

12.	Non reducingsugar(%)	4.02±011	6.19±0.21	1.37±0.11
13.	Reducing Sugar(%)	3.20±0.12	6.81±0.44	1.25±0.02
14.	Total Phenolic compound (mg/g)	1.38±0.016	0.208±0.02	41.07±0.23
15.	Antioxidant (%RSA)	60 ±0.095	21.23±0.77	90.02±0.14
16.	Calcium(mg/lt.)	85.2	1.78	145.80
17.	Iron (mg/lt.)	2.73	63.20	0.54

Data are expressed as mean ± standard deviation of triplicate experiments (n=3)

Table 3 gives the summary of the analysis of the three juice samples such as Beetroot juice, pineapple juice and *moringa* leaves juice. The percentages of crude protein in beetroot juice pineapple juice and *moringa* leaves juice of values is 0.22%,0.13%,,4.65 respectively. The protein content in *moringa* leaves higher than beetroot and pineapple juice. The presence of ascorbic acid, phenolic compounds and antioxidant content in beetroot juice, pineapple juice and *moringa* leaves juice is indicate of above table5.The *moringa* leaves juice containing high amount of ascorbic acid,total phenolic compound and free radical scavenging activity as compare to beetroot juice and pineapple juice is shown in above table 2. Beetroot and pineapple juice contained less amount of vitamin C, total phenolic compound and free radical scavenging activity as a result *moringa* leaf juice is been added which is a high source of vitamin C, TPC and antioxidant.

Table 4: Sensory Evaluation of control drink by varying beetroot juice and pineapple content

Sample code	**Appearance**	**Taste**	**Flavor**	**Texture\body**	**Overall acceptability**
T1	7.5	7.0	6.5	6.0	6.5
T2	7.0	7.0	7.0	6.5	7.0
T3	7.5	6.5	6.5	7.0	7.0
T4	7.0	6.5	7.0	6.5	7.5
T5	7.5	7.5	7.5	7.0	7.0
T6	8.5	8.0	8.0	8.3	8.5
T7	8.0	7.5	7.6	7.7	8.0
T8	7.5	7.0	7.5	7.5	7.5

Out of the above results obtained from table No.4 sample T6 i.e 75% Pineapple juice and 25% beetroot juice gives good characteristics of drink and sample containing more than 25ml beetroot juice gives more flavour and dark colour of beetroot to drink and below 25ml beetroot juice cannot give proper taste as well as proper colour. finally prepared drink with pineapple juice i.e.sample T6 gives a good sensory parameter and over acceptability. Therefore sample T6, containing 75% pineapple juice and 25% beetroot juice was selected as a standard for further reference and will be comparing with prepared drink.

Table 5: . Sensory Evaluation of control drink by varying beetroot juice,pineapple and *moringa* leaves juice

Sample code	Appearance	Taste	Flavour	Texture\body	Overall acceptability
Control	8	8.5	8.0	8.0	8.5
T1	7.9	7.4	7.3	7.7	7.6
T2	7.5	7.4	7.3	7.6	7.9
T3	7.5	7.0	7.3	7.9	7.3
T4	7.8	7.4	7.6	7.9	7.8
T5	7.9	7.5	7.7	8.0	7.8
T6	8.5	8.0	8.2	9.0	8.5
T7	7.5	7.7	7.7	8.0	7.5

Out of the above results obtained from table No.5 sample T6 i.e 60% Pineapple juice, 25% beetroot juice and 15% *moringa* leaves juice gives good characteristics of drink and sample containing more than 15ml of beetroot juice gives more flavour of *moringa* leaves to drink and below 15ml *moringa* leaves juice cannot give proper taste as well as the overall acceptability prepared drink. finally sample T6 gives a good sensory parameter and over acceptability. Therefore sample T6, containing 60% pineapple juice, 25% beetroot juice and 15% of *moringa* leaves juice was selected as a standard for further reference and will be comparing with prepared drink.

Table 6: physicochemical Analysis of blended health drink

Sr.no	Parameter	Health Drink

1.	Protein (%)	0.78±0.30
2.	Ascorbic acid(mg/100ml)	24.0±1.20
3.	Betalain(mg/100ml)	18.0±1.30
4.	T.S.S (^{0}Brix)	12±0.60
5.	Acidity (%)	0.33±0.30
6.	p^{H}	4.5±0.50
7.	Total sugars (%)	9.80±0.60
8.	Reducing Sugar(%)	2.13±0.11
9.	Non-Reducing Sugar(%)	7.67±0.47
10.	Total Phenolic compound (mg/ml)	1.04±0.03
11.	Antioxidant (%RSA)	14.49±0.48
12.	Calcium(mg/100ml.)	31.58±1.70
13.	Iron (mg/100ml.)	0.1073
14.	Manganese(mg/100ml)	0.144
15.	Sodium(mg/100ml)	30.2±1.4
16.	Magnesium(mg/100ml)	0.723

Nutrient Content of the Blended RTS Beverages

The nutrient content of the freshly processed blended fruits (pineapple) and vegetable(beetroot and moringa leaves) blended health drink beverages were analyzed and presented in Table 3. It was noticed that all the blended health drink beverages contained the same TSS, acidity and pH of 15° Brix, 0.250 per cent and 3.95 respectively as per FPO specification. The prepared mixed fruit and vegetables blended health drink from the blends of pineapple, beetroot and moringa leaves(60:25:15). They reported that the chemical constituents of the blended health drink was 12^{o}Brix TSS, 0.35 per cent acidity, 4.5 pH, 2.13 per cent reducing sugar, 7.67 percent non reducing sugar, 13.00 per cent total sugar and 24 mg/100ml of ascorbic acid. It is also containing total phenolic compound and antioxidant activity 104.1mg/100ml and 14.49% respectively and high amount of mineral such as calcium, magnesium, iron and sodium in above table 3.

Shelf life study of blended health drink

The shelf life study of control and blended health drink were carried out for 75days in refrigerated temperature and 45days in at room temperature.

Effect of storage on blended health drink at room temperature

The effect of storage period on nutritional composition of blended health drink at room temperature presented in table 7.The nutritional parameter such as acidity, TSS, total sugar,Non reducing sugar,radival scavenging activity and polyphenolic compound decreases day to day and pH, reducing sugar increases as shown in table 7.

Table 7: Effect of storage period on nutritional composition of blended health drink at room temp.(28±2^{o}C)

Days	%acidity	TSS (brix)	Vit.c (mg/ml)	pH	%total sugar	%non reducing sugar	%reducing sugar	%RSA	Total phenolic compound
0	0.35	12.00	24	4.20	9.80	7.67	2.13	14.49	104.01
8	0.33	12.09	21.60	4.31	9.87	7.52	2.35	12.38	95.70
15	0.32	12.20	19.20	4.37	9.98	7.46	2.52	11.00	87.22
22	0.30	12.28	16.80	4.41	10.06	7.32	2.67	10.39	81.22
30	0.29	12.35	14.40	4.45	10.13	7.27	2.86	9.65	77.36
37	0.28	12.44	10.80	4.50	10.24	7.15	3.09	8.60	71.82
45	0.27	12.70	8.40	4.57	10.37	6.97	3.40	7.42	67.35

Effect of storage on blended health drink at refrigerated temperature (4±2^{o}C)

The effect of storage period on nutritional composition of blended health drink at refrigerated temperature presented in table8.The nutritional parameter such as acidity,TSS,total sugar, Non reducing sugar, radical scavenging activity and polyphenolic compound decreases during storage and pH, reducing sugar increases as shown in table 8.

Table 8: Effect of storage period on nutritional composition of blended health drink at refrigerated temp.(4±2^{o}C)

Days	% acidity	TSS (brix)	Vit.c (mg/ml)	pH	%total sugar	%Non reducing sugar	% Reducing sugar	%RSA	Total phenolic compound
0	0.35	12.00	24.00	4.20	9.80	7.69	2.13	14.49	104.01
8	0.34	12.02	22.80	4.22	9.82	7.66	2.16	14.33	101.86

15	0.33	12.07	21.60	4.25	9.85	7.59	2.26	13.94	99.08
22	0.32	12.09	20.40	4.27	9.89	7.51	2.38	13.63	97.54
30	0.32	12.12	19.20	4.29	9.95	7.41	2.48	13.45	95.08
37	0.31	12.13	18.00	4.31	9.98	7.33	2.65	12.96	93.69
45	0.31	12.15	17.50	4.32	10.01	7.28	2.73	12.13	91.38
53	0.30	12.17	16.80	4.33	10.05	7.22	2.83	11.86	89.53
60	0.30	12.18	16.20	4.34	10.09	7.17	2.92	11.34	84.60
67	0.29	12.20	15.60	4.37	10.12	7.08	3.04	10.86	81.99
75	0.29	12.21	14.40	4.40	10.17	6.98	3.19	10.18	77.67

Colour analysis of blended health drink during storage

Colour analysis of blended health drink during storage by using hunter colorimeter.

Effect on colour of blended health drink at room temperature during storage

The following table.20 shows the colour changes of blended health drink during storage of room temperature. The lightness(L*),redness(a*),yellowness(b*) and chromatocity(c*) value of blended health drink is decreases during storage and value h* is increases shown in table 15.

Table 9: Effect on colour of blended health drink at room temperature during storage (28±2°C)

Days	**L***	**a***	**b***	**c***	**h***
0	**4.39**	**12.85**	**2.74**	**12.89**	**8.11**
15	**3.07**	**10.74**	**1.84**	**11.43**	**10.56**
30	**2.18**	**8.81**	**1.13**	**9.77**	**11.03**
45	**1.68**	**8.03**	**0.84**	**8.86**	**11.74**

Where,

L* - Lightness

a* - Redness

b* - Yellowness

c* - Chroma

h* - hue

Effect on colour of blended health drink at refrigerated temperature during storage (4±2°C)

The following table 21.shows the colour changes of blended health drink during storage of refrigerated temperature. The lightness(L*),redness(a*),yellowness(b*) and chromatocity(c*) value of blended health drink is decreases during storage but slowly changes as compare to room temperature and value h* is increases shown in table 21.

Table 10: Effect on colour of blended health drink at refrigerated temperature during storage (4±2°C)

Days	L*	a*	b*	c*	h*
0	4.39	12.85	2.74	12.89	8.11
15	3.82	11.82	2.08	12.01	10.17
30	3.03	10.91	1.82	11.58	10.78
45	2.47	9.86	1.24	10.78	11.16
60	2.15	8.95	1.09	9.86	11.48
75	1.86	8.21	0.78	9.11	11.77

Conclusion

It is possible to blend pineapple, beetroot and moringa leaves in different proportion to prepare ready-to-serve beverage. The colour and flavour of any processed product plays an important role while tasting the same. The processed RTS beverages was found to be highly acceptable in taste and secured the organoleptically scores as 8.5. The blended pineapple, beetroot and moringa leaves ready-to-serve beverages are having high potential for commercialization and marketability. The introduction of new types of value added and nutrient enriched fruit juice based beverages might improve socio-economic status of the country by enhancing the export trades.This study suggest that beetroot, pineapple and moringa leaves drink has high amount of nutritive chemical constituents that can be beneficial to human being.

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Development of Innovative Finger Millet-Watermelon Seed Powder Drink Mix

S.V. Ghodke, O. N. Dhanke, U.P. Dere and A. J. Dhamdhere

Abstract

Finger millet, being rich in calcium, polyphenols and dietary fiber is crucial for the diet of not only pregnant and lactating mother but also of children. Watermelon seeds are a powerhouse of nutrients like folate, iron, zinc, copper, magnesium, potassium. These seeds are considered to be highly nutritious, as they are also rich in amino acids, proteins and vitamin B complex. All these nutrients together help in promote health of consumer. Finger millet and water melon seed powder provides an option to technologist for utilization of it in various convenient foods. Instant food mixes comprises cereals, pulses, spices and other ingredients in varying proportion. Apart from being convenient to prepare and easy for consumption, these food products should also have sufficiently high nutrition, to result in good quality of life for the consumers. An investigation was carried out to develop finger millet and watermelon seed based nutritious drink mix and their sensory and nutritional evaluation was carried out. Four types of drink mix powders were formulated by addition of 0%, 8%, 16% and 24% finger millet powder with 15% watermelon seed powder. All samples were organoleptically acceptable. Addition of finger millet flour and watermelon seed increased the nutritional value of drink mixes.

Keywords: *Finger millet powder, Watermelon seed, Instant drink mix*

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Introduction

The rate of diabetes and obesity are expanding in an exponential way universally and to battle them, complex sugars with larger amounts of dietary fiber and phytochemicals are becoming popular (Shobana *et al.*, 2007). Entire cereal grains offer a several medical advantages so usage of it as an extraordinary ingredient is expanding globally (Jones, 2010). Epidemiological investigations have exhibited that customary utilization of entire grain and their value added product protect against the danger of cardiovascular sicknesses, type II diabetes, gastrointestinal diseases and a various other medical issues (McKeown, 2002). Millets are significant harvests in semiarid and tropical locales of the world because of their protection from irritations and ailments, short developing season, and efficiency under strong and dry season conditions when major cereal grains can't be depended upon to give supportable yields. Millets are underutilized in many developed countries. (Chandrasekara *et al.*, 2010). Millets are rich source of nutrients viz. the dietary fiber, minerals, phenolics and vitamins and offers health benefits (Antony *et.al.*, 1996). There is an immense potential to process millet grains into value-added foods and beverages in developing countries. Furthermore, millets free from gluten are advisable for celiac patients. Millet also has an application as an adjunct in some food formulations (Malleshi *et al*. 1995; Malleshi 2003).

Finger millet (*Eleusine coracana* L.,), a staple food for a large segment of the population in India is important millet grown largely in various regions. It is a naked caryopsis with brick red-coloured seed coat. Finger millet is in spotlite from recent years owing to its nutritional benefits and high amount of dietary fibers (e.g. Water soluble and insoluble fibers), minerals (calcium, phosphorus and iron), essential amino acids and polyphenol content. It’s rough fiber and mineral substance are especially higher than those of other staple grains like wheat and rice. Its protein substance is generally better adjusted and it contains more lysine, threonine, and valine than different millets (Ravindran 1991; Sripriya *et al.*, 1997). Fibre incorporation in food products enhances the sensory properties and lowers calories of finished product. Finger millet also has application in infant, geriatric and health foods (Kudake, 2018). Finger millet, being calcium rich helps in strengthening bones for growing children and people. It also assists in maintenance of bone health in adults. Finger millet reduces osteoporosis in bones and substantially reduces risk of fractures or orthopedic ailments (Rastogi, 2015). It is used in the form of the whole meal for preparation of traditional foods, such as *roti* (unleavened breads or pancake), *mudde* (dumpling) and *ambali* (thin porridge). The seed coat of the millet is an edible component of the kernel and is rich source of phytochemicals like phytates, polyphenols, tannins, trypsin inhibitor factors and dietary fibres which are consumed as nutraceuticals in recent times.(Ramchandra *et al., 1977)*

Watermelon seed, a waste from watermelon fruit is nutritionally rich but not utilized and are considered as a waste material. Watermelon seeds contains protein, fiber, vitamin B, phenolic compound, minerals (such as magnesium, potassium, phosphorous, sodium, iron, zinc, manganese and copper), and posses antioxidant activity which promulgate health benefits (Braide, 2012).The watermelon seed proteins mainly comprise of globuilin and glutelin which are readily digestible with high amino acid score(Wani *et al.*, 2011) These proteins have excellent functional properties for the production of high quality protein products (Giami *et al.* 2004; Wani *et al.*, 2011). Watermelon seeds generally are reported to contain approximately 35% protein by weight of decorticated seeds that have a nutritionally amino acid profile (Jack, 1972). The seeds of watermelons are known to have economic benefits especially in countries where cultivation is on the increase. The seeds are for instance used to prepare snacks, milled into flour and used for sauces. Oil from the seeds are used in cooking and incorporated into the production of cosmetics (Jensen, 2011). It has already been established that the seeds of melon fruits are rich in oil and protein. In Nigeria, oil was produced from these seeds (Akoh *et al.*, 1992).

Cocoa powder is consumed from hundreds of year due to its good taste, flavor and health benefits. Cocoa is one of the richest sources of polyphenols especially abundant in flavonols. Cocoa polyphenols (Epicatechins) have antioxidant properties, which endow them with various positive effects against several pathological disorders, including cardiovascular disease, inflammatory processes, and cancer. The beneficial effects of cacao are most likely due to an increased bioavailability of Nitric oxide. This may explain the improvement in endothelial function, the reduction in platelet function, and the potentially beneficial effects on blood pressure, insulin resistance, and blood lipids.

Instant powder mixes are simple, convenient and fast to prepare food products in which some of the ingredients are premixed. Instant cocoa powder drink is a very popular instant food mix product present in the market, not only among children but also among adults. Factors owing to such popularity of cocoa based products and drink powders are good dispersability and solubility (Benkovic *et al.*, 2015), their unique sensory and pleasant melt- in- the- mouth properties (Aprotosoaie *et al.*, 2016). This investigation is undertaken to develop innovative finger millet cocoa drink mix with watermelon seeds to cultivate health benefits of finger millet and watermelon seeds.

Methodology

Ingredient

Finger millet, cocoa powder, water melon seeds and sugar are procured from local market. These were brought to laboratory of food science and technology and used for processing.

Instruments

All the instruments required like physical and analytical balance, hot air oven, muffle furnace, soxlhet apparatus, Kjeltron apparatus, blender and sealing machine were used from MIT College of Food Technology, Pune.

Packaging material

Aluminium zip lock pouches were procured from local market for packaging owing to its good barrier properties of water vapour transmission rate.

Methods

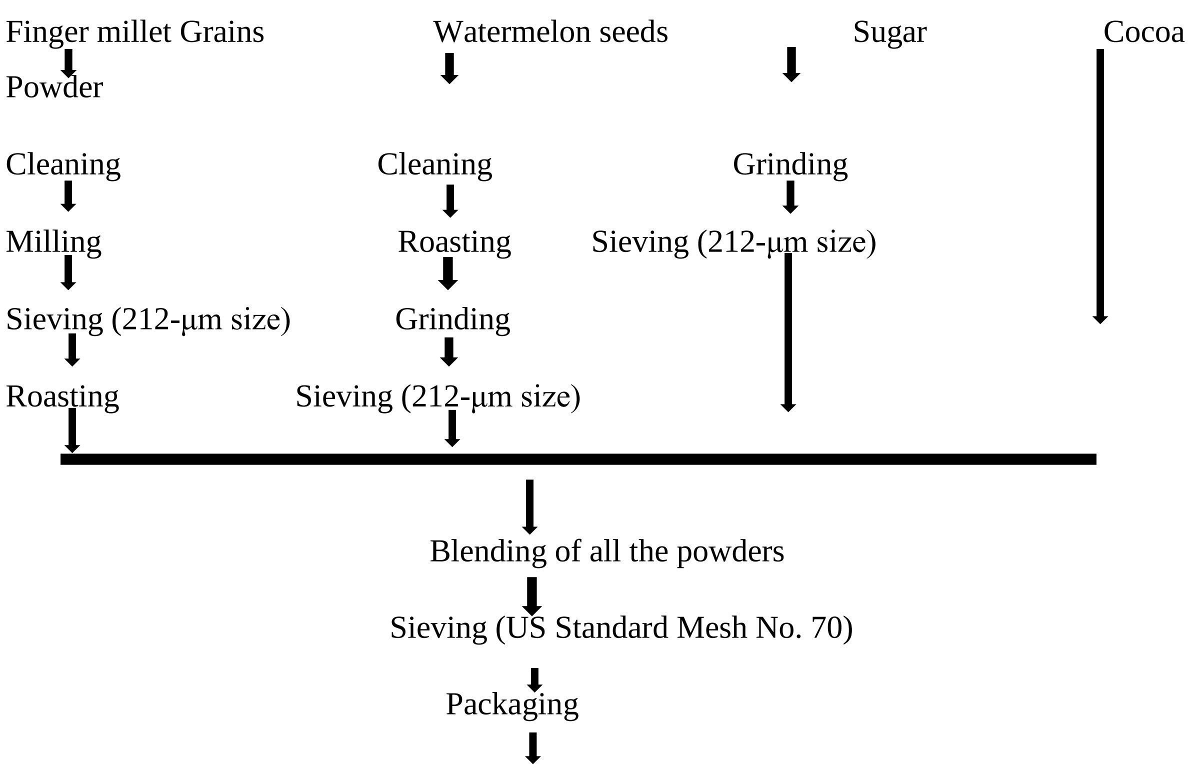
Processing Technology for finger millet-watermelon seed powder drink mix

Finger millet grains were cleaned to remove the dirt and foreign particles. The grains were milled to fine flour and sieved to fineness using US Standard Mesh no.70. (212-µm size). The flour is then roasted at 70-80°C for 5 mins. This developed a pleasant aroma and unique taste to the flour. Watermelon seeds and sugar were milled to fine flour and sieved to fineness using US Standard Mesh no.70 (212-µm size). All the prepared powders were then blended along with cocoa powder according to the set composition. The formulated mixture was then sieved using

US Standard Mesh No.70 (212-µm size).The powder was then packed in aluminium zip lock pouches and sealed.

Table 1 Proportion of finger millet-watermelon seed powder drink mix

Samples	Ingredients (%)			
	Finger millet Powder	**Cocoa Powder**	**Watermelon seed powder**	**Sugar Powder**
S_0	00	31	15	54
S_1	8	23	15	54
S_2	16	15	15	54
S_3	24	7	15	54



Sealing
⬇
Store at dry place at room temperature

Fig 1 Processing technology of finger millet-watermelon seed powder drink mix

Proximate Analysis

Parameters of the proximate analysis (Moisture, Ash, Crude protein, Fat, Total carbohydrate and Energy) of the raw materials as well instant drink mix powder was analyzed.

Determination of moisture

The moisture content was determined by method given by S.K.Thimmaiah (1999). The sample was weighed 5g and taken in previously weighed moisture box and dried in hot air oven at 105°C for 2 hours. The loss in weight was calculated and expressed in per cent. After cooling in the desiccators, the sample was weighed again. The loss in weight was recorded as moisture content.

$$\text{Moisture Content (\%)} = \frac{W1-W2}{W1} \times 100$$

Where, W1- Weight of Fresh sample

W2- Weight of Dry sample

Determination of total ash

Total ash content of sample was determined by the method given by Thimmaiah (1999). The sample was ignited at 600°C for 4 to 6 hrs in a muffle furnace.

$$\text{Ash Content (\%)} = \frac{\text{Weight of Ash}}{\text{Weight of Sample}} \times 100$$

Determination of protein

Protein content of sample was estimated as per method described by Thimmaiah (1999). Protein was determined by microkjeldal method which is based on the determination of the amount of reduced nitrogen present in sample.

$$\text{Nitrogen (\%)} = \frac{(\text{Sample Titre} - \text{Blank Titre}) \times \text{Normality of HCL} \times 14.01 \times 100}{\text{Weight of sample (mg)}}$$

Protein (%) = Nitrogen (%) × 6.25

Determination of fat

Fat was extracted from an oven dried sample. Fat was estimated using soxhlet apparatus as per method explained by Thimmaiah (1999). Petroleum ether was used for the extraction of fat. Extraction was done for 3hrs on heater. Solvent was evaporated on heater then cooled and weighed. The difference in weights gives the quantity of fat extracted.

$$\text{Crude Fat (\%)} = \frac{\text{Weight of Ether soluble material} \times 100}{\text{Weight of sample}}$$

Determination of crude fibre

2 g fat extracted sample was weighed and crude fibre was estimated by the method given by Thimmaiah (1999).

$$\text{Crude Fibre (\%)} = \frac{\text{Loss of weight noted} \times 100}{\text{Weight of sample taken}}$$

Determination of carbohydrate

Determination of carbohydrate is performed using Anthrone method given by Thimmaiah (1999).

$$\text{Carbohydrate (\%)} = \frac{\text{Sugar value from graph (mg)}}{\text{Aliquote of sample used (0.5 or 1 ml)}} \times \frac{\text{Total Vol. of extract (ml)}}{\text{Wt. of sample}} \times 100$$

Determination of calcium

For the determination of minerals sample was ashed first at 600°C for 5 to 7 hrs. It was determined by method given by Thimmaiah (1999). Calcium was precipitated as calcium oxalate. The precipitate was dissolved in hot dilute H_2SO_4 and titrated with standard potassium permanganate.

$$\text{Calcium (mg/100g)} = \frac{\text{Titre} \times \text{normality of KMnO4 of ash solution} \times 20 \times \text{total volume} \times 100}{\text{ml of ash solution taken for estimation} \times \text{wt of sample taken for ashing}}$$

Organoleptic evaluation

The organoleptic assessment in respect of colour, flavour, texture, taste and overall acceptability was evaluated by semi-trained judges using nine point hedonic scale (Amerine *et al.*, 1965). The samples were blind-coded by special codes; the panelists were not informed about the experimental approach.

Result and Discussion

Proximate Composition of finger millet, cocoa powder and watermelon seeds

Table 2: Proximate Composition of raw ingredient

Parameters	Finger Millet	Cocoa Powder	Watermelon Seeds
Moisture (%)	8	6.2	4.4
Crude fat (g/100g)	1.3	10	44.5
Protein(g/100g)	7.7	23	34.1
Crude fiber(g/100g)	3.6	30	7.9
Carbohydrate(g/100g)	72.6	55	17.8
Calcium(mg/100g)	334	128	58.3
Energy(Kcal/100g)	336	400	350

*Each value is average of three observations

The raw materials were studied for their proximate composition and results are tabulated in Table 2. The data from table reveled that carbohydrates was recorded highest in Finger millet (72.6 g/100g) followed by cocoa powder (55g/100g) and watermelon seeds (17.8) indicating raw material as a good source of energy provider. Water melon seeds are rich in protein (34.1 g/ 100 g) and fat (44.5 g/100g) as compared other ingredients providing body building need of children and other population. Cocoa powder was found to be rich in crude fiber (30g/100g) which act as a digestive track cleanser. Calcium, a vital mineral for bone health found highest in finger millet (334 mg/100g) followed by cocoa powder (128mg/100g) and watermelon seeds (58.3 mg/100g). The data from table reveals energy value of cocoa powder, watermelon seeds and finger millet was 400, 350 and 336 Kcal/100g respectively. The results obtained for finger millet are more or less similar with observations recorded by Ravindran G. (1991).

Sensory profile of finger millet-watermelon seed powder drinks mix

Table 3 Sensory profile of finger millet-watermelon seed powder drinks mix

Sample	**Sensory parameters**				
	Colour	**Texture**	**Taste**	**Flavor**	**Overall Acceptability**
S_0	7.5	7.3	7.4	7.4	7.4
S_1	7.7	7.6	7.6	7.4	7.5
S_2	7.8	7.7	7.8	7.5	7.7
S_3	6.9	6.6	6.6	6.7	6.8

*Each value is average of ten observations

Organoleptic characteristics of formulated samples were assessed by semi-trained judges using 9 point hedonic scale and average scores obtained are presented in Table 3. It has been observed from, colour values of prepared samples were in the range of 6.9 to 7.8.Texture and taste scores are in range of 6.6 to 7.7 and 6.6 to 7.8 respectively. Sample formulated with 16% finger millet powder shown to have highest scores for colour (7.8), texture (7.7), taste (7.8), flavor (7.5) and overall acceptability (7.7) against other samples.

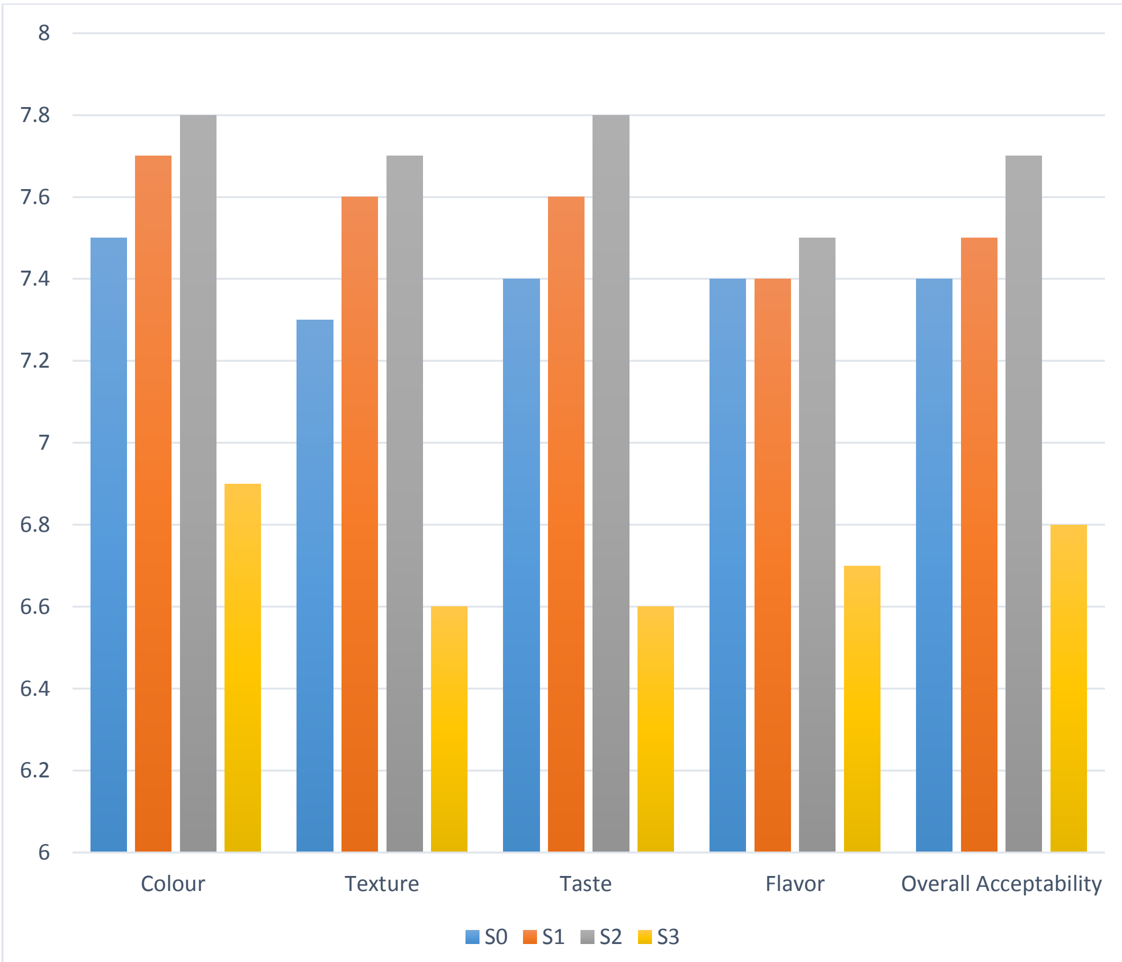


Fig 1 Sensory profile of finger millet-watermelon seed powder drink mix samples

Proximate Composition of finger millet-watermelon seed powder drink mix samples

Table 4: Proximate Composition of finger millet-watermelon seed powder drink mix (g/100g)

Parameters	**Samples**			
	S_0	**S_1**	**S_2**	**S_3**
Moisture (%)	4.5	4.7	4.8	4.5
Fat (g)	9.7	9.0	8.3	7.6
Protein(g)	12.2	11.0	9.7	8.5
Fiber(g)	10.4	8.4	6.2	4.1
Carbohydrate(g)	73.7	75.1	76.5	77.9
Calcium(mg)	5	32.2	59.3	86.4

*Each value is average of three observations

Drink mix samples were analyzed for chemical constituents. The results obtained are illustrated in Table 4. It has been observed from the table that moisture content of the mix ranges from 4.5 to 4.8%. The fat content ranges from 7.6 to 9.7%, protein content from 8.5 to 12.2%, fiber content from 4.1 to 10.4%, Carbohydrate content from 73.7 to 77.9% and the calcium content ranges from 5 mg/100g to 86.4 mg/100g. Fibre due to decrease in cocoa powder the fibre content in the product decreased as cocoa is rich in fibre content and the protein and fat content also decreased due to increase in cocoa powder.The proportion of finger millet was increased as finger millet is rich in calcium the calcium content increased also the carbohydrate content also increased due to finger millet.

Conclusion

The enrichment of chocolate drink mix with finger millet and watermelon seeds has increased the nutritional quality of the product. The product being rich in all the macronutrients can be used to tackle malnutrition in the children. Addition of watermelon seeds has increased sensorial acceptability along with nutritional enrichment.

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Development of ready to eat snack enriched with horsegram

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Abstract

Horse gram *(Macrotyloma Uniflorum)* is one of the underutilized legume and inexpensive source of protein, calcium and iron. Presence of anti-nutritional factors has toned down its use. Many researchers have worked on the pretreatments to be given on horse gram to reduce down anti-nutritional factors out of which simplest way is to go for soaking, germination and drying. The anti-nutritional factors such as tannin were reduced on giving such pretreatment whereas some research proves the enhancement of protein, calcium, iron and phosphorus. In recent years, due to increasing demand of functional & nutraceutical foods many crops are explored. Horse gram is found to have more calcium and iron along with protein and dietary fibres and few anti-oxidants under legumes category. These properties are acting as a driving force for many researchers. Under the thought of exploring horse gram a ready to eat product was developed using horse gram with the aim to have more protein in the end product. An initiative taken for exploration of horse gram lead to the development of cost effective product (nacho) with excellent nutritional properties having more protein, calcium and iron content. Successful outcome of the research gives value addition to horse gram which indirectly helps farmer and a nutritious product with multiple benefits can be made available to customers which becomes win-win situation

Keywords: Antioxidant, Calcium, Horse gram, Iron, Nutraceutical

Introduction

Horse Gram (*Macrotyloma uniflorum*) is not very popular but consumed in few parts of India. Recent food studies have found various medicinal uses of horse gram. Some of the important health benefits of horse gram include its usefulness as diabetic food, its ability to reduce cholesterol, helps in weight loss, its ability to keep the digestive tract healthy, and its iron source which is useful for women with pregnancy and menstrual problems and its benefits for skin. It contains good amount of protein with good amino acid profile especially with the high lysine content. It is a rich source of Iron, calcium, potassium and molybdenum. It contains other polyphenols and phenolic acids which have medicinal properties. Overall horse gram offers tremendous nutritional value.

Medicinal properties of horse gram have extensive history in India. Various parts of the plant are in use by Ayurvedic practitioners for treatment of kidney stones, jaundice, asthama, and urinary disorders. Research has found that horse gram delays digestion of carbohydrates in drug-induced rats and has anti-diabetic potential. It possesses ability to reduce blood sugar and also help reduce insulin resistance in type 2 diabetes (Prasad & Singh, 2014). It also contains high amount of dietary fibers which helps in reduction of cholesterol content (Dwivedi, *et al.*, 2015).Various polyphenols in horse gram have demonstrated antioxidant properties. These antioxidants are concentrated more in the seed coat (Tiwari *et. al.*, 2013) which help in preventing body cells from oxidative damage from free radicals. Horse gram has diuretic properties which help in dissolving kidney stone. Presence of polyphenols in horse gram is considered to be effective in treating these worms. It is believed to aid in digestion and reduce gastro intestinal problems.

With an aim to explore horse gram a ready to eat product (Nacho) was developed, ultimate results were obtained with enhanced protein, calcium and iron content. Pretreatments like soaking, germination and drying were given to horse gram to reduce down its anti-nutritional content (Tannin).

Materials and methods

Investigation material like Horse gram, Corn flour, Wheat Flour, Rice Flour, Cumin, Black pepper, Red chilli powder and zero trans-fat sunflower oil was purchased from loni-kalbhor local market. All the trials and finalized product was done at MITCFT, MITADT University. Pretreatment was done on horse gram to reduce down the anti- nutritional factors (Tannin, phytic acid and oxalic acid). Previous researchers (Prasad & Kumar, 2014) have found that soaking done for 24hrs and germination done for 72hrs gives better results in terms of reduction in anti-nutritional factors. Malted horse gram was used in variations (30, 40 and 50 %) with other process ingredients to develop a nacho. After multiple trials, optimization of horse gram percentage was done on the basis of sensory analysis. Sequence of pretreatment given to the horse gram is shown in fig 1. Soaking was performed at 20 ^{0}C for 24hrs, germination at 25 ^{0}C for 72 hrs was carried out in germinator and drying was performed in cabinet drier at 60^{0}C for 6hrs. Grinder (make: Bajaj glory grinder) was used for grinding dried horse gram. Fig 2 depicts the manufacturing process of ready to eat product (nachos) enriched with horse gram. Finalized process contained Horse gram (30 %), Corn flour (30 %), Wheat Flour (20 %), Rice Flour (10 %). Packaging material used for packing end product and for storing dried horse gram was HDPE (High Density Polyethylene).

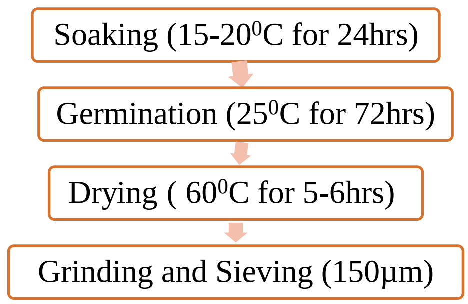

Fig 1: Pretreatment done on horse gram

Horse gram as a raw base material was analyzed for protein (kjeldhal method), tannin (folin denis method), Carbohydrates (difference method), Crude fibre (Fibre therm), Calcium (Titrimetric method), Fat (Soxhlet) and ash (Muffle Furnance) (Ranganna, 1986). After germination of horse gram same tests were repeated. Raw horse gram analyzed for Physical characteristics like length to breadth ratio, 1000 kernel weight, Angle of repose, Bulk density, True density, Tap density, Porosity, and sphericity. Ultimate end product was analyzed for Moisture, Protein, Fat, Carbohydrates, crude fibre, Calcium, Iron and Energy Value. Microbial analyses (Total Plate Count) to ensure safety of product and Sensory evaluation was performed on to finalize the end product (Ranganna, 1986). The sensory evaluation of different organoleptic characteristics i.e. Colour and Appearance, Mouth feel, Taste, flavour and Overall Acceptability were carried out by semi- trained panellists on 9 point Hedonic scale. Packaging material was analysed for GSM, thickness and tensile strength using tensile strength testing machine.

Chemical analysis like moisture was determined by hot air oven method, fat using soxhlet apparatusa, protein by Kjeldhal method, ash using muffle furnace, crude fiber and carbohydrates was analyzed as method mentioned in Ranganna, 1986. Tannins were measured by using folin-denis method. Calcium content was analyzed as method mentioned in Thimmaiah. S. K. (1999).

Packaging material used was analyzed for GSM, Thickness and Tensile strength. HDPE was used as a packaging material.

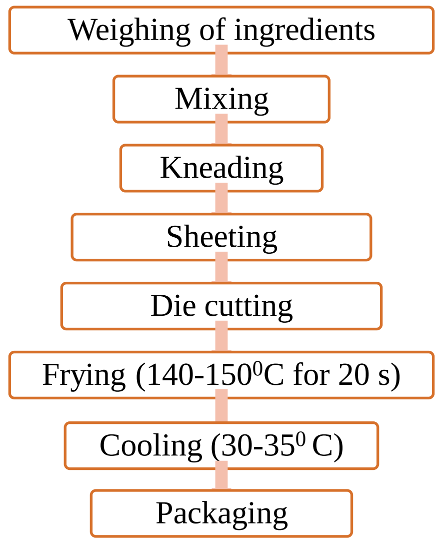

Fig 2: Manufacturing process of Horse gram enriched nachos

Result and Discussion

Horse gram purchased from the local market was analyzed for physicochemical analysis and results obtained are shown in table 1 and 2. Physical characteristics obtained for l/b ratio was 1.43, 1000 kernel weight 30.7g, 22.62^{o}, Bulk Density 0.85 g/ml, true density 1.33g/ml, tap density 0.88g/ml, porosity 36 %, sphericity 0.66 %. Chemical characteristics obtained for raw horse gram were moisture 3.96 %, Fat 3.97 %, Protein 36.84 %, Ash 1.96 %, Crude fibre 15.6 %, carbohydrate 53.27 %, Tannin 4.22 %, Calcium 0.244 % and Iron 0.008 %. Tannin content was measured in raw horse gram and pretreated horse gram and a comparison was drawn.

Table 1: Physical characteristics of raw Horse gram

Sr. No	**Physical Parameters**	**Composition**
1	Length/breadth ratio	1.43
2	1000 kernel weight	30.7g
3	Angle of repose	22.62^{o}
4	Bulk density	0.85g/ml
5	True density	1.33g/ml
6	Tap density	0.88g/ml
7	Porosity	36%
8	Sphericity	0.66%

Table 2: Chemical

characteristic of raw horse gram

Chemical Parameters	Composition (%)
Moisture	3.96
Fat	3.97
Protein	36.84
Ash	1.96
Fiber	15.6
Carbohydrate	53.27
Tannin	4.22
Calcium	0.287
Iron	0.008

Ready to eat product developed was similar to nachos available in the market. Various trials and market analysis was done before finalizing the product. Product was tried with and without the inclusion of dry yeast and was compared with the market available nachos. Sensory performed for color, texture, appearance, taste and overall acceptability is mentioned in table 3 where S1 indicated market sample, S2 indicates ready to eat (Nacho) developed without yeast and S3 with yeast.

Table 3: Sensory analysis

Sample	Color	Taste	Texture	Appearance	Overall Acceptability
S1	7	7.28	7.52	6.8	7.15
S2	7.7	7.88	7.55	7.6	7.6825
S3	7	6.93	6.24	6.66	6.7075

Chemical characteristics of ready to eat product developed was Moisture 4.95 %, Fat 22.40 %, Protein 17.80 %, Ash 2.94 %, Crude fibre 6.82 %, Carbohydrates 51.91%, calcium and iron 0.2209 % and 0.08 % respectively as depicted in Table 5. Packaging material preferred was HDPE (High Density Propylene) which was analyzed for GSM, Thickness, Tensile strength and elongation %. Tensile strength obtained was 0.09 Kg/cm^2. GSM was $42.4g/m^2$, Thickness 0.436

mm and elongation 418 %. Throughout the process (raw horse gram to processed product) calcium content was found to be reduced from 0.287 % to 0.221 %. The reduction in calcium content was obtained during soaking and sprouting treatments due to the leaching out of the mineral in the soaking water. Microbial analysis was done for the end product which included E.Coli testing and TPC (Total plate count). Results showed nil E. Coli presence and TPC found was 9.06CFU/gm.

Table 4: Reduction of calcium content

Sr. No.	Sample	% Calcium
1	RHG	0.287
2	GDHG	0.244
3	RTE Snack	0.221

RHG: Raw Horse gram; GDHG: Germinated and dried horse gram; RTE: ready to eat final product

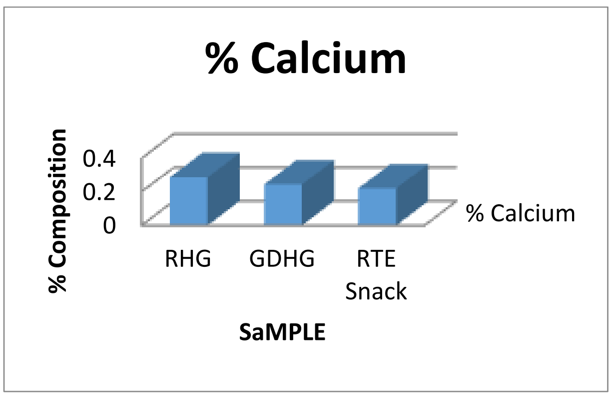

Fig 3: Effect of processing on calcium

Table 5: Chemical analysis of horse gram enriched ready to eat product (nachos)

Chemical Parameters	Composition (%)
Moisture	4.95%
Fat	22.40%
Protein	17.80%
Ash	2.94%
Fiber	6.82%
Carbohydrate	51.91%
Tannin	3.96%
Calcium	0.221%
Iron	0.08%

After the analysis of both the raw and germinated Horse gram, it was observed that protein, fibre, carbohydrates, increased and calcium and iron content gradual decreased along with anti-nutritional factor like tannin (Moktan & Ojha, 2016). Almost all the physicochemical and functional characteristics were significantly affected by both soaking and germination (Handa, *et al.*, 2017).

Table 6 : Effect of processing on tannin content

Sample	% Tannin
RHG	6.51
GDHG	4.22
RTE Snacks	3.96

RHG: Raw Horse gram; GDHG: Germinated and dried horse gram; RTE: ready to eat final product

Conclusion

Horse gram is the richest source of protein and available in economic price, due to this is known as "poor man's meat". Study aimed to develop a ready to eat product having nutritional benefits. Horse gram was used to develop ready to eat snack seeking with a chance to give good nutritional value at the end. Product had good amount of Protein content which is 17.80 %, calcium and iron 0.2209 % and 0.08 %. Pretreatments given (Soaking, Germination and Drying) gave 39.1 % reduction in tannin content. Sensory analysis also gave optimum acceptability compared to the market sample. The product intends to nourish the consumer with nutritional aspect along with taste.

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Diabetic Complications and Food Habits in India

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Abstract:

WHO estimated the diabetes as the seventh leading cause of death in 2016. India is deemed as the " world's capital of diabets''. Diabetes is result of bribery of junk foods and sedentary lifestyle on the line of westernization. This paper involves study of diabetic complications (such as cardiovascular disease, diabetic neuropathy, diabetic nephropathy, diabetic retinopathy and gestational diabetes) on the basis of nutritional deficiencies and recommended dietary allowance by ICMR.

Keywords: nutritional deficiency, diabetic complications, vegetarian diet solutions, Recommended Dietary Allowance.

Introduction:

"Drugs they never cure, they sometimes relive, but they always console"

-kranz and Caar (writers of reference book of pharmacology)

Treatment of lifestyle disease like diabetes can be done only by medicines. But, standardization in lifestyle and food habits are needed to maintain blood sugar at optimum level. Medicines can be bought but not the health.

Food habits were varied according to rule of various empires over the time. From the civilizations of Harappa and mohenjo-daro (2500 BC), till today. So, Indian food habits are greatly influenced by Aryans , Maurya and gupta empire, mughals, portugese, british, Chinese as well as various continental cooking styles (after globalization). Indian meals are known for it's nutritional balance. Our food styles are also diversified by traditions, socio-economic status, religional belifes and social/global trends.

South Indian meals are mostly including fermented foods, which are easy to digest, enhancing nutritional value as well as maintains overall gut health and good availability of B-complex vitamins which is rear in vegetarian foods. Also, unrefined coconut and sesame oil used for cooking are helps to maintain heart and overall health.

Bengali food styles are having Persian and Islamic cuisine's touch. It is famous for unique taste and nutrition combination. Due to inclusion of fish is known for it's B-complex vitamins and omega-3 availability, dal and rice which is rich in essential amino acids and Mishti Doi for overall good gut heath.

North Indian foods are specially known for it's seasoning and taste. It is rich in both proteins as well as carbohydrates. North Indian food is also has impact on cooking styles of various states. Preference to milk and dairy products in daily meals is it's speciality.

Rajasthani food style is famous for creation of semi-perishable and as there is scarcity of water, Most dishes are fried, roasted or backed. Gujarati meal is a combination of all kinds of tastes. Bajra is staple food of gujrat which is also nutritional one. These are some of the leading cooking styles.

But now-a-days, population is attracting towards non-nutritional junk foods, sedentary lifestyle and it's acceptance is now getting social status. Awareness about physical exercise and meditation are also lacking in most of Indians, converting youngest country as obese, diseased and older than it's average age.

If a person gets diabetes then it is necessary to maintain blood sugar at it's optimum level and should have nutritionally balanced intake. Otherwise, you might suffer through diabetic complications.

Research methodology:

For this paper, secondary data method is adopted. In which, nutritional deficiencies associated with diabetic patient and resulting complications, are studied by compairing with standard RDA's by ICMR.

Background and core:

In year 2015, non-communicable diseases accounted for 53% natural deaths in India. 24% by cardiovascular disease.

<u>Diabetic neuropathy:</u> nerve damage that can occure if you have diabetes .This results in nerve damage of leg, joint damage, urinary tract infections, sharp drops in blood pressure , digestive problems, sexual dysfunctions, increased or decreased sweating.

Nutritional deficiencies that can be responsible are as follows :

vit-B12, copper, vit E, vit-B6, vit-B1, etc.

<u>diabetic retinopathy:</u> it generally affects 80% people who had diabetes for 20 years or more.

each year in united states diabetic retinopathy accounts for 12% of all new cases of blindness.

Overtime too much sugar in your blood can lead to the blockage of tiny blood vessels that nourish retina, cutting of it's blood supply. As a result, eye attempts to grow new blood vessels. But these new blood vessels don't develop properly and can leak easily.

Nutritional deficiencies: vit-A, vit-D, vit-B12, omega-3 fatty acids, vit-E, zinc

<u>Diabetic nephropathy:</u> 25% people are facing diabetic nephropathy. having high blood glucose levels due to diabetes can damage the part of kidneys that filters your blood, damaged filter becomes leaky and lets protein to out.

Kidneys contain millions of tiny blood vessel clusters(glomerulli) that filter waste from your blood. High blood pressure can cause further kidney damage by increasing the pressure in the delicate filtering system of kidneys.

Responsible nutritional deficiencies: vit-D, vit-B12, vit-B6

Cardiovascular disease: This is major cause of death in both type-1 and type-2 disease.

In micro vascular disease, there is thickening of capillary basement membrane but increased capillary permeability which leads to the formation of haemorrages, the leakage of exudates of fibrin and odema from vessel walls ; these vessels then become thickened and blocked.

In macro vascular disease, involving coronary, cerebral and peripheral artrie as well as the aorta, seems to be a more severe form of the common atherosclerotic disease observed in western society. Now also common in India.

Responsible nutritional deficiencies: vit-D, coenzyme Q10, iron, vit-B1, amino acid deficiency, magnesium, calcium, potassium

Conclusion:

According to SRS Survey, 27.85% population of India is vegetarian. India has five states that could be considerd as vegetarian and are- Rajasthan(74.9%), Haryana(69.25%), Punjab(66.75%), Gujrat(60.95%), Madhya Pradesh (50.6%). In India those people are mostly deficient in protein, B-complex vitamins , omega-3 like essential fatty acids, etc. number of Indians are facing diabetic complications due to these nutritional deficiencies and lack of exercise, deemed our country as “capital of diabetes”. Suggestions are framed by taking those nutritional deficiencies into consideration.

Suggestions: suggestions included vegetarian sources for deficiencies which can be reasons for those diabetic complications.

- Daily intake of one seasonal fruit having low glycemic index-

  Dried apricots, red grapefruit (subtropical citrus fruit), watermelon has high GI but, low GL so can be eaten in moderate level, passion fruit, tangerine, avocado, kiwi, honeydew melon, apple, cherries, pears, plums, fresh strawberry , blueberry, raspberry, mulberry, peaches, orange, pomegranate, fresh coconut, banana,etc.

- Use alternative sources of milk like unsweetened (soymilk fortified with vit-B12, almond milk, rice milk fortified by vit-D) together with dairy milk.
- Try to involve soy chunks, fortified cereal meals, nutritious oatmeal, peanut snacks, sprouts, whole grain products, etc. in your breakfast. Dry fruits like almonds, walnuts are also good for you.
- Once in week go for fortified Tofu (soya paneer), swiss chesse, seaveges, white button mushrooms, etc. and rotations of different pulses each day.

- There should be plenty diversity in vegetables like spinach, broccoli, green leafy vegetables, radish, carrot, cucumber, beet, along with other regular vegetables like cabbage, cauliflower, capsicum, celery, and once in a week potato or pumpkin in moderate amounts.
- Try to use multigrain flour, crude edible oils.
- Frequent shifts in edible oils for cooking like groundnut oil, safflower oil, sesame oil, sunflower oil, coconut oil, etc. which is to be used in very less amounts in meals.
- Avoid addictions- try to avoid alcohol or not more than 2 gulps of alcohol in one day period. Try to drink it with food. Always dilute it with water, club soda, or diet soft drinks.

Smokers are 30-40% more likely to develop type-2 diabetes than non-smoker person. Smokers may develop (kidney disease, retinopathy, peripheral neuropathy, etc)

Tobacco leads to develop insulin resistance.

- Use low calorie or zero calorie sweeteners (artificial sweeteners) than normal sugar.
  Try to avoid prolonged use of artificial sweeteners as it can change the balance of our gut bacteria. This could make our cells resistant to insulin we produce.
  The sweet taste of sweeteners triggers cephalic phase insulin release, causing small rise in insulin level .
  Sucralose and saccharin may raise insulin levels in humans;
- Do not take any vitamin and mineral supplement without physician advice.
- If you have insulin resistance, exercise actually makes your insulin more effective .That is your insulin resistance goes down when you exercise and your cells can use glucose more effectively. Exercise can also help people with type-2 diabetes to avoid long term complications, especially heart problem.

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Food Security and Present Trends of Consumption

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Abstract:
Food security means ensuring that all people at all times have access to the food they need for a healthy, active life. There is a gradual shift in the present trends of consumption from traditional food to the high value food; is a good indicator for food processing prosperity. The study is based on the secondary source for research methodology. There are different factors such as changing lifestyle, diet diversification, health consciousness, consumer behaviour, urbanization, generation gap which affects consumption pattern and having impact on the food security. Hence, with the help of significant strategies we can deal with the key requirement of the future which could able to sustain food security.

Keywords: Per capita consumption, trends, food security etc.

Introduction:

Food Security refers to the situation where people are able to obtain sufficient food of acceptable quality and variety at all times. India ranks 2nd in terms of production of fruits and vegetables. According to Ministry of Agriculture India's output of fruits and vegetables increased by to 284.74 MT in 2018-19 as compared to 281.75 MT in 2017-18.

The nutritional intake from fruits and vegetables is higher among urban population than that of rural population. Along with the urbanization, people are likely to increase their calorie intake at a higher pace through fruits and vegetables. According to study, Indians spent approximately 35% of their total spend on food, which is whooping around $ 330 Billion in a year. Increased income through value addition to agricultural raw materials is one way to achieve food security across India.

Objectives of the study:

1. To assess the present condition of food security in India.
2. To analyze per capita consumption for different food grains and horticultural crops.
3. To study the different factors affecting present trends of consumption

Research Methodology of the study:

The present study is descriptive in nature and purely based on the secondary data source. Secondary information has been collected from various sources such as Journals, magazines, research articles, reference books, annual report of the ministry, data source, NSSO, conference proceedings and from different websites.

Scope of the Study:

"Food security means ensuring that all people at all times have access to the food they need for a healthy, active life". Increasing food production contributes to food security within communities and nations by making more food available and by generating employment and income. Food Security refers to the situation where people are able to obtain sufficient food of acceptable quality and variety at all times.

Natural factors such as natural disasters and human factors such as war can affect food security. Natural disasters such as droughts, floods and earthquakes can wipe out entire harvest, causing severe food shortages. Human factors such as wars and conflicts among nations also threaten food supply because crops and livestock may be destroyed. But increased production alone cannot guarantee food security. Increased income through value addition to agricultural raw materials is one way to achieve this.

Overall, food security has identified and analyzed six key requirements for the future.

1. Balancing future demand and supply sustainably to ensure that food supplies are affordable.
2. Provide a sufficient supply of staple food and micronutrients rich foods without encouraging excessive consumption of unhealthy food.
3. Develop the food policies that will ultimately be beneficial to agriculture, human health and environment.
4. Achieving global access to food and ending hunger. This recognizes that producing enough food so that everyone can potentially be fed is not the same thing as ensuring food security for all.
5. Managing the contribution of the food system to the mitigation of climate change.
6. Maintaining biodiversity and ecosystem services while feeding the world.

Food Security and Future Requirement:

It aims to present a framework for thinking about the future priorities and challenges, with an emphasis on what needs to be done in future to tackle all problems.

1. Substantial changes will be required throughout the different elements of the food system and beyond if food security is to be provided for a predicted nine billion people upto 2050. More food must be produced sustainably through the spread and implementation of existing knowledge, technology and best practice, that enables food producers to benefit from all of these. Waste in all areas of the food system must be minimized.
2. Addressing climate change and achieving sustainability in the global food system need to be recognized. The food system makes extensive use of non-renewable resources and consumes many renewable resources in the nature. It releases greenhouse gases, nitrates and other contaminants into the environment. Directly, and indirectly through land conversion, it contributes to the destruction of biodiversity
3. It is necessary to regenerate moves to end hunger. Greater priority should be given to rural development and agriculture sector to address issues such as malnutrition and gender inequalities.
4. A collaborative effort to build more sustainable food production, processing, distribution and consumption to enhance economic, environmental and social health.
5. To maximize the benefits of globalization and to ensure the food security. The food system is globalised and interconnected. This has both advantages and disadvantages.

Per capita consumption:

Per capita consumption is nothing but quantity of the specific product available to the per unit of the population in the country per day or year. There has been a gradual shift in consumer demand from cereals to high value items such as fruits and vegetables, dairy products, meat and fish according to NSSO (National sample survey office). Expenditure on essential items (food, clothing) is declined to percent contribution to total consumer expenditure as shown in Table 1.

Table 1: Per capita net availability of foodgrains per day in India (grams per day)

Year	Cereals	Pulses	Food grains	Milk	Fruits	Vegetables
1990	431.5	41.1	472.6	----	----	----
2009-10	407.0	37.0	444.0	258	75	285
2010-11	407.0	31.6	438.6	281	92	300

2012-13	408.6	35.4	437.1	298	182	363.2
2016-17	443.7	43.0	486.8	355	200.6	378.13
2017-18	465.3	54.7	488.7	375	207.9	393.76

(Source: NSSO and Horticultural Statistics at a Glance 2018)

Currently food grains constitute about one fifth of the total value of output from the agriculture and allied sector which is less than the contribution from the livestock sector. (S*ource: CSO*).

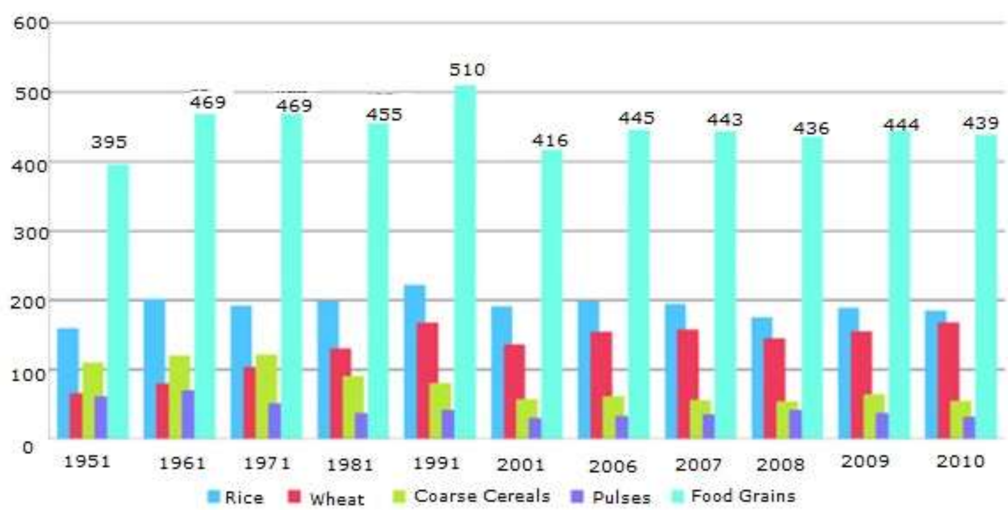
The shares of fruits and vegetables and livestock have shown an increasing trend in recent years implying that they have been growing at a much faster rate than the traditional crops sector. The percent calorie supplied by carbohydrates, fats and proteins in Average diet shown in table 2.

Table 2 % Calorie provided in the diet

Diet	**% Calorie provided in the diet**		
	Carbohydrates (%)	**Proteins (%)**	**Fats (%)**
Western Diet- Adults	40-55	15-20	30-40
Indian Diet - Middle Income group	65-75	10-15	15-20

The per capita per day net availability of cereals and pulses declined since 1990's. Availability of the food grains (grams per capita per day) shown with the help of table 3.

Table 11.3 Per Capita Availability of Cereals and Pulses



India has made substantial progress in terms of overcoming national food insecurity by giving priority to self-sufficiency in food grain production by following an agricultural strategy well known by the name 'green revolution'. As a result of the new strategy, the food grain production increased from 82.02 million tonnes in 1960-61 to 281.37 million tonnes in 2018-19.

India's estimated food grain production for the year 2018-19 is **281.37 MT**, which is increased with 9% as compared to year 2014-15. Indian food industry accounting for 16% of world population and 12% of world food production, today India is one of the largest producers and consumers of food in the world.

According to Ministry of Agriculture India's output of fruits and vegetables increased by to 284.74 MT in 2018-19 as compared to 281.75 MT in 2017-18. It indicates that the country has achieved self sufficiency in the minimum nutrition requirement of fruit and vegetable. It is estimated that per capita fruits availability in our country is 207.9 grams per day which is far below the recommended quantity of 230 grams per capita per day.

Factors affecting present trends of consumption:

Gradually people are changing their consumption style with modern era. Following are some of the parameters useful to know about the changing consumption trends:

1. Changing life style: changing life style and lesser time to spend in kitchen have resulted into the introduction of new products like pasta, soups, RTE.
2. Health Consciousness: As people are becoming more health conscious, there is a growing trend towards well packed, branded products rather than the loose and unpacked formats. People focuses on the health attributes so demand of nutritional food, food drinks increases.
3. Varying consumer behaviour: Food consumption pattern of urban Indian families has changes dramatically to accept the western culture. Consumers prefer trying new add-ons to their meal for experiencing varied flavours and taste.
4. Generation Gap: It contains distinguishing features, fashion preferences and taste of the young generation. Their demand for fast food, semi processed and processed food increases due to impression of western culture.
5. Urbanization: Rapid urbanization has effect on food consumption by changes in dietary behaviour pattern. More calorie intake (cities with greater number of food choices) compared with rural work, produces obesity and diabetics.

6. Retailing: Supermarkets are now major players in the agri food economy in most part of the world. It provides nutritional benefits with substantial improvement in the standards of food quality and safety. Ex. Chilling of animal based food at competitive price.
7. Food industry marketing: Marketing has taken advantage of increased per capita income in developing countries, where consumers are spending more on foods. Many big industries use marketing campaign to catch the attraction of the consumer.
8. On the Go Consumption: Companies are gradually realizing the significance of new points of sale and consumption in the Indian market place. These include places like railway station and bus stand besides malls that have gained confidence in last decade. It increases the popularity of packaged food and RTE foods.
9. Decline in traditional food items: Economic survey shows that decline in consumption of traditional food items such as cereals, pulses, overall food grain availability. This decline is in fact a sign of prosperity with people consuming better quality food and diversifying the diet to non vegetarian food such as eggs, meat, fish along with fruits and vegetables.
10. Diet Diversification: It includes introduction of multiple new categories to cater to the specific group of population. Fortify the foods with nutrients and produce nutritionally balanced foods. Reduce contents like salt, sugar, saturated fats and anti-nutritional factors to selected category of peoples.

Research Findings and Conclusion:

1. With concern to food security and emphasis on future needs sustainable development in Agriculture is possible.
2. The contributions of fruits and vegetables and livestock have shown an increasing trend in recent years implying that they have been growing at a much faster rate than the traditional crops.
3. Though we got self sufficiency in terms of fruits and vegetables, per capita availability is still lower than the global average.
4. Due to different factors peoples are gradually shift their taste and preferences from traditional food items to high value added food items.
5. Collaborative efforts for more sustainable food production, processing, distribution and consumption to enhance economic, environmental and social health.

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Formulation and Quality Evaluation of Finger Millet (Ragi) Fortified Cookies

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Abstract

India is the agriculture nation and largest producer of millets. As per the studies carried by scientist there is huge need for treatment of cholesterol related diseases, awareness and child feeding and nutrient supplementation. The present investigation is carried out for the formulation of finger millet (Ragi) cookies. This research work aimed at development and innovation of cookies fortified with Ragi flour. Ragi is the richest source of calcium and magnesium than other millets. For the formulation of cookies refined wheat flour and Ragi flour taken in the ratio of 90:10, 80:20 and 70:30 respectively. The sensory evaluation is carried out by semi-trained panel members to find the consumer acceptability of the prepared cookies. Chemical analysis carried out to determine the nutritional content of the finger millet cookies. It was observed that the cookies prepared with 20% of Ragi were acceptable. The optimized Finger millet cookies had Protein (6.13%), Fat (21.13%) and Carbohydrate (60.13%). The prepared cookies are affordable for consumption.

Keywords: Finger millet, Nutritional content, Fortification, innovation, Analysis.

1. Introduction

The population of India is day by day increasing with the increase in capital the demand of consumption of bakery products is also increasing. The demand of bakery products is increasing at the rate of 10.07% per annum [1]. Baked products are very popular because of its convenience and easy availability. Moisture content of the baked product is very low so having the good perishability [2]. Bread, cookies, cake, pastries and muffins are the common bakery products. Cookies are also known as the flat cake which are crispy in texture [3]. Bakery products such as biscuits /cookies have high consumer acceptance and are important for delivering bioactive compounds in to human diet [4]. The important ingredients used in making the cookies are refined wheat flour, sugar, margarine, milk powder and baking powder.

Finger millet (*Eleusine coracana*) is traditional crop of Jharkhand also known as ragi, nachni or nageli. It is good source of carbohydrate, fiber, calcium and iron. Finger millets one of the important millet having the brick red colour and round in shape [5]. Karnataka is the biggest producer of the finger millet. Finger millet contains carbohydrate (81.5%), protein (9.8%), crude fiber(4.3%) and mineral (2.7%) [6]. Finger millet has the several health benefits it is useful in reducing the body weight. Good source of fiber so used in the reducing the cholesterol from the body. It act as the medicinal source as helpful in curing the diseases like anemia, diabetes, brittle bones and osteoporosis [7].

The main objective of the study is utilization of finger millet in the production of bakery product such as Finger millet fortified cookies and its quality evaluation with consideration of the sensory, physicochemical and shelf life study analysis.

2. Materials and Method

2.1 Raw materials

The required raw materials for the preparation of Finger millet cookies like Ragi, Refined Wheat flour, Sugar, Margarine, Milk powder, Baking powder, Cashew nut, Tutti-Frutti and Vanilla essence were procured from the Balaji super market, Loni kalbhor, Pune. Chemicals used for the analysis were analytical reagent (AR) grade and procured from Mumbai and used as such.

2.2 Methods

2.2.1 Preparation of Finger millet flour

The procured Finger millet (Ragi) was cleaned to remove the impurities. After that drying was carried out at 60°c in cabinet drier for 4 hrs by spreading the layer of ragi about 1.5cm. The dried Ragi was subjected for milling. The obtained flour was sieved using the 36 BSS sieve. The obtained flour was packed in HDPE packaging material for the further production and development of cookies [8].

2.2.2 Production of Cookies

Standardisation of product was carried out by formulating three trials (S_1, S_2 and S_3) with reference (S_0) to the standard recipe as given in the **(table no.01)**. The ingredients required for the preparation of the cookies were weighed according to the recipe. Refined wheat flour, Ragi flour and baking powder sieved. Creaming process carried out with the addition of refined sugar using cream beater for 10-15 min. Flour was mixed with the creamed mixture. Milk powder first dissolved in water and then added. Water was added according to the requirement until the final consistency not obtained. Kneading process carried out and dough prepared. Sheeting process of the prepared dough carried out with the help of sheeting machine. Cashew and tutti- frutti added on the top surface for the appealing purpose. Cutting was carried out with the help of moulds for the desired shape. Baking was done at 140°C for 15 min. cooling of the baked product was done at room temperature. The prepared cookies were packed in HDPE packaging material as the primary packaging material and finally in the plastic trays.

Table no. 01 Innovations and trials:

Sr. No.	Ingredients	S_0	S_1	S_2	S_3
1	Refined wheat flour (g)	100	90	80	70
2	Finger millet flour (g)	-	10	20	30
3	Sugar (g)	55	55	55	55
4	Margarine (g)	50	50	50	50
5	Milk powder (g)	5	5	5	5
6	Tutti-frutti (g)	5	5	5	5
7	Cashew (g)	5	5	5	5
8	Baking powder (g)	1	1	1	1
9	Vanilla essence (drop)	1	1	1	1

Process flow sheet

Weighing of all the ingredients

↓

Sieving of ragi flour, refined wheat flour and baking powder together

↓

Creaming of margarine

↓

Addition of sugar and then creaming for 10-15 min

↓

Addition of flour to creamed mixture and knead it

↓

Addition of water as per requirement to get medium soft consistency of dough

↓

Pre-heat oven at 140°C

↓

Sheeting

↓

Moulding

↓

Place the moulded cookies in baking tray

↓

Baking (140°C for 15 minutes)

↓

Cooling

↓

Packaging and Storage at cool and dry place

Figure no. 1 Process flow sheet for cookies

2.2.3 Different analysis

2.2.3.1 Sensory analysis

The sensory evaluation of different organoleptic characteristics i.e. colour, appearance, taste, flavour and overall acceptability were carried out by semi trained panellist by using 9 point Hedonic scale. The average score was calculated for individual organoleptic properties. Sensory evaluation is carried out by 10 evaluators for various sensory attributes from like extremely to dislike extremely.

2.2.3.2 Physicochemical analysis

The Physicochemical analysis was carried out to determine the nutritional and quality attributes of the prepared cookies. For the determination of the nutritional qualities the cookies were converted into the powdered form. The proximate or nutritional composition including moisture, protein, fat, carbohydrate, ash and mineral composition was carried out. The moisture content of the cookies was determined by dry oven method [9]. The ash content of the cookies sample was determined by the standard procedure as given in AOAC [10]. Protein and Fat content of the sample were estimated by AOAC methods [11]. Carbohydrate was analysed by methods given in the manual of AOAC [12]. The mineral analysis was carried out according to the standard procedure [13]. The physical parameters like Diameter and thickness were calculated using vernier calliper.

2.2.3.3 Shelf life study analysis

The storage studies were carried out for 60 days in the HDPE packaging material with the consideration of different parameters like OAA score, moisture content and weight of cookie at dry storage condition and room temperature. The inspection and observation were carried out after every 15 days from the initial.

3 Results and Discussion

3.1 Sensory evaluation

Sensory evaluation of cookies carried for the acceptability of the product from the consumer. The data obtained from the (**table no. 02)** Revealed that the sample no. 2 was more acceptable [Refined wheat flour (80): Finger millet flour (20)] according to the OAA score. Study shows that as there was increase in the quantity of the finger millet flour the simultaneous effect on the sensorial parameters. Sensorial study revealed that the texture of the sample no 2 cookies have the more acceptance. The results obtained were also plotted in the form of spider plot graphical representation **(Figure. no. 2)** [14].

Table no. 02 Sensory analysis result

Sample	Colour	Appearance	Texture	Taste	Flavour	Overall acceptability
S0	8	8.1	7.5	7.8	7.8	7.7
S1	7.5	7.54	7.79	7.12	7.25	7.44
S2	7.91	7.79	8.04	7.91	7.62	**7.89**
S3	7.54	7.5	7.35	7.08	7.16	7.32

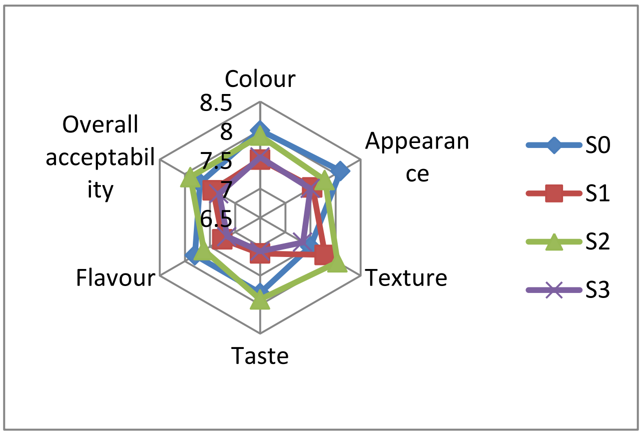


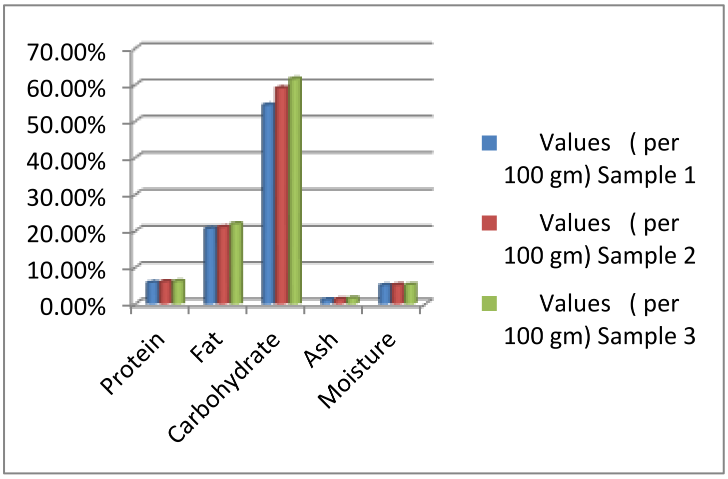
Figure no. 02 Graphical representation of sensory score

3.2 Physicochemical and storage study analysis

The physical and chemical analysis of cookies plays an important role for the quality determination of the product. The comparative results for the Nutritional composition of the three different trials were plotted in the (**Table no. 03)**The obtained results were also plotted in the graphical representation **(Figure.no.03)**. The results obtained for the standardised sample was given in the (**Table no. 04)**. The calorific value (451.17 ± 0.253 Kcal per 100 g.) of cookies was calculated by formula method the conversion used was 4 kcal g^{-1} protein, 4 kcal g^{-1} carbohydrates, 9 kcal g^{-1} fat. The study revealed that the prepared product was high in carbohydrate content (59.13 ± 0.033g). The obtained result showed that the iron and calcium content of the prepared cookies was (8.4 ± 0.124mg) and (144 ± 1.24mg) respectively. Physical parameters of the cookies like weight, diameter and thickness calculated. The result showed that weight, diameter and thickness of cookies (9.74 ± 0.01g), (5.12 ± 0.008cm) and (0.74 ± 0.009cm) respectively.

Table no.03 Nutritional composition of cookies

Test	**Values (per 100 gm)**			**Method**
	Sample 1	***Sample 2***	***Sample 3***	
Protein	5.9 %	6.12%	6.23%	Micro-kjeldahl system
Fat	20.73%	21.13%	22.02%	Soxtron fat extraction system
Carbohydrate	54.47%	59.13%	61.65%	By anthrone method
Ash	1.18%	1.34%	1.57%	By muffle furnace
Moisture	5.13%	5.25%	5.31%	Hot air oven
Iron	8.4 mg	10.138 mg	12 mg	Colorimetric method
Calcium	144 mg	160 mg	176 mg	Titration



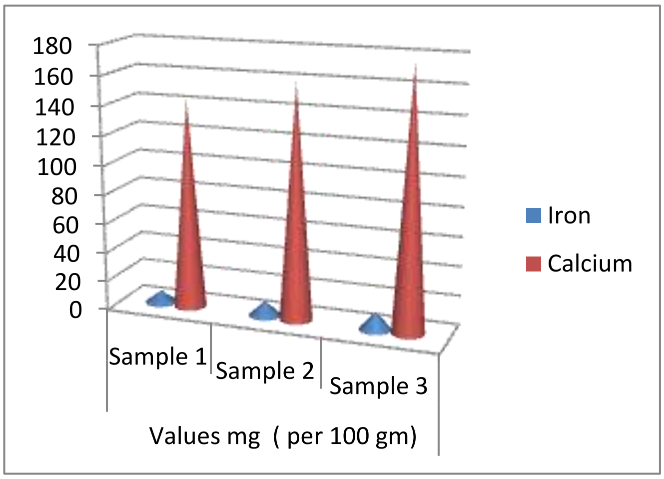


Figure no. 03 Graphical representation of Nutritional composition

Table no. 04 Physicochemical analysis of standardised formulation

Sr. No.	**Parameters**	**Values/100g**
1	Energy (Kcal)	451.17 ± 0.253
2	Protein	6.12 ± 0.008
3	Fat	21.13 ± 0.016
4	Carbohydrate	59.13 ± 0.033
5	Ash	1.34 ± 0.01
6	Moisture	5.13 ± 0.008
7	Iron (mg)	8.4 ± 0.124
8	Calcium (mg)	144 ± 1.24
9	Weight (g)	9.74 ± 0.01
10	Diameter (cm)	5.12 ± 0.008
11	Thickness (cm)	0.74 ± 0.009

The storage study analysis revealed that the reduction in the OAA score from the initial day to 60days. The results obtained were plotted in the **(Table no. 05)**. The moisture content of the cookies sample also increases from (5.13%) to (6.93%). Due to increase in the moisture content and due to the physicochemical changes the weight of the cookies sample also increases. The study showed that the prepared cookies sample have the shelf life of 60days at dry and room temperature storage condition.

Table no. 05 Results of storage study analysis

Sr. No.	Days	OAA score	Moisture content (%)	Weight (g)
1	0	7.89	5.13	9.74
2	15	7.84	5.15	9.77
3	30	7.8	5.98	10.02
4	45	7.2	6.18	10.32
5	60	6.9	6.93	10.95

Conclusion

The optimized ingredients composition for the cookies was refined wheat flour (80g), finger millet (ragi) flour (20g), Sugar (55g) and margarine (50g). The sensory studies shows that the cookies with (80:20) (refined wheat flour : finger millet flour) was more acceptable. The proximate composition of the prepared cookies was Carbohydrate (59.13 ± 0.033g), Protein (6.12 ± 0.008g), Fat (21.13 ± 0.016 g), Ash (1.34 ± 0.01g), Ca (144 ± 1.24mg), Fe (8.4 ± 0.124mg) and Energy (451.17 ± 0.253 kcal). The prepared cookies had the shelf life of 60 days at room temperature. The overall study has shown that the use of finger millet (ragi) has a huge potential for the preparation of fortified cookies. The utilization of millets can be enhanced with the help of production of bakery products.

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ICT tool application for Soil Water Conservation Structures Design

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Abstract: This issue includes article that takes over various methods and topics related to soil and water conservation, irrigation in the agriculture sector. This includes the various methods of building proper architectural infrastructure that provides the farmers to conserve water from evaporating and also from sipping into the soil. A firm analysis of soil texture, type, chemical properties, roughness and the drain properties are being calculated from over last5 years in Konkan region. This Proposed system would be a standalone application, or it would be a website, Android app too. Various e-Agriculture Related apps and websites are present but the system that is related to Konkan region is not yet present. The proper use of soil and water is must to ensure the future of our surroundings and out future Generations

This proposed system gives you the opportunity to test the soil properties and suggests you the proper infrastructure (Nala , Damns , Bridges, canals) . Depending upon the river, water source the system would decide which structure is appropriate for the desired location. The Soil bulk density and pH would be evacuated in this system. Rainfall and weather prediction would be also included in this system.

Key word: -Agriculture,e-Agriculture,apps,website

I. INTRODUCTION

Konkan region receives an average annual rainfall of 3500 millimeter. Still the region faces the water scarcity in the non-monsoon seasons. Due to hilly terrain most of rainwater goes quickly as the surface runoff and also causes severe soil erosion. Hence it is essential to harvest the rainwater.

Water harvesting refers to the act of runoff water storage in ponds for off-season use. Water harvesting can be achieved by construction of structures like farm ponds, small check dams, nala bunds, gully plugging, percolation tanks etc. These structures are integral part of the soil and water conservation activity and are important components of the watershed development and management programme. Nala bunds either made up of earthen material or cement masonry. It stores the water increase percolation improves soil moisture regimes and regulates flood water. Competent civil and agro-engineering techniques need to be used in the design, layout and construction of permanent check dams to ensure proper storage and adequate outflow of surplus water to avoid scours on the downstream side for long-term stability of the dam. It is therefore essential to make survey and study the geo-morphology of watershed for planning, designing and execution the work of soil and water conservation structures. The water harvesting structures need to be tested for hydrologic, hydraulic and structural design before their execution so as to ensure their safety as well as their functional efficiency.

In the state of Maharashtra, nala bunding

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works are being carried out since 1969. The soil and water management activities in the state are being carried out in integrated manner on watershed basis since 1983. Nala bunding is one of the important activities of the comprehensive watershed development programme in the state.

The Department of Agriculture, Government of Maharashtra has constructed earthen and cement structures commonly called as Nala bunds, in order to harvest surface runoff under various soil and water conservation programmes. Present study is undertaken to study and compare the design of cement nala constructed by the Department of Agriculture with the standard design. A cement nala bandh in the agricultural watershed of shivnari, Dapoli tahsil will be selected for evaluation with, the following objectives;

1) To design the cement nala bund by following standard design procedure for the site in Shivnari watershed
2) To compare the design parameters of existing cement nala bund with standard design.

Soil is the most essential source and need of food, protein fiber and shelter to us humans. Basically all the life in soil is perceived as something important. Soil plays an important role in day to day life as well as water too. During Rainy season the quality of the soil gets down to lack of important factors present in the soil. This proposed system allows the farmers and other villagers to maintain the soil quality and the level of the water above the ground and below the ground too. This proposed system helps to find out the best infrastructure for the need of conservation of water and soil based on the geographical analysis bass civil defense geographical and civil infrastructures that depending upon a wide range of soil type the soil covering the Earth surface takes many years to develop but the quality of the soil should be maintained. Sometimes to increase the amount of potassium in the soil the soiled has to be. Burnt but due to search manmade activities the quality of the soil gets degraded. Now going to the water conservation part we should not let the water operate so we should build some sort of infrastructure that helps us to analyse soil type texture chemical properties and the dream properties of the soil and the water in Maharashtra various types of soils are found mainly red soil black soil and the Texas soiled that includes rocks table stand

Soil erosion

In agriculture soil erosion is also known as the removal of the top layer of the soil by man made calamities or natural calamities what are the forces searches water wind air although these forces are associated with the farming activities in the village. The concept of erosion reviews the nutrient rich layer from the soil and its lost the potential of the soil to sustain the nutrients that provides the plant is being reduced. Without the water the soil becomes a land just like a desert that is unable to support life form thus we can say soil erosion is a naturally occurring process that affect all landforms and all and types. Soil erosion can be classified in mainly two types number 1. Accelerated and II geographical erosion

Water erosion

Globally we found CVR types of water erosion and soil erosion basically the detachment of soil particles from its original place due to the movement of water is called as water erosion first leading to the water from runoff rain and irrigation it may be caused due to snow melt contribute to the soil erosion but the rainy water is the main factor that leads to the movement of detachment of soil particles. the transportation for the teleportation of the soil erosion of the soil organic and inorganic particles with the water flowing along the slope deposits in the surface water bodies that leads to the landscape position change in the water is known as water erosion.

- ✓ **Hydraulic Ram:**

The hydraulic ram, sometimes abbreviated *Hydram* or *Hiram pump,* is a simple automatic device, which utilizes the kinetic energy of water falling from a moderate height to raise a part of it to much greater height. It is also called as "Zero Energy Pump". It is continuous in operation, requires no lubrication and supervision, need less maintenance and minimum wear and tear. In hilly region of India in general and Konkan in particular, there are numerous sites where hydraulic ram could be installed, thus reducing human drudgery in carrying head load of drinking water along hills or turning unproductive and unused lands to efficient farming unit. The simplicity of construction and automatic operation of hydraulic ram make it especially adapted to remote rural areas, which often have problems of non-availability of commercial energy sources such as electricity and lack of skilled manpower for maintenance and repair of engine/motors and pumps.

5 RESEARCH ACTIVITIES AND ACHIEVEMENTS:

a. Varieties /Implements released: NIL

b. Research Recommendations:

Department of Soil and Water Conservation Engineering of faculty of Agricultural Engineering is working on Natural resource management for sustainable agricultural production. This department is involved in the research activities related to soil and water conservation through watershed management in Konkan region. In last 10 years it has come up with 16 research recommendations which will be beneficial to farmers of Konkan region in improving productivity of agricultural produce. These recommendations are related to improved design of soil and water conservation structures for Konkan region, life of some important structures, hydrologic behaviour of watersheds in Konkan, selection of suitable structure and development of software for scientific and location specific design of soil and water conservation measures. Estimation of erosivity at various locations, development of erodibility maps and use of remote sensing and GIS for studies on soil erosion in Konkan region. These recommendations are as follows;

MATERIALS AND METHODOLOGY

This chapter presents the techniques and methodologies adapted to design and to evaluate cement nala bund selected for study. The structure was constructed during year 2010-2011 in Shivanari Watershed under the NWDP by the Department of Agriculture, Government of Maharashtra.

Location

Dapoli Taluka is confined in between Sahyadri hills at east and Arabian Sea at west have Geographical area of 86,400 ha, out of this 52,500 ha is cultivable area, 30,200 ha is cultivated area, 1,300 ha is culturable waste land, and 3,000 ha is current fallow. Dapoli Taluka ranges from Latitude-17^{0}36’ N to 17^{0}54’ N and Longitude-73^{0}05’E to 73^{0}20’E. The climate in this region is humid with relative humidity ranges from 55 per cent to as high as 99 per cent (Jagtap, 2004). The details of the structure selected for study are given in Table 3.1.

Table 3.1**: Details of water harvesting structures**

Sr.No.	**Description**	**Cement nala bund**
1.	Watershed location	Shivnari
2.	Gat No.	1/3
3.	Distance from Dapoli, km	27
4.	Year of construction	2010
5.	Storage volume claimed by Department of Agriculture, TCM	5.84
6.	Catchment area, ha	92 ha.

3.2) Design of cement nala bund:-

Design of cement nala bund structure was completed under hydrological design, hydraulic design and Structural design.

3.2.1) Hydrological design: watershed and climatical characteristic were consider for hydrological design of cement nala bund.

3.2.1.1) Determination of peak rate of runoff

$$Qpeak = \frac{CIA}{36}$$

Where,

Q_p = peak rate of runoff, m^3/s

C = Runoff coefficient

I = Intensity of runoff, cm/h for the design recurrence interval and for duration equal to the time of concentration (t_c) of the watershed

A = Area of watershed, ha

3.2.1.2) Calculation of runoff coefficient: -

Runoff coefficient was be decided upon soil type, land use and slope.

Table3.2: Value of C used in Rational method

Vegetation cover and slope	Soil Texture		
	Sandy loam	Clay and silt loam	Clay
Cultivation land			
0 - 5%	0.30	0.50	0.60
5 – 10%	0.40	0.60	0.70
10 – 15%	0.52	0.72	0.82
Pasture land			
0 – 5 %	0.10	0.30	0.40
5 – 10 %	0.16	0.36	0.55
10 – 15 %	0.22	0.46	0.60
Forest land			
0 – 5 %	0.10	0.30	0.40
5 – 10 %	0.25	0.35	0.50
10 – 15 %	0.30	0.50	0.60

3.2.1.3) Time of concentration

Time of concentration of watershed was determined by using the maximum length of flow and fall along the line.

$$tc = 0.00032\ (L)^{0.77}\ (S)^{-0.385} \quad \text{……(3.2)}$$

Where,

tc = Time of concentration, h

L = Length of flow, m

S = Watershed gradient, m/m

3.2.1.4) Maximum rainfall intensity

Maximum rainfall intensity, 'I' for Dapoli for a return period of 25 years was estimated as follow (Savane and Kubal, 2005)

$$I = \frac{7.9932\ T^{0.1814}}{(t + 1.0)^{0.811}} \quad \text{…… (3.3)}$$

Where,

I = Intensity of rainfall, cm/h for the design recurrence interval and for duration equal to the time of concentration (tc) of the watershed

T = Return period, year

t = Duration, h

3.2.2) Hydraulic design

3.2.2.1) Spillway width

The width of spillway will decided from the existing width of nala. The dimensions of spillway will be selected such that the peak flow of runoff can pass safely.

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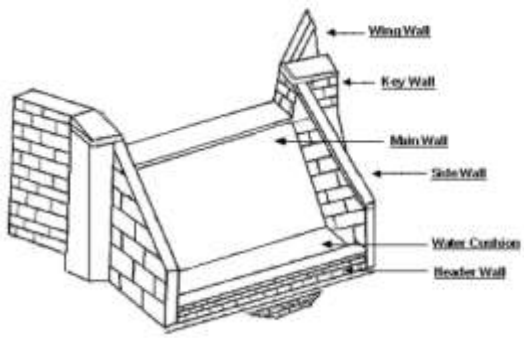

Fig 3.1. Isometric view of cement nala bund

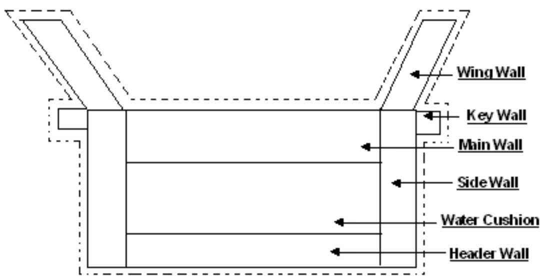

Fig. 3.2. Foundation Sketch of Cement nala bund

3.2.2.2) Flow depth

$$d = \left[\frac{Q_p}{1.711\,W}\right]^{0.67}$$

Where,

d = Flow depth, m

Q_p = Peak rate of runoff, m^3/s

W = Spillway width, m

3.2.2.3) Freeboard (f)

f = 1.5 (Y) …… (3.5)

Where,

f = freeboard, m

Y = 0.2 to 0.4

3.2.2.4) Gross freeboard (F)

F = f + d

Where,

d = Flow depth, m

3.2.2.5) Height of water storage

Height of water storage is 2/3 height of water

3.2.2.6) Total height of bund (H)

H = F + h ……. (3.7)

Where,

F = Gross freeboard, m

h= Height of water storage, m

3.2.2.7) Top width of bund (b)

$b = 0.55(H)^{0.5}$ …… (3.8)

Where,

H = Total height of bund, m …… (3.4)

3.2.2.8) Bottom width of bund (B)

$$B = \frac{H}{1.5}$$

3.2.2.9) Side slope of bund

Side slope of bund = 1: 0.60 (H: V)

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3.2.2.10) Water cushion

Height of water cushion, $d_w = 0.82(d)^{.33} h^{0.5}$ ...... (3.10)

Width of water cushion b_w = 1.33 x $[(d_w + h)^{0.5} \times d]$ ...... (3.11)

Depth of water cushion = $\frac{1}{6}$ (Width of water cushion) …… (3.12)

Length of water cushion, l_w = Length of Main wall

3.2.2.11) Apron

Width of apron = 2 (d + h) …… (3.13)

$$\text{Thickness of apron} = \frac{2 + (d + h)^2}{30}$$
…… (3.14)

Length of apron= Length of water cushion

3.2.2.12) Header wall Total len

Length of header wall = width of apron

Width of header wall (b_h)=0.6 m (minimum)

3.2.2.13) Key wall

Key wall width = Top width of bund

Key wall Height = Total height of bund

Key wall Length = 0.6 m (minimum)

3.2.2.14) Creep length

Creep length = 6 × water storage depth (d)

3.2.2.15) Side wall

Length of Side wall = (B - b) + b_w + b_h …… (3.15)

Width of Side wall =0.6 m (minimum)

Height of side wall and wing wall at junction = Total height of nala bund

Height of side wall and header wall at junction = 1.5 ×d

3.2.2.16) Wing wall

Length of wing wall = Width of side wall

Width of wing wall = 0.6 m (minimum)

3.2.2.17) Total length of nala bund

Length of nala bund = 2(Key wall Length) + Length of main wall + 2(width of side wall)

3.2.3) Structural Design of nala bunds

Structural design of water harvesting structure ensures the stability analysis of the structure. The stability analysis of the selected structures was carried out by checking factor of safety of each structure against sliding, overturning, crushing and tension. The various forces acting on structures moments developed and other factors are calculated in each case.

Singh *et al.* (1990) stated that a structure can fail in the following ways

i. It may slide forward

ii. It may overturn

iii. The material may get crushed due to maximum compressive stress acting normal to the section and

iv. The tensile stress set up in the section, which may open the joints of the masonry and ease its failure. Therefore stability analysis of masonry structure should be made for safety of structure.

The stability of the nala bund is due to the self-weight of the wall, perhaps aided by passive resistance developed in front of the wall. These structures can be classified as

i. Structure subjected to water pressure and

ii. Structure subjected to the earth pressure

The stability of the nala bund is due to the self-weight of the wall, perhaps aided

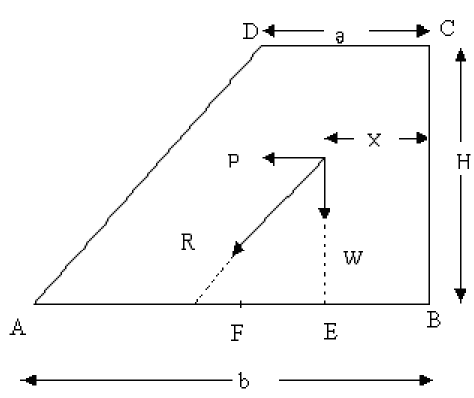

Fig. 3.3: Analysis of forces acting on nala bund

3.4.1) Structure subjected to water pressure

Weight of dam or retaining wall acting vertically downwards W and Horizontal water pressure P

The weight of dam per unit length is given by

$$W = \frac{(a+b)}{2} \times H \times \rho \quad \text{...... (16)}$$

Where,

a = Top width of nala bund,m

b = Bottom width of nala bund, m

H = Total height of nala bund, m

ρ = Density of masonry,gm/cc

And this acts at a distance

$$X = \frac{a^2 + ab + b^2}{3(a+b)} \quad \text{...... (17)}$$

The horizontal water pressure P is computed by using the formula for intensity of pressure of water at any depth

$$P = \omega X \quad \text{...... (18)}$$

Where,

ω = Density of water,gm/cc

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X = Depth below surface of water where pressure is measured

The horizontal water pressure is given by the area of the pressure intensity diagram

$$P = \frac{1}{2} \times h \times h \times \omega \quad ......(19)$$

$$A = \frac{\omega h^2}{2}$$

Where,

h = depth of impounding water,m

This pressure acts at a distance $\frac{H}{3}$ above the base when water is impounded, the resultant force on the dam is given by $R = (P^2 + W^2)^{0.5}$ and it act at base AB at F in Fig. 3.8.

When there is no water, the value of horizontal water pressure P is zero. Hence the resultant is given by R = W and it cut the base AB at E. The distance EF is called shift of reaction (Z). And the correlation between shift of reaction and the height of dam is given by

$$Z = \frac{P}{W} x \frac{h}{3} \quad ...... (20)$$

As O is the middle point of AB then

$$e = OF = BF - BO \quad ......(21)$$

$$e = X + Z - \frac{b}{2}$$

Where,

e = eccentricity

3.4.3) Condition for stability of structure

a) Safety against sliding

The horizontal water pressure, P causes the section to slide but it is resisted by the frictional resistance set up at the base. If μ is the coefficient of friction the maximum friction resistance set up is equal to μW. Hence for stability against sliding, P must never exceed μ W.

$$\text{Factor of safety} = \frac{\mu W}{P} \quad ...... (22)$$

b) Safety against overturning

For stability of the section against overturning the balancing moment must be equal to overturning moment

i.e. $$Z = \frac{P}{W} \times \frac{h}{3} \quad ...... (23)$$

Factor of safety against overturning = $\frac{\text{Limiting balancing moment}}{\text{Overturning Moment}}$

$$= \frac{W \times EA}{P \times \frac{h}{3}} \quad ...... (24)$$

c) Safety against crushing

In order to avoid crushing of the masonry at the base f_{max} the maximum compressive stress acting normal to the base must be less than the permissible compressive stress for the masonry.

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i.e. $f_{max} \leq$ Permissible compressive stress

Or $\frac{W}{b}\left[1+\frac{6e}{b}\right] \leq$ Permissible compressive stress …… (25)

d) Safety against tensile stress

To avoid tension within the structure, the eccentricity 'e' should not be more than b/6 on either side of middle base, i.e. about point O. The resultant R will have to be within the middle third of base. Hence for no tension at the base.

$$X + Z = \frac{2}{3} b$$

…… (26)

By following above procedure the cement nala bund was designed for Hydrological, Hydrualic and structural design. The designed dimension were compare with the dimension obtain from TAO office and during visit to structure the dimension were check by actual measurement.

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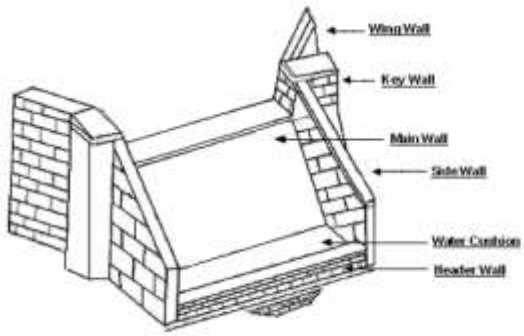

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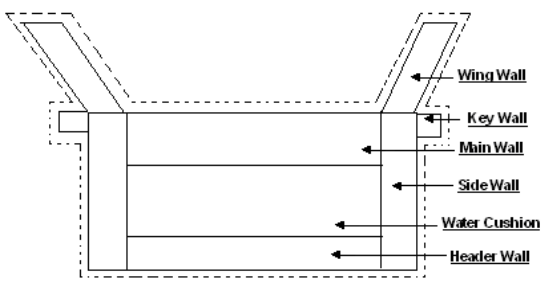

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Height of side wall and wing wall at junction = Total height of nala bund

Height of side wall and header wall at junction = 1.5 $\times$d

3.2.2.16) Wing wall

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Width of wing wall = 0.6 m (minimum)

3.2.2.17) Total length of nala bund

Length of nala bund = 2(Key wall Length) + Length of main wall + 2(width of side wall)

3.2.3) Structural Design of nala bunds

Structural design of water harvesting structure ensures the stability analysis of the structure. The stability analysis of the selected structures was carried out by checking factor of safety of each structure against sliding, overturning, crushing and tension. The various forces acting on structures moments developed and other factors are calculated in each case.

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Singh *et al.* (1990) stated that a structure can fail in the following ways

v. It may slide forward

vi. It may overturn

vii. The material may get crushed due to maximum compressive stress acting normal to the section and

viii. The tensile stress set up in the section, which may open the joints of the masonry and ease its failure. Therefore stability analysis of masonry structure should be made for safety of structure.

The stability of the nala bund is due to the self-weight of the wall, perhaps aided by passive resistance developed in front of the wall. These structures can be classified as

iii. Structure subjected to water pressure and

iv. Structure subjected to the earth pressure

The stability of the nala bund is due to the self-weight of the wall, perhaps aided

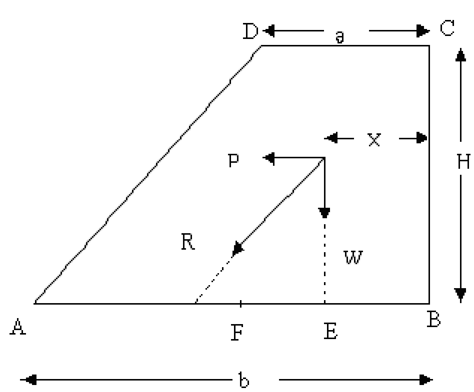

Fig. 3.3: Analysis of forces acting on nala bund

3.4.1) Structure subjected to water pressure

Weight of dam or retaining wall acting vertically downwards W and Horizontal water pressure P

The weight of dam per unit length is given by

$$W = \frac{(a+b)}{2} \times H \times \rho \quad \ldots\ldots (16)$$

Where,

a = Top width of nala bund,m

b = Bottom width of nala bund, m

H = Total height of nala bund, m

ρ = Density of masonry,gm/cc

And this acts at a distance

$$X = \frac{a^2 + ab + b^2}{3(a+b)} \quad \ldots\ldots (17)$$

The horizontal water pressure P is computed by using the formula for intensity of pressure of water at any depth

$$P = \omega X \quad \ldots\ldots (18)$$

Where,

ω = Density of water,gm/cc

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X = Depth below surface of water where pressure is measured

The horizontal water pressure is given by the area of the pressure intensity diagram

$$P = \frac{1}{2} \times h \times h \times \omega \quad ......(19)$$

$$A = \frac{\omega h^2}{2}$$

Where,

h = depth of impounding water,m

This pressure acts at a distance $\frac{H}{3}$ above the base when water is impounded, the resultant force on the dam is given by $R = (P^2 + W^2)^{0.5}$ and it act at base AB at F in Fig. 3.8.

When there is no water, the value of horizontal water pressure P is zero. Hence the resultant is given by R = W and it cut the base AB at E. The distance EF is called shift of reaction (Z). And the correlation between shift of reaction and the height of dam is given by

$$Z = \frac{P}{W} x \frac{h}{3} \quad ...... (20)$$

As O is the middle point of AB then

$$e = OF = BF – BO \quad ......(21)$$

$$e = X + Z - \frac{b}{2}$$

Where,

e = eccentricity

3.4.3) Condition for stability of structure

a) Safety against sliding

The horizontal water pressure, P causes the section to slide but it is resisted by the frictional resistance set up at the base. If μ is the coefficient of friction the maximum friction resistance set up is equal to μW. Hence for stability against sliding, P must never exceed μ W.

$$\text{Factor of safety} = \frac{\mu W}{P} \quad ...... (22)$$

b) Safety against overturning

For stability of the section against overturning the balancing moment must be equal to overturning moment

$$\text{i.e.} \quad Z = \frac{P}{W} \times \frac{h}{3} \quad ...... (23)$$

Factor of safety against overturning = $\frac{\text{Limiting balancing moment}}{\text{Overturning Moment}}$

$$= \frac{W \times EA}{P \times \frac{h}{3}} \quad ...... (24)$$

c) Safety against crushing

In order to avoid crushing of the masonry at the base f_{max} the maximum compressive stress acting normal to the base must be less than the permissible compressive stress for the masonry.

i.e. $f_{max} \leq$ Permissible compressive stress

Or $$\frac{W}{b}\left[1+\frac{6e}{b}\right] \leq$$

Permissible compressive stress …… (25)

d) Safety against tensile stress

To avoid tension within the structure, the eccentricity 'e' should not be more than b/6 on either side of middle base, i.e. about point O. The resultant R will have to be within the middle third of base. Hence for no tension at the base.

$$X + Z = \frac{2}{3}\ b$$

…… (26)

By following above procedure the cement nala bund was designed for Hydrological, Hydrualic and structural design. The designed dimension were compare with the dimension obtain from TAO office and during visit to structure the dimension were check by actual measurement.

SUMMARY AND CONCLUSIONS

Summary

The study was undertaken to evaluate the water harvesting structures (cement nala bund) constructed by the Department of Agriculture, Maharashtra State. The cement nala bund at Shivnari watershed situated in Dapoli Tahsil of Ratnagiri District was selected for study. The structure was constructed during 2010.

For design of cement nala bund by using Rational method peak discharge (3.692 m^3/s) was calculated. The height of cement nala bund, spillway position and relative dimensions were calculated by considering hydrological and hydraulic design procedure and structural design. Existing peak flood of watersheds was more than the estimated peak flood due to incorrect runoff coefficient. The cement nala bund was calculated for the hydrological, hydraulic and structural design. The dimension of existing nala bund was compared with design dimensions for the existing structures. The results of comparison are summarized as below

Most of the design and existing dimension of cement nala bund was more or less same. Major differences were in total height of bund, height of water cushion, depth of water cushion, width of water cushion, width of apron, thickness of apron, length of side wall. The cement nala bund existing peak flood computed by the Department of Agriculture (21.722m^3/s) was more than the estimated peak flood(3.692m^3/s). The cost of construction of existing nala bund was found to be higher than the cost calculated for the structure, designed by the standard procedure. Stability analysis revealed that selected nala bund was found to be safe from stability analysis.

Conclusions

From the analysis of data and results obtained from comparison

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between existing and designed dimensions of the nala bund following conclusions are deduced.

1. In cement nala bund, total height of existing cement nala bund was 0.6 m higher than designed nala bund. Dimensions of other components viz. total length of bund, bottom width of bund, height of water cushion, width of water cushion, width of apron, thickness of apron, key wall length, key wall height, length of wing wall, length of side wall were lesser than existing cement nala bund structure.
2. The cost of construction of dam computed by Department of Agriculture was found to be 62.86 % higher than the actual cost calculated by the standard design procedure.
3. The existing and designed dimensions of nala bund are found to be safe from stability point of view.
4. The procedure used by the Department of Agricultural needs to be modified by considering the hydrologic, hydraulic and structural design and form economical point of view of the nala bund.

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Impediments to Efficient Storage Practices for Food-Processing MSMEs in Pune

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Abstract

Micro, Small and Medium Enterprises (MSMEs) have been one of the leading contributors to India's growth as well as the competitiveness. But one crucial aspect that daunts the country's entrepreneurs is India's logistics sector, especially its storage and warehousing (S&W) sector. Previous studies have captured warehousing inadequacies in the country but do not focus on the plight of smaller enterprises. Based on a purposive sample of 54 food-processing MSMEs in Pune, the paper focuses on analysing the problem of storage and warehousing. Based on structured interviews, it was found that the MSMEs lack the finance to avail extensive storage facilities even though they deal with highly perishable products. The impediments to the usage of storage facilities are high costs, distance from processing centers, space insufficiency, and outdated technology. The main impact is on the scale of production of MSMEs, which was below their potential because firms do not have adequate storage space. Lack of adequate storage facilities also has a direct effect on the amount of food loss, the prices realized from sales and the market share. MSMEs in Pune perceive that better and more affordable facilities shall help cut costs and increase output and profits.

Keywords: food-processing, MSME, storage, warehousing, food loss

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1 Introduction

The last five decades have been a monumental period for the Micro, Small and Medium Enterprises (MSMEs) in the country. They contribute significantly to industrial production output, exports, and generate the maximum employment only second to agriculture (Ministry of Micro, Small and Medium Enterprises, 2018). But these triumphs often conceal the various limitations that MSMEs face even to date. One crucial aspect that daunts the country's entrepreneurs is India's logistics sector, especially storage and warehousing. Storage and warehousing (S&W) is an integral link between production units and consumption centers; inefficiency in this link would then cause massive disruption to the supply chain management. However, this sector in India remains at its nascent stage with unorganized and fragmented players, leaving major scope for improvements (Das, Rathi, Bachkaniwala, Bangera & Gupta, 2014).

Generally, food processing units face a lot of problems related to underutilization of resources capacity, technological obsolescence (handling and storage) and high volatility in market prices. Because the produce under food processing units is highly perishable, the varying requirement of processing conditions and expensive cold chain facilities tend to add to the woes as compared to other industries (Kachru, 2012). Hence, the focus of this research paper is to identify the extent to which storage and warehousing pose problems to the food-processing MSMEs in Pune, further drawing inferences from the collected data to understand plausible trends among the surveyed MSMEs.

Studying the S&W sector should, therefore, be not just from a performance perspective but also from the inclusivity standpoint. The S&W sector in India has been propelled in the recent past with investment initiatives but drawbacks still persist when it comes to efficiency or affordability. Food-processing MSMEs deal with highly perishable products and are in dire need of adequate storage facilities. Research points out that the lack of availability or cost constraints forces them to continue business in the absence of storage facilities and has unwelcome consequences on food wastage, prices, and market share.

The Hindu Business Line (2012) reports that since warehouses are primarily under the control of small/local providers, the sector is highly fragmented. Presence of small players who occupy a majority of the market share is the main reason for low capacities, poor handling and monitoring facilities. Intense competition from non-registered business entities that offer a smaller space for storing goods is another challenge to overcome. Smaller sizes limit the ability of warehouse owners to invest in high–quality construction, technology, and modern material handling equipment.

Das et al. (2014), Nath (2011), Asian Productivity Organization (2016) give elaborate accounts of the state of warehousing sector in India, the recent growth rate trends and its performance improvement as compared to other countries. Authors such as Adigal (2015), Negi & Anand (2015) have elucidated the warehousing problems in India and have given a remarkable illustration of its relationship with post-harvest losses. The ASSOCHAM (2013) study further mentions that India, despite being a leading global food producer continues to be one of the largest food wasters on an annual basis. These articles and reports have portrayed improvements in the S&W sector to be a need of the hour for the country.

However, previous literature focused on highlighting the effects of warehousing inadequacies on smaller stakeholders such as MSMEs is quite limited. The current study, thus, strives to bring to light an aspect that has constantly been overlooked and yet deserves great attention. The paper, therefore, focuses solely on food-processing MSMEs in Pune, it being one of the leading producers of horticulture as well as dairy products. The underlying aim of the research is not only to identify common storage practices undertaken by small enterprises, but to also understand the perceptions of various MSMEs with regards to storage facilities, affordability, and efficiency. Through descriptive analysis and statistical tools, it can be revealed that most food-processing units in the city rely on godowns (basic storage facilities) that help them minimize costs but agree that restructuring and improvement in the S&W sector can help boost their output and profits.

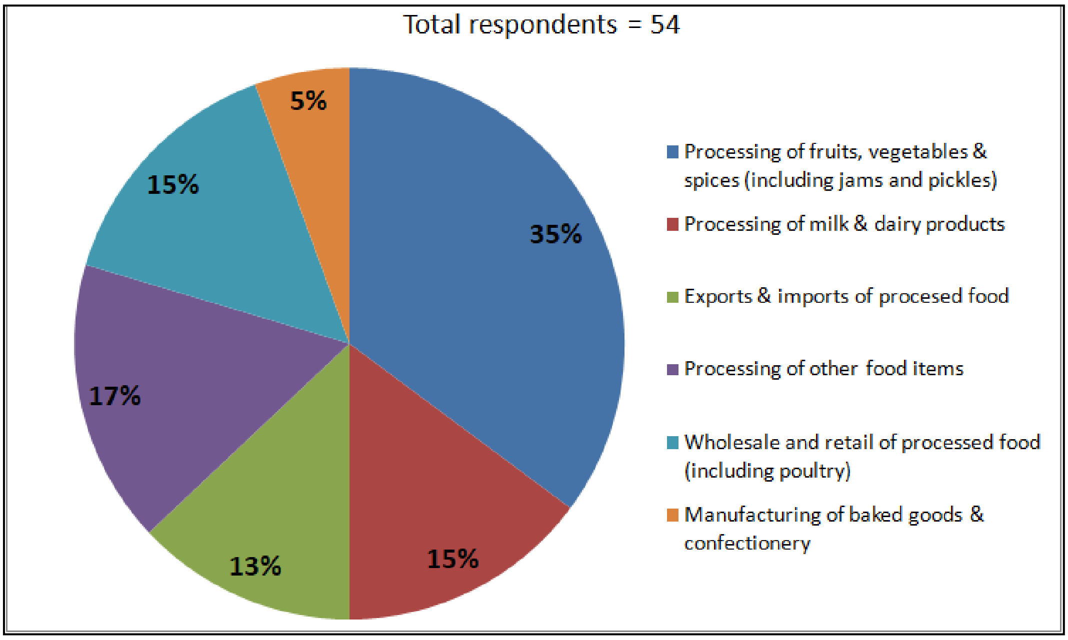
2 Data and Methods

A cross-sectional analysis was adopted for the purpose of the survey. It is a type of observational study that analyzes data from a population, at a specific point in time. We have collected data through mailed questionnaires, personal interviews, and telephonic interviews. The total respondents of our research totaled 54 from all three methods of response collection. The respondents were MSMEs in Pune that engaged in the processing of agricultural products into one or more forms of food. The MSMEs dealt in either primary, secondary, tertiary food-processing or in a combination of two or more.

In the above context, primary food-processing refers to transforming agricultural products into something edible or merely increasing the shelf life of the product. This includes shelling nuts, canning, milling, the butchering of meat, canning or pasteurizing milk. Secondary food-processing is the creation of food by using one or more agricultural products as the ingredients. This includes making wine, baking bread, making sweets or other dairy products. Lastly tertiary food-processing is the making of high-value ready-to-eat products like instant foods or health drinks.

Figure 2.1: Classification of respondents according to activity engaged in

Source: Primary Survey



3 Results and Discussion

For the primary research, 54 enterprises which fall in the category of MSMEs were surveyed out of which 39 were manufacturing enterprises and 15 provided services. 46 of these enterprises were run by a sole proprietor and 8 of them were a private limited company. These enterprises were randomly selected from different parts of Pune and varied on the basis of investment i.e., 9 of these enterprises fall in the category of microenterprises, 25 falls in the category of small enterprises, and 20 under medium enterprises. They also varied on the basis of the activities they are engaged in, which comprised processing of milk and dairy products, processing of fruits and vegetables, exports and imports of processed food products, manufacturing of baked goods and confectionery, manufacturing of pickles and spices, wholesale and retail of chicken, manufacturing of mix sprouts, jams and sauce, aloe vera juice and health drinks, food flavors and essences, and areca nuts.

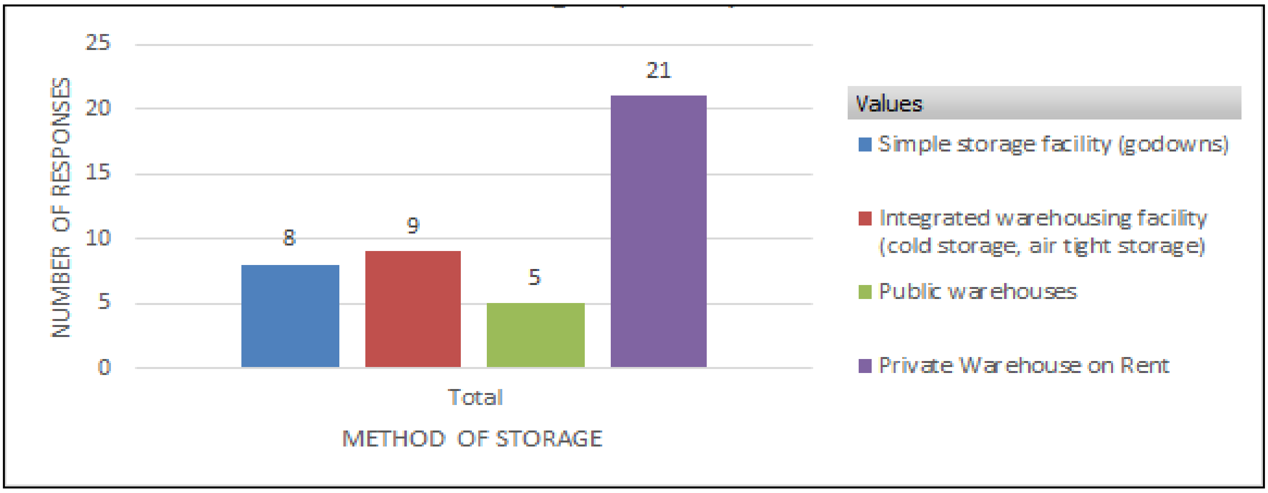
Storage practices

Storage is one of the key concerns of all businessmen. 48.1% of the MSMEs stored their goods before processing while 44.4% of the MSMEs stored their goods after processing. 16 MSMEs which comprise of 29.6% of surveyed MSMEs stored their products neither in godowns nor in warehouses. The enterprises which store their goods either own a warehouse/godown or store their goods in public or private warehouse/godown on rent. Among all the MSMEs surveyed, 8 owns a godown and 9 owns a warehouse. Some enterprises dealing in perishable items have a mini cold storage facility inside their shops. As the scale of operation of these MSMEs is limited so they have adopted the concept of a godown/warehouse in their shops for becoming self-sufficient in their day to day operation.

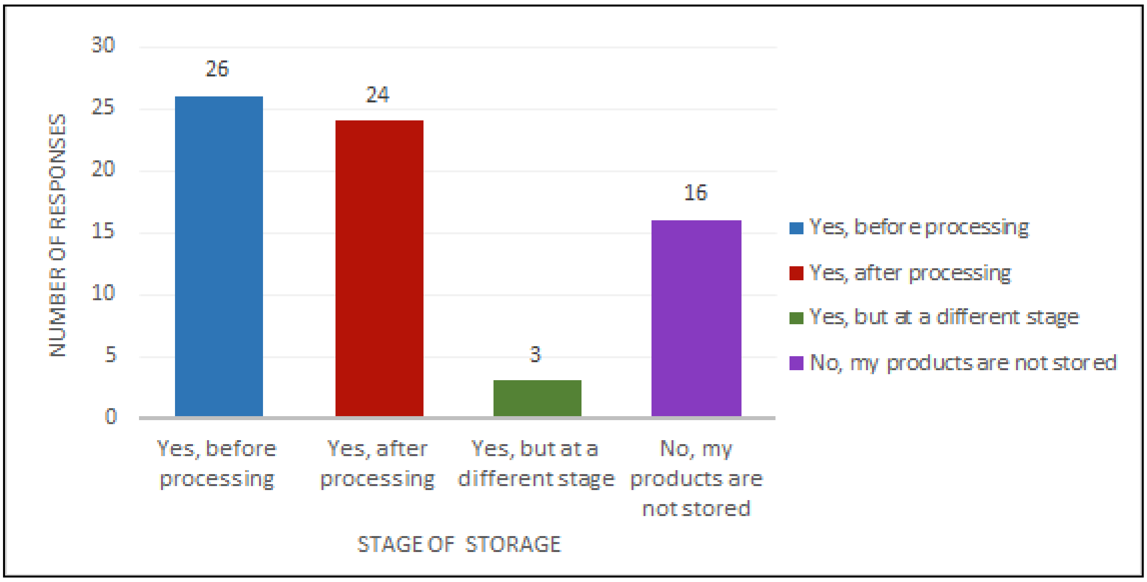
MSMEs have long battled the need for finance and continue to do so till date. The Government of India through its various schemes and ministries have attempted and encouraged the construction of public warehouses across the country. This is mainly undertaken by Food Corporation of India (FCI), Central Warehousing Corporation (CWC), and State Warehousing Corporation (SWC). Public warehouses are definitely cheaper and are meant to cater to the needs of those who cannot afford private warehousing facilities. However, the survey portrayed surprising results as out of those who opted for rented storage, a mere 8 availed public warehousing facilities as opposed to 21 MSMEs that availed private warehousing facilities on rent.

The main reason observed behind this trend was the unsatisfactory conditions of public storage facilities. Despite increased efforts as quoted by government reports, stakeholders of these facilities report that the technology used is outdated, the supply is far less than demand and the added problem of product losses due to power cuts and improper storage. The majority of MSMEs made use of warehouses as they deal in agricultural produce or processed food, their perishable nature being a concern for immediate spoilage would mean that integrated warehouses that allow for temperature and humidity regulations are better suited for longer shelf life and better sales. Enterprises that availed both godowns and warehouses (owned or rented) were mainly engaged in the processing of fruits & vegetables or in the exporting and importing of processed food products (Figure 3.1).

Looking at the stage at which storage is practiced reveals that 26 respondents or store their products before processing and close behind is the count for those storing after processing, 24 respondents. Out of the total responses received, it is observed that enterprises that engaged in exporting and importing of processed food products were mostly the ones to make use of storage facilities at two different, followed by those that produced pickles, jams, and a few that undertook primary processing of fruits & vegetables. Several MSMEs that engaged in primary processing of agricultural produce were revealed to not store their products at all (Figure 3.2).



Source: Primary Survey



Source: Primary Survey

The 16 MSMEs which do not store their goods in warehouse/godowns either do not require storing their goods or are not able to store their goods either due to high costs or unavailability of warehouse/godowns. Out of these 16 enterprises, 31.5% sell their goods immediately after processing/manufacturing either because the goods are perishable such as fruits and milk products or due to a high value of the goods such as cotton bail. Those that responded as not requiring warehousing facilities sold their products immediately after processing or mentioned that production was undertaken as per demand for their products. These enterprises also bought raw materials depending on the demand of their customers. Hence they were able to continue business without suffering from product losses or wastage of raw materials. Immediate selling of high-value goods helps in reducing the risks associated with the good. Whereas the others that were seen to not store their products did so because of two reasons, one being the costs of warehousing facilities and the other being

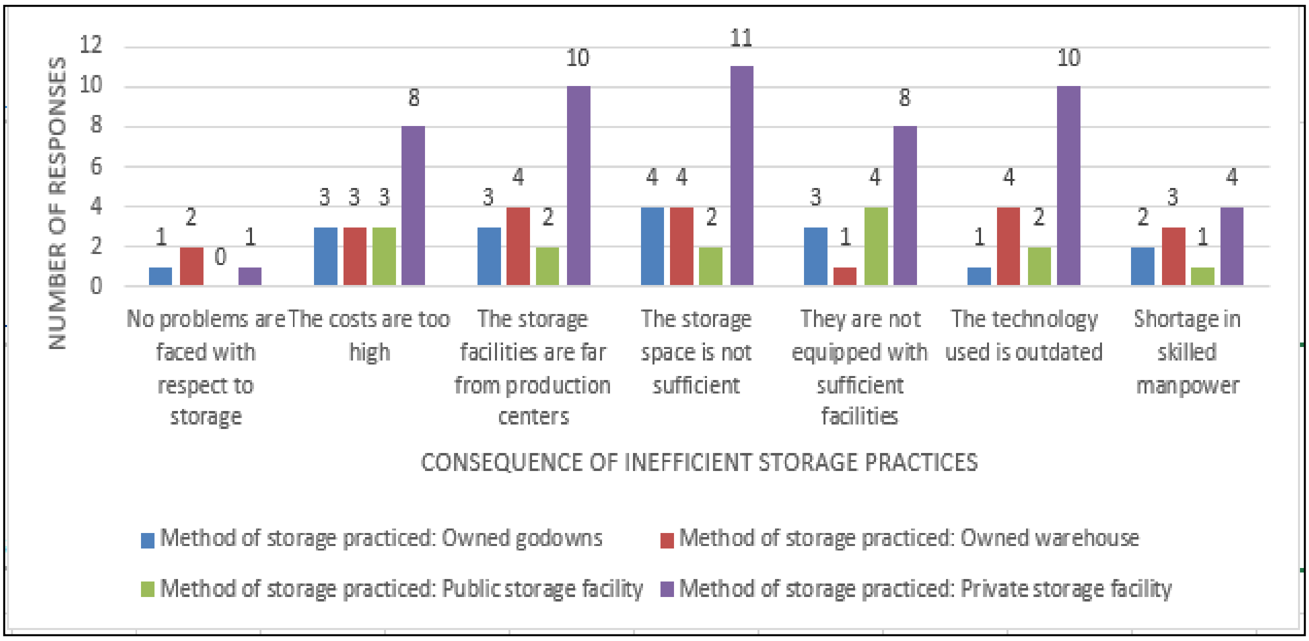
	Scale of enterprise

unavailability of these facilities close to their enterprise. Having to avail storage facilities that are at a considerable distance from the center would only add to transportation costs. The problem of cost constraint is evident to be a concern to micro, small as well as medium scale enterprises.

Factors that contribute to storage problems and their consequences

During the survey, we learned about various problems that are faced by MSMEs regarding the storage facility used by them (Figure 3.3). Majority of the MSMEs conceded and the results are as follows:

- 22.2% believed that no problems are faced with respect to their current storage method whereas 40.7% of the MSMEs believed that the costs of storing into warehouse/godowns are very high.
- 37% of the MSMEs said that the warehouse/godowns are located away from production centers.
- 38.9% believed that the current storage space is not sufficient.



Source: Primary Survey

Table 3.1: Consequences of inefficient storage practices

Consequences of inefficient storage practices	Micro	Small	Medium	Total
Manufactured/processed foods are gone to waste because of damage	4	9	11	24
The production is less than potential because excess products cannot be stored for future	6	15	8	29
The prices realized are low	4	9	9	22
Inability to capture a bigger market share	6	7	7	20
There is no scope for exporting our products	2	8	6	16
Others	1	2	1	4

Source: Primary Survey

The main reasons for warehousing problems as recalled by MSMEs are high costs, distance from processing centers and space sufficiency. These were seen to have direct impact on the amount of wastage that was incurred, the prices realized from sales, production levels, and market share. Relatively fewer enterprises identified these issues as affecting their ability to export products. These consequences are more or less equally worrisome to micro, small as well as medium scale enterprises. However, the main impact was believed by the respondents to be on their production scale. It was reported by 29 MSMEs that they currently have an output value which is less than their predicted potential. This is because many enterprises are forced to process only as per demand in the market. Since many products are perishable in nature, lack of warehousing facilities means that massive sales cannot be practiced during the off-season periods. Agricultural products once procured have to be processed immediately and sold off, leaving no scope of storing for a better period. Furthermore, this was of the greatest concern to small scale enterprises. Closely after this was the problem of wastage, with 24 responses, this being led by medium scale enterprises (Table 3.1).

Udyog Aadhar Registration

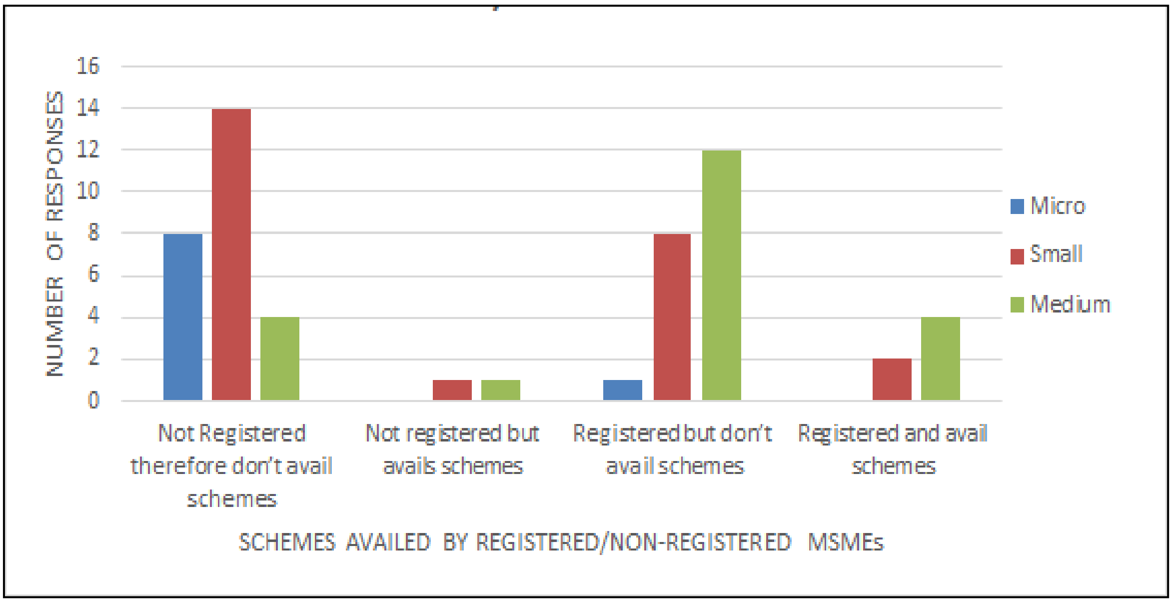
Udyog Aadhar is a twelve digit Unique Identification Number provided by the M/o MSMEs, Government of India for small and medium enterprises in India. 37 of the surveyed enterprises were registered under Udyog Aadhar and the remaining 17 did not get themselves registered due to various reasons. The three main reasons which were identified were Cumbersome Procedures, Unavailability of the required documents, Unawareness of the process. 12 of 17 enterprises agreed that they were unaware of the process or about the presence and use of Udyog Aadhar. This, in fact, highlights an alarming shortcoming of the Ministry of MSMEs. Despite their serious efforts to improve the ease of the registration process, along with making it absolutely cost-free; the results have not been quite promising as expected.

But the point of greater focus is the availing of schemes. Registration under the M/o MSME is encouraged first and foremost because it makes the enterprise eligible to avail schemes that are rolled out by the concerned ministry. To our dismay, the enterprises when questioned were unaware of any schemes regarding warehousing facilities provided by the Ministry. Amongst those who identified themselves as registered but not availing any schemes, 3 respondents quoted that the reason behind the same was that the eligibility criteria for availing the schemes could not be met by the enterprise. The criteria include profit levels, years since commencement and locality. Therefore as per the study conducted, registration had minimal effects on the S&W aspect of MSMEs (Figure 3.4).

Source: Primary Survey

Summary of perception based questions

According to the survey conducted by us the perspectives of the MSMEs on the various aspects of



the enforcement and efficiency of the MSME Act are as follows:

- 53.7% disagreed (including strongly disagree) that there are sufficient number of warehouses/ godowns in the MSME area whereas only 25.9% agreed (including strongly agree) to it.

- 55.5% disagreed that there were warehouses/godowns located near the production centers while only 31.4% agreed to it.
- When asked about the affordability of the warehousing/ godown facilities or services, 42.5% disagreed that they are affordable while only 20.3% agreed that they are affordable.
- A majority of people i.e. 68.5% people disagreed that the public warehousing/ godown facilities are of good quality whereas only 14.8% agreed to it
- 40.7% disagreed that they have enough options between public and private warehousing/godown facilities to choose from whereas 42.5% agreed to it.
- When asked about the positive direct relation among higher profits and better warehousing facilities a majority of them strongly agreed i.e. 94.4% while only 5.5% of them were indifferent. None of the respondents disagreed.
- Also, 90.7% of them agreed that better warehousing/ godown facilities will minimize the product losses while 7.4% were indifferent and 1.9% disagreed to it.

Table 3.2: Perception of MSMEs towards the ability to earn higher profits and minimize losses

		Products are sold immediately after processing
Higher profits can be earned with better storage facilities	Strongly disagree	0
	Disagree	0
	Indifferent	1
	Agree	5
	Strongly agree	11
Product losses can be minimized with better storage facilities	Strongly disagree	0
	Disagree	1
	Indifferent	1
	Agree	3
	Strongly agree	12

Source: Primary Survey

The main hypothesis of whether improved storage facilities can help increase the profitability of the business and reduce losses is proved through the above table. The respondents claimed to have not used any storage facilities as the products were sold immediately after processing, but out of the 16 of them agreed that storage facilities can help them earn better profits, with only 1 respondent being indifferent. And on the other hand, respondents were positive that storage facilities if availed can help them reduce losses, with 12 respondents portraying strong acknowledgment.

4 Conclusion

Though food processing units are one of the most important industries in the study area, the respondents were seen facing manifold problems. Where public warehouses face technological problems and inefficiency issues, the private warehouses make MSMEs face problems of being situated far away from production centers. When such problems are realized by the owners of the various enterprises, they try selling off their products immediately after they are processed (putting in godowns which are also prone to rodents) so that they do not incur huge losses and thus adjusting their sales pattern accordingly. A better warehousing facility, including good and timely transportation, can ensure higher profits, as agreed to by almost all the respondents we collected data from. A proper regulation to guard against poor catalyst of low production can bring forth cost-efficiency in the production line and help in reducing the price ultimately paid by the consumers. The Ministry of Micro, Small and Medium Enterprises should take measures to reduce constraints faced and work towards making schemes approachable to one and all.

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Millet Processing: A Profitable Enterprise

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Abstract: The credit of establishing the "Agricultural processing unit" on millet processing at Timmapur village of Shiggaon Taluk, Haveri district in 2012 goes to Mr.Manjunath Bagade. Earlier Mr. Bagade's father had flour mill in 1963. Even though Mr. Bagade studied till SSLC, he has achieved a lot in millet processing and marketing in Karnataka. When he started processing unit, he had only cleaning and grading machines. But through his experience, University intervention, persistent hard work and dedication he fabricated different types of machineries for millet processing. Now he owns a large scale millet processing unit equipped with destoner, grading machine, dehusking machine with blower, semolina making unit and flour mill. Dehusking of millets like little millet, foxtail millet, barnyard millet, proso millet and brown top are taken up. Processing of millet is done up to 30 tons per month. He purchases grains from farmers and has established good value chain to millets and is a premier processor of millets in Karnataka. Preparation of animal feed is another venture he has taken up by using waste and unfilled grains. Net income received by processor is around 1,74,750/- month.

Key words: Macro processor, Millet processing, Marketing, Dehusking.

Introduction

Primary processing of millets is a vital step for obtaining grain-rice and for further processing of grains for consumption. Processing of millets which are without husk (naked grains) viz., sorghum, pearl and finger millet is easy, whereas processing of millets with husk namely little, proso, kodo, barnyard, foxtail and browntop millets is difficult. These have inedible husk which needs to be removed through processing. The major challenges in processing small millets are; small size of the grains, variations in the raw materials due to variation in varieties, cultivation practices , microclimate across production regions, variations across the crops and pest infestation and rancidity (Anonymous, 2016). Small millets are the staple food for millions. Farmers growing these millets also consume it themselves and one of the major bottlenecks is the non -availability of small scale mills. Their slow digestibility and nutritive value makes them one of the most preferred commodities even among health conscious population. Technology used for converting the grain into edible form and thereby enhancing its quality is known as processing. Processing of cereals and millets plays significant role during its utilization as food. Minor millets can be consumed by processing them into rice, flour, sprouting, roasted, popped, salted ready-to-eat grains, porridges and fermented products (Jaybhaye *et al*.,2014).

Millets are most commonly available in the form of pearled and hulled kind. In the absence of specialized processing machineries for millets, it is processed in wheat or rice processing systems. The grain recovery from these machineries is low varying from 63 – 79%, with 16 – 29% husk and 5 – 9% bran. The polished grain is called 'millet rice' and recovery of millet rice is not complete, about 10-15 % of grains remains still with husk and needs to be pounded and is laborious. These processing steps add value to these millets three to four-folds and make them acceptable to the elite urban consumers as niche food or health food.

Little millet especially needs to be harvested at right time or else falls to ground and gets damaged which calls for development of machinery for harvesting and threshing. Due to non-availability of proper milling technology the major constraints for wide spread utilization of millet are its coarse fibrous seed coat, coloured pigments, astringent flavour and poor keeping quality of the processed products (Desikachar, 1975). Hence the study was taken up to document the millet processing machineries and economics of "**Agricultural processing unit"** at Timmapur village.

Methodology

The study was conducted during the year 2018-19 at Timmapur village, Shiggaon taluk, Haveri district of Karnataka. An in-depth interview was conducted to elicit information on millet processing unit using self- structured questionnaire. It Consists of general information of the respondent as well as specific information regarding machineries used for processing, capacity of processing machineries, yield obtained after processing of different millets , expenditure of the processing unit, waste and its utilization, cost incurred for processing and income of the processing unit. Problems and challenges faced by unit were also recorded. Frequent visits were made to record the data.

Results

Earlier Mr Manjunath's family occupation was flour milling, later they started paddy milling. Some of the farmers were cultivating minor millets in and around Haveri district. So processing of millets i.e., dehusking was done at very small scale in the beginning, where dehusked grains were used for household consumption. With the projects of the Department of Foods and Nutrition millet melas were conducted and simultaneous efforts of Krishi Vigyan Kendras awareness was created among public which increased the demand of processed millets. As the awareness of beneficial effects of millets increased the quantity of millets growing and dehusking also increased. During 2001 Shri Manjunath earned Rs. 6000 per month. With the intervention of UAS Dharwad and Department of Food Science and Nutrition the equipment like de-stoner, grader and dehuller were installed to improve the quality of the de-husked grains.Earlier 15-20 percent of grains remained unhusked, whereas with intervention the quality of the grains improved with less than one percent of unhusked grains. Training of millet vermicelli and other products, packaging, marketing avenues were provided by KVK, Dharwad and KVK Hanumanamatti. With this he got interest in fabrication of machineries and installed large scale machineries.

Table 1: Processing machineries prevailing in agricultural processing unit

Sl. No.	Particulars of machineries	Output/ Performance	Power requirement (hp)
1	Vermicelli maker	500 kg/day	5
2	Grader	300 kg/hr	1
3	Destoner	300 kg/hr	2
4	Dehuller	300 kg/hr	3
5	Rice polisher	300 kg/hr	3
6	Millet polisher	250 kg/week	5
7	Flour mill	200 kg/day	5
8	Pulveriser	200 kg/hr	5
9	Chilly Pounder	150 kg/hr	1
10	Rice cleaner	150 kg/hr	3
11	Rava making machine with grader	100 kg/hr	10
12	Feed grinder mixer	500 kg/hr	5

Table 1 shows that processing machineries prevailing, their capacity and power requiredfor them in agricultural processing unit. In the unit per day 500 kg vermicelli was prepared but the process is seasonal depending on the customer demand. Grader, destoner, dehuller and rice polisher yield grains up-to 300 kg per hour. 250 kg millets are polished per week and for one day 200 kg flour can be milled. Rice cleaner and chilly pounder gives 150 kg per hour output. 100 kg rava can be prepared for an hour. Preparation of animal feed was another venture he has taken up by using waste and unfilled grains, about 500 kg animal feed was prepared per hour.He has fabricated graders, de-stoners, winnowing and de-husking machineries using available spare parts so he achieved maximum efficiency and less cost for installation. These findings are parallel with studies of Singh (2010) who tried to mechanize the milling process by developing dehuller for barnyard millet and optimized the machine parameters for maximizing efficiency, minimizing specific energy consumption and broken grains. The actual dehulling efficiency (88.3±2.8%), specific energy consumption (0.078± kW h/kg grain) and broken grain (6.1±1.1%) were obtained with the optimized machine parameters (9 canvas strips and 3 mm over hanging width) and operational parameters (8.6 m/s peripheral speed; 5 passes and 8.4% db moisture content).

The Agriculture Processing Unit runs with overall 60 hp power source. To avoid the power problems during the power cuts he installed diesel engine generator and modified it with tractor engine parts so that 6 to 8 hours per day the unit can run continuously.

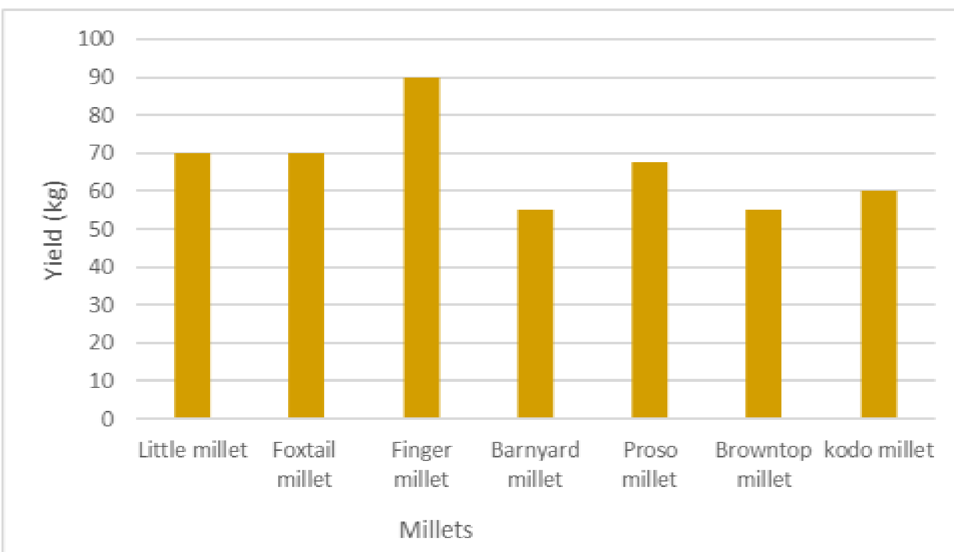

Figure 1: Dehusked grains obtained after processing in Agriculture processing unit of Timmapur

Figure 1 indicated that dehusked grains obtained after processing unit. Dehusking of the different millets were done in the unit. After polishing 1 quintal of Finger millet it yields about 90 kg grains, little

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and foxtail millet yields an average 70 kg with a range of 65 to 70 kg followed by proso millet (60 to 75kg), kodo millet (55 to 65 kg), barnyard and brown top millet (50 to 60 kg).Yield of the millet rice depends on the crop season,variety, maturity of the grain, moisture content of the grain, cleanliness of the grain and thickness of the pericarp.These findings are parallel with studies of Hadimani et al. (1995) who found that yield of pearl millet rice varied according to variety.Thirty eight cultivars of pearl millet in McGill mill for 30 s under 1.4 kg pressure and glumeswere separated by aspiration. The yield of pearled grains and brokens varied from 80.0 to 96.8% and 0.9 to 30.3%, respectively. Similar studies on head yield and bran of minor millets and pearl millet grains found to vary from 63.2 to 90.0%, and 5.0 to 11.0%, respectively. Lohani and Pandey (2008) also revealed that still lower milling percentage in barnyard millet (70.77) at 10% moisture level and found that the degree of polish increased with increase in time of milling but at the cost of linear decrease in milling yield and exponential decrease in the head yield. Thus, there is significant difference in milling percentage and head yields among the milled millet types and this may be attributed to the intact hard seed coat and relative difference in size of grains of particular millet.

Table 2: Cost incurred for processing of millets by Agriculture processing unit of Timmapur

	Particulars	**No/Q**	**Rate(Rs)**	**Amount (Rs)Per month**
Variable cost	Purchasing of all millets	507 quintal	3526.6	17,88,000
	Labour	6 no.	300/day	54,000
	Electricity	1 month	30000	30,000
	Packaging material	600 polyethylene bags	20	12,000
	Spare maintenance	1 month	10,000	10,000
	Grease	5kg	300	1,500
Fixed cost	Interest on building infrastructure loan			30,000
	Interest paid on Machinery loan			1,00,000
				20,25,500/-

Table 2 indicated the cost incurred for processing of millets by agriculture processing unit. For purchasing of all millets from the farmers he paid 17,88,000/- rupees. Everyday engaging 6 labours it accounted for 54,000 rupees. He spent on an average 30,000 rupees as electricity bill. For packaging

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material and spare maintenance he spends 10 thousand rupees per month on an average. For machinery about 5 kg of greasing is done which costs about 1500 rupees. For construction of processing unit he spent 15 lakh rupees and now he is getting maintenance charge of Rs.30,000 per month. Machinery installation he spent 20 lakh rupees and per month the maintenance fee is 1lakh rupees. In this way Mr. Manjunath Bagade getting 20,25,500 Rupees of monthly expenditure of the processing unit.

Table 3: Gross income realized by processor of Agriculture processing unit of Timmapur

Activity	Output per month (q)	Selling price (Rs/quintal)	Amount (Rs)
1.Millet processing			
a)Little millet rice	72.42	6500=00	4,70,750=00
b)Browntop millet rice	30	13,000=00	3,90,000=00
c)Foxtail millet rice	75	5000=00	3,75,000=00
d)Barnyard millet rice	30	7000=00	2,10,000=00
e)Proso millet rice	40	7000=00	2,80,000=00
2. Animal feed preparation	300	1600=00	4,80,000=00
Total			**22,05,750=00**

Gross income obtained from different operations by processor of Agriculture processing unit is presented in Table 3. Little millet rice is the maximum selling millet in the unit and gross income realized by selling 72.42 kg of little millet rice on an average was rupees 4,70,750/- per month. Similarly by selling browntop millet, foxtail millet, barnyard millet and proso millet his gross income is on an average 3.9 Lakhs, 3.75 Lakhs, 2.1 and 2.8 lakhs rupees respectively. Sri Manjunath Bagade is fruitfully utilizing the waste viz., preparing animal feed using husk and immature grains by which he earns 4.8 Lakhs. Totally his gross income is Rs.22,05,750/- per month. Excluding his expenditure he is getting 1,74,750/- Rupees profit per month. The unit will run for 6 months per year depending on the availability of the raw materials. In the off season he educates the farmers about the health benefits of millets and cultivation practices by conducting programs in villages.Seasonal deficiency and high cost of raw materials has been the most important constraints affecting his processing business.

Conclusion

The above discussion on the economic aspects shows that millet processing has been sustainable agri based enterprise in Haveri district. The availability of millet rice has promoted the consumption of millets. In Karnataka large scale millet processing units are countable, in that Mr. Manjunath Bagade is one of the successful entrepreneurs.

Acknowledgment

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Prediction of Irrigation Water Quality Parameters in Konkan Region using Artificial Neural Network Technique

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ABSTRACT

The Ratnagiri districts has a coastline and creeks, agricultural land is reported to be saline due to sea water ingress along the coast and creeks. Ground water quality has become saline therefore rendering it unsuitable for irrigation. Prediction will help to suggest the type of amendment to be adopted or suitable measure to be adopted in that area. In the present study, artificial neural networks (ANN) were used to derive and to develop models for prediction KR (Kelly's Ratio), Percent Na (Percent Sodium), PI (Permeability Index), RSC (Residual Sodium Carbonate), SAR (Sodium Absorption Ratio) and SSP (Soluble Sodium Percentage) as groundwater quality parameters of Ratnagiri District by using post monsoon season values of existing groundwater quality parameters collected for time period 1999-2014 from GSDA, Navi Mumbai as input variables i.e. Na, Mg, K, $CaCO_3$, HCO_3. The ANN model was developed with multilayer feed forward back propagation (MLFBP) with sigmoid transferred function. While developing ANN model for different input parameters, three steps were followed as identification of model structures, evaluate the performance and adopting model for forecasting. The model development data set was further divided into three subsets; training set; cross validation set and testing set in 70:15:15 proportions. The ANN models were developed for prediction KR, Percent Na, PI, RSC, SAR and SSP using Neurosolutions. Performance of model was evaluated by statistical criteria included correlation coefficient, Root Mean Square Error, Index of Agreement, Mean Bias Error. The analysis revealed that selected ANN based model shown correlation coefficient (r>0.95), RMSE(<0.3438), IA(>0.91) and MBE(<-0.2450) for Model 3-2-1 to predict KR, Model 4-2-1 to predict percent Na, Model 4-6-1 to predict PI, Model 4-4-1 to predict RSC and Model 3-6-1 to predict SAR and SSP during post monsoon season. The results confirmed that developed ANN models found suitable for prediction of water quality indicators used for irrigation purpose. The recommend number of nodes in hidden layer can be used for modelling of water quality indicators under limited data conditions.

(***Key words***: Artificial neural network, Water quality parameters, Irrigation Water Quality)

Artificial neural network is a massively parallel distributed information processing system that has certain performance characteristics resembling biological neural networks of the human brain (Junsawang *et al*., 2007). ANN was developed as a generalization of mathematical model of human cognition or neural biology. Their development was based on the following rules: Information processing occurs at many single elements called nodes, also referred to as units, cells or neurons. Signals are passed between nodes through connection links. Each connection link had as associated weight that represents its connection strength. Each node typically applied a non linear transformation called an activation function to its net input to determine its output signal.

The basic building block of an ANN was neuron. They receive an input and produce an output, which was to be passed to other neurons in other layers. Neurons having similar characteristics in an ANN were arranged in groups called layers. The neurons in one layer were connected to those in the adjacent layers, but not to those in same layer. The strength of connection between two neurons in adjacent layers was represented by connection strength or weight/s. Similar study was carried out by Khandelwal and Singh (2005) Yesilnacar *et al.* (2008) and Ehteshami *et al.* (2016) and predicted result of chemical parameters of groundwater by ANN was very satisfactory and acceptable and seen to be a good alternative of groundwater parameter prediction

Materials and Methods

An ANN normally consists of three layers, an input layer, a hidden layer and an output layer. Input layer usually received input signal values. Neurons in output layer produce output signal. ANN found useful for modeling and prediction of uncertain and complex phenomena. A neural network trained from previous data to forecast future events, without accurately understanding physical parameters which influence present and future events. In training network was adjusted based on comparison of output and target, until network output matches the target. The number of nodes in input layer depends on number of parameters used in estimating Residual sodium carbonate (RSC), Sodium adsorption ratio (SAR), soluble sodium percentage (SSP), Permeability index (PI), Percent Sodium (% Na) and Kelly's ratio (KR). In present study six input parameters namely, CO_3^{2-} , HCO_3^- , Ca^{2+}, Mg^2, K^+ and Na^+ were considered as nodes in input layer.

The available data was divided into a model development set and evaluation data. According to Rao and Rao (1995) and Kumar (2002, 2008) the data was then normalized in order to train network.. The model development data set was further divided into three subsets; training set; cross validation set and testing set in 70:15:15 proportions. The first subset was used for computing and updating the network weights and biases where as second subset was used for cross validation. The error in validation set was monitored during the training process. When validation error increases for a specified number of iterations, training was stopped, and weights and biases at the minimum of the validation error were returned. The most common architecture; composed of the input layer, where data are introduced, the hidden layer where data were processed and output layer where results of given inputs were obtained was used with learning functions namely Levenberg-Maquardt learning algorithm (Zanetti *et al*., 2007). Single hidden layer with sigmoid transfer function in both input layer and hidden layer was used. The network was trained for 5000 epochs and with goal for mean squared error of 0.001. The number of neurons in input and output layers were fixed as per given combinations. The numbers of neurons in hidden layer were varied as per input parameters in input layer i.e. maximum twice input parameters (2n) in order to get best performance.

The evaluation of performance of different ANN model for different station was done using statistical analysis. The artificial neural network techniques were also used for evaluation of groundwater quality parameters during post monsoon seasons for irrigation purpose. The ANN models were tested using different statistical indicator such r, MBE, RMSE and I.A. (Jacovides and Kontoyiannis, 1995, Vazquez and Feyan, 2003, Willmott, 1982 and Stockle *et al.,* 2004)

Results and Discussions

The ANN model was developed with multilayer feed forward back propagation (MLFBP) with logistic sigmoid transferred function. While developing ANN model for different input parameters, three steps were followed as identification of model structures, evaluate the performance and adopting model for forecasting. The ANN models were developed for prediction KR, Percent Na, PI, RSC, SAR and SSP using Neurosolutions. In ANN modeling the KR, Percent Na, PI, RSC, SAR and SSP, selection of model parameters are very important i.e. input, output and model structure.

Performance of ANN for different neurons in hidden layer for KR

Table 1 showed that, correlation coefficient (R) of model 2 was highest among all three models but the IA was high in model 1. Mean bias error and RMSE for model 1 was lowest among all. MBE values indicate negative sign that's means it underestimating the values of KR. Therefore, model 1 (3-2-1) was better for predicting KR values during post monsoon season in Ratnagiri district.

Performance of ANN for different neurons in hidden layer for percent Na

It is observed from Table 1 that, R and IA values found to be constant for training, testing and cross validation in all cases. But values of MBE and RMSE changes more comparatively in training, testing and cross validation to R and IA values. It may due to the fact that MBE was found to be nearer to zero and therefore changes were more visible on small scale. MBE was lowest in model 1.

MBE values indicate negative sign that's means it underestimating the values of percent Na. RMSE was lowest among all models. Performance of Model was better as compared to model 2 and model 3. Therefore, for post monsoon season model 1 (4-2-1) model was best suited for prediction of percent Na values during post monsoon season for Ratnagiri district.

Performance of ANN for different neurons in hidden layer for PI

It is observed from Table 1 that, correlation coefficient (R) for training and testing and cross validation 1.00, 0.98 and 0.99 was observed. There was very close index of agreement for training, testing and Cross Validation 1.00, 0.99 and 0.99, respectively for model 3. Mean bias error was close to zero in negative direction. RMSE was observed lowest among all the models for training, testing and cross validation in post monsoon season for Ratnagiri district. In Ratnagiri district, for post monsoon season model 3 (4-6-1) model was best suited to predict PI.

Performance of ANN for different neurons in hidden layer for RSC

Data pertaining to performance indices viz. Correlation coefficient (R), Index of Agreement (IA), Mean Bias Error (MBE) and Root Mean Square Error (RMSE) of different models for changing number of neurons is given in Table 1. It was observed that, R values in training, testing and cross validation was nearly equal for all considered models. In the case of IA that, change in the number of neurons in hidden layer improved performance of ANN models. But values of MBE and RMSE changes more comparatively in training, testing and validation to the R values. The value of correlation coefficient and IA was equal in model 2, 3 and 4. MBE and RMSE was low as in model 2 compared to other three models. Model 2 (4-4-1) was best suited to predict RSC in Ratnagiri district for post monsoon season among four models.

Performance of ANN for different neurons in hidden layer for SAR

The correlation coefficient (R) for training (0.98), testing and cross validation (0.97) was observed. An index of agreement for training (0.97), testing (0.90) and Cross Validation (0.91) was observed. Mean bias error close to zero. The biasness which was indicated by Mean Bias Error (MBE) represents underestimation when it was negative. RMSE was close to zero for training, testing and cross validation during post monsoon season for Ratnagiri district. Therefore, Model 3(3-6-1) was best suited to predict RSC in Ratnagiri district for post monsoon season among three models.

Performance of ANN for different neurons in hidden layer for SSP

It is observed from Table 1 that, the correlation coefficient (R) for training, testing and cross validation was observed 0.99 and index of agreement for training, testing and cross validation was observed 1.00 for model 3. Mean bias error close to zero and lowest among all models. The biasness which was indicated by Mean Bias Error (MBE) represents underestimation when it was negative. RMSE was also lowest among the entire model for training, testing and cross validation during post monsoon season for Ratnagiri district. Therefore Model 3 (3-6-1) was best suited to predict SSP in Ratnagiri district for post monsoon season among three models. It is also depicted from Fig. 1 that, comparison of actual KR value and predicted KR value from neural network. Also from 1:1 line graph it was clear that predicted ANNs values with observed KR values for testing and cross validation distributed well on both sides of the line. Similar trend was observed for per cent Na, PI, RSC, SAR and SSP.

Discussion

The different ANN models were developed for prediction of water quality indicators such as KR, % Na, PI, RSC, SAR and SSP to test the suitability of groundwater for irrigation purpose for post monsoon periods. The output of predicted water quality indicators were compared with observed parameters using statistical performance indicators. The analysis revealed that selected ANN based model shown correlation coefficient more than 0.98, index of agreement more than 0.98 with less bias error and mean error in terms of MBE and RMSE for post monsoon season. The analysis revealed that selected ANN based model shown correlation coefficient (r>0.95), RMSE(<0.3438), IA(>0.91) and MBE(<-0.2450) for Model 3-2-1 to predict KR, Model 4-2-1 to predict percent Na, Model 4-6-1 to predict PI, Model 4-4-1 to predict RSC and Model 3-6-1 to predict SAR and SSP during post monsoon season. The results confirmed that developed ANN models found suitable for prediction of water quality indicators used for irrigation purpose. The recommend number of nodes in hidden layer can be used for modelling of water quality indicators under limited data conditions. In 94.60 and 97.95 per cent of study area, the groundwater was found suitable for irrigation purpose as per irrigation water quality standards during ost monsoon season.

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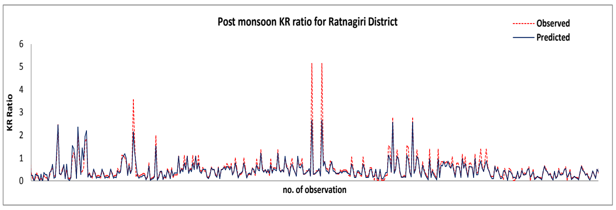


(A): Comparison of actual and predicted KR value from neural network

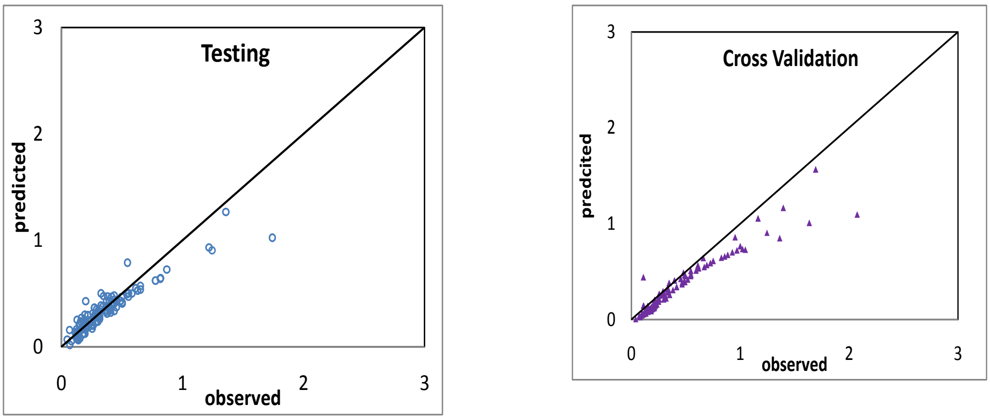


Fig. 1: Comparison of predicted with observed KR values for testing and cross validation (Post monsoon)

Table 1: *Performance of the various groundwater parameters*

Parameter	Architecture	Data set	Correlation	MBE	RMSE	IA
KR	**3-2-1**	Training	0.92	-0.0478	0.1674	0.94
		Testing	0.94	-0.0211	0.1005	0.94
		Cross validation	0.95	-0.0759	0.1451	0.95
percent Na	**4-2-1**	Training	0.98	-0.4682	3.2246	0.99
		Testing	0.99	-0.4081	2.0632	0.99
		Cross validation	0.99	-1.0383	2.6365	0.99
PI	**4-6-1**	Training	1.00	-0.0270	0.0719	1.00
		Testing	0.98	-0.0173	0.0725	0.99
		Cross validation	0.99	-0.0144	0.0629	0.99
RSC	**4-4-1**	Training	1.00	0.0379	0.0713	1.00
		Testing	0.99	0.0225	0.0579	1.00
		Cross validation	1.00	0.0335	0.0599	1.00
SAR	**3-6-1**	Training	0.98	-0.2176	0.3698	0.97
		Testing	0.97	-0.1348	0.2482	0.90
		Cross validation	0.97	-0.2137	0.3438	0.91
SSP	**3-6-1**	Training	0.99	0.0440	1.7385	1.00
		Testing	0.99	-0.4797	1.4172	1.00
		Cross validation	0.99	-0.2450	1.7354	1.00

PRODUCTION OF NATURAL BANANA BLOSSOM CONCENTRATE

Shwetha Acharya[1], C. R. Ramesh[2], Humeera Tazeen[3]

ABSTRACT

Most foods derive their characteristic flavour from bioactive compounds derived from plant sources present at levels ranging from parts per billion to parts per million. On the broad canvas of nature, some plant species evolved with far higher levels of flavour compounds than others. In the present paper banana blossoms were used as a source of flavour and to test its potential in flavouring other foods. Essential oils extracted by solvent method using dehydration banana blossoms found ready use in the soft drinks and confectionery. Banana blossom were pre-treated with 0.2% lactic acid solution to minimize enzymatic browning reaction and then dehydrated. The dehydrated banana blossoms were powdered and extraction was done by using ethanol and water. It was observed that ethanol extracted flowers gave the maximum yield.

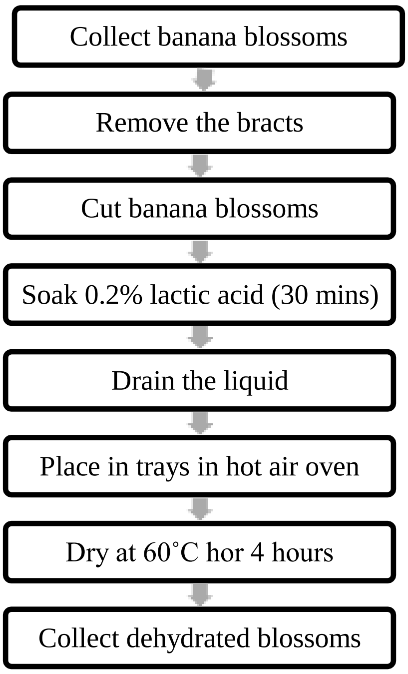
Keywords: Banana blossoms, dehydrated, extraction.

INTRODUCTION

Banana blossom ***(Musa paradisiaca)*** is a highly nutritious edible flower. It is rich in nutrients and antioxidants with several health benefits. To increase the shelf life of the banana blossoms, they are usually dehydrated. Kanchana *et al.* (2005). In southern Indian states people used banana blossom in preparation of curry paired with rice or wheat bread. According to Bhaskar *et al.* (2011) banana blossom contained abundant dietary fibre(5.74g/100g) that helps maintain health reduce cholesterol level and obesity. Researcher Loganayaki, *et al.* (2010) also quoted that banana flowers are good source of antioxidants that helps to resist various diseases. Banana blossom flower are usually extracted by using chloroform, water, and ethanol. According to Kumar (2012) banana blossom has tremendous nutritional value and health benefits which aids in treating bronchitis, dysentery, ulcers etc. Banana blossom is usually discarded as an agricultural waste, since its of high nutritional value it can be utilized as an ingredient in food formulations. Elaveniya *et al. (2014)* states that banana plants are now being cultivated in many countries and are largely produced with a production to 88 million metric tons. Banana blossom is considered as a by-product of banana cultivation. Banana plant as such, is beneficial in many ways.

Even today, flavor forms a significant part of the flavorist's repertoire and training normally covers the subject in great detail.

MATERIALS AND METHODS



Pre- Treatment for Banana Blossom

Fig 1. Flow Chart of Drying of Dehydrated Blossoms

Banana Flower Extract Preparation by Cold Extraction

1kg of dehydrated banana blossom powder was dipped in 95 % ethanol and incubated on rotary shaker at 80-120 rpm for 15 days at room temperature. The extracts were filtered (Whatman No.1 filter paper) and concentrated then placed on water bath to obtain crude extract. Venkatesh, K *et al.* (2013)

Sensory evaluation banana blossom extract

The flavour extracted from dehydrated banana blossom were subjected to sensory evaluation. The sensory evaluation and acceptability test were carried out using 9 point hedonic scale by 2 trained panel members and 2 semi trained panel members from the company. The banana blossom extract showed highest scores of 8.8, 8.6, 8.7, 8.5, 8.6 and 8.7 for appearance, texture, colour, aroma, taste and overall acceptability respectively. Sensory evaluations of sample are presented in the Fig. 2.

RESULTS

Results obtained during the experiment show that the samples of banana blossoms powder were analysed for proximate composition using AOAC (Association of Official Analytical Chemists) methods. The nutritional values of the banana blossoms are mentioned in below table 1.

Table 1. Nutrient Compositions Banana Blossom

Nutrient compositions	Content (%)
Moisture	14.4
Protein	1.4
Fat	0.66
Ash	1.5
Crude fiber	37.5
Carbohydrates	83.39

Sensory evaluation of banana blossom extract showed highest scores of 8.8, 8.6, 8.7, 8.5, 8.6 and 8.7 for appearance, texture, colour, aroma, taste and overall acceptability respectively. Sensory evaluations of sample are presented in the Fig. 2.

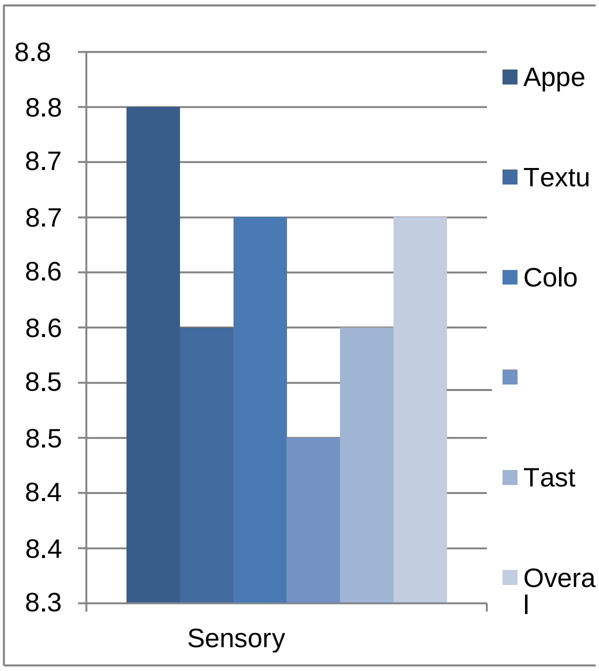


Fig 2. Sensory Evaluation of Banana Blossom Extract

CONCLUSION

Results obtained showed that the banana blossom after pre-treatment reduced browning; by immersing banana blossom slices in 0.2 % lactic acid solution for 30 minutes followed by drying at 60˚C for 4 hours was acceptable with respect to appearance, flavor and overall quality.

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Smart farming- Way of Agricultural Development

R. S. Patil[1], M. M. Kadam[2]& G. A. Wandare[3]

Abstract

Smart farming represents the application of modern Information and Communication Technologies (ICT) into agriculture. Following the plant breeding and genetics revolutions, this Third Green Revolution is taking over the agricultural world based upon the combined application of ICT solutions such as precision equipment, the Internet of Things (IoT), sensors and actuators, geo-positioning systems, Big Data, Unmanned Aerial Vehicles (UAVs, drones), robotics, etc.Smart Farming has a real potential to deliver a more productive and sustainable agricultural production, based on a more precise and resource-efficient approach.The process of applying robotics, automatic control and artificial intelligence techniques at all levels of agricultural production, including farm bots and farm drones.Smart Farming is a farming management concept using modern technology to increase the quantity and quality of agricultural products. Farmers in the 21st century have access to GPS, soil scanning, data management, and Internet of Things technologies. By precisely measuring variations within a field and adapting the strategy accordingly, farmers can greatly increase the effectiveness of pesticides and fertilizers, and use them more selectively. Smart farming is necessary for the overall economic development of farmers.With almost 70% of the Indian population depending on agriculture and its services and around 75% of the population residing in rural areas, agro-based economies like India are typical realm for applicability of smart agriculture. The combined efforts of the Government and industry shall kick-start this journey of rural development and steer the country towards socio-economic equality.

(**Key words**- smart farming, agriculture, advanced techniques)

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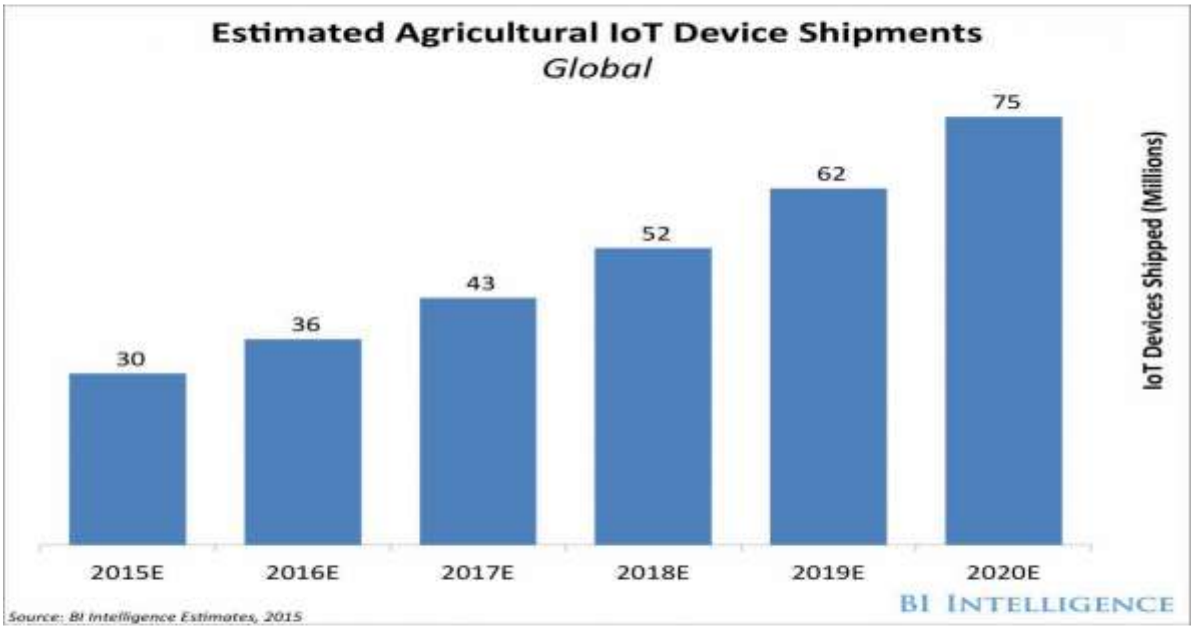
The World & Indian Scenario

The farming industry will become arguably more important than ever before in the next few decades. The world will need to produce **70% more food in 2050** than it did in 2006 in order to feed the growing population of the Earth, according to the **UN Food and Agriculture Organization.** To meet this demand, farmers and agricultural companies are turning to the Internet of Things for analytics and greater production capabilities. Technological innovation in farming is nothing new. Handheld tools were the standards hundred s of years ago, and then the **Industrial Revolution** brought about the cotton gin. The 1800s brought about grain elevators, chemical fertilizers, and the first gas-powered tractor. Fast forward to the late 1900s, when farmers start using satellites to plan their work.



Agro-based economies like **India** are a perfect working ground for smart agriculture and its applicability. A recent study by **Statista** has shown that smart agriculture is expected to take up $26.76 billion of global market size by 2020 and **Asia** is expected to hold **40 % of the global market** share. According to **NASSCOM** report, India has around 40 startups dealing in smart agriculture. With that said most of these firms are research and development organizations and only a nominal number of solutions have been actually implemented in the farms.

The use of IoT for digitization of farms has caught the attention of the Government of India and the same has been included in the government's draft policy releasedin 2015. The focus areas for smart agriculture have been identified as precision farming, data analytics for farmers, alert systems for variance in pest control requirements and storage, and drones for unmanned pest control.Recently, some commercial smart agriculture solutions have been introduced to the market. Besides this, the continuous research in this field by research as well as industrial organizations has steered a staggering growth in product development for this arena

Agriculture has been a neglected field as far as technological use and applicability are concerned, which is more so in developing countries like India where funds for technological adoption are limited and technical expertise for using the available technologies is inadequate. **The improving accessibility of low-cost IoT sensors and affordable solutions for smart agriculture has mitigated the challenges associated with adoption of IoT-based big data analytics in agriculture, to a large extent.**

It would not be wrong to state that IoT in agriculture is simply the coming together of information technology, telecommunications and sensor technologies. Some of the best examples of how IoT can be used in agriculture include development of smart irrigation facilities, facilitating check on soil vitals and performing a real time monitoring on crop health. **In simple words, the vision is to empower farmers of different educational and cultural backgrounds and help them enhance their crop production with the help of state-of-the-art technologies.** This movement can prove to be quite a revolution particularly for agro-based economies like India.

Use Cases for Smart Agriculture

Smart agriculture encompasses a number of applications. Some of the best -known use cases of this concept are as follows –

1. **Precision Farming**

A practice or process followed for improving the accuracy and control over farming and livestock management is commonly referred to as precision farming. Typically, this practice makes use of automated hardware, sensors, robotics and control systems, in addition to other technologies, to achieve its purpose. Precision farming continues to be the most popular application of smart agriculture.

Weather station is another popular smart agriculture gadget. Data collected from farming sensors can be mapped onto weather conditions to determine the best crops for the area. Moreover, this approach can also be used to make interventions for improving the capacity of cultivation and profits generated. Some IoT devices being used in this area include Pycno and Smart Elements.

Precision Farming and other Modern Technologies **System of Rice Intensification (SRI)**, which improves the productivity of rice by 30 to 35% in the conventional varieties and over 50% in hybrids, is another potential source of technological revolution for small and marginal farms. It is a skill intensive technology that cuts the need for inputs such as seeds and fertilizers while rising yields per ha. The area under SRI has increased progressively since 2000-01. The leading states that are practicing this are **Tamil Nadu, Bihar and Tripura**. The government may consider expanding the scope of the technology through extension programs as a part of its strategy to bring the **Green Revolution to eastern India**

Similarly, modern machinery such **as laser land levellers, self-propelled sprayers, precision seeders and planters, transplanters** for rice and vegetable seedlings, multi-crop threshers, harvesters for cereals and sugarcane today allow technically highly efficient farming and resource conservation. The single operation of laser levelling can reduce water application charges by **25 to 30%** with greater water use efficiency. **Coupled with precision farming, the resources conservation technologies like zero tillage and residue management can reduce the cost of cultivation by 25 to 30% over conventional farming practices**. It is predicted that in the next ten years, **Nano-technology** led application will play a critical in agriculture.

These applications are related to release and **efficient dosage of water and fertilizers and drugs (for livestock) and herbicide delivery.** We may also see the emergence of Nano sensors for soil quality, plant health monitoring and pests detection. The Nano-particles for new pesticides, insecticides, and insect repellents may also come to play an important role. Recently, **Madhya Pradesh has introduced a programme on raised bed planting of soybean in the State.**

Planting of soybean on ridges has helped conserve water and raise productivity. **Micro irrigation via sprinklers** and drips has helped bring dramatic change in several pockets of the country especially in undulating topography and sand dunes areas where no other method of irrigation can work. **Hi-tech horticulture** like poly house cultivation of vegetables, flowers, medicinal plants and fruits constitutes one of the most technology and skill intensive agricultural practices. Being remunerative and skill oriented it can also attract youth. However, being capital intensive, it requires access to credit and participation of business entrepreneurs. While technology and knowledge intensive agriculture holds enormous promise, it must be remembered that they are also capital intensive and would displace labour.

Therefore, while the government may create a facilitating policy framework for private entrepreneurs to engage in these practices, it should resist the temptation to indiscriminately subsidize them and prematurely push farmers towards them. The emphasis should be on informing farmers of the opportunities new technologies offer, improving access to credit and creating an enabling policy environment for their adoption without major direct financial commitments.

2. **Smart Greenhouses**

Smart greenhouse is a step ahead of the regular greenhouses. In these setups, the microclimate is controlled and monitored to ensure optimal plant growth. Some of the smart agriculture solutions that support this capability include Growlink, Farmapp and GreenIQ.

3. **Livestock Management**

There are specialized sensors for livestock management that can be attached to every livestock animal on the farm. These sensors collect data about animal health and maintain a log of the performance. Solutions like Cowlar and SCR by Allflex place collar tags on the animal and record data like health, activity, nutritional data and temperature. Insights on the herd can also be provided on the basis of collective data assessment.

4. **Agriculture Drones**

Drones can be put to excellent use in the agricultural industry. Typically, there are two types of drones namely, ground-based and aerial drones. These drones can be incorporated in agricultural systems for applications like soil analysis, field evaluation, planting, irrigation and assessment of crop health.

Some of the characteristic benefits of using drones for this sector comprise –

- Saves time
- Easy to use
- Includes GIS mapping
- Allows imaging of crop health
- Increases yield

The use of drones provides immense control to the farmer in terms of the field, altitude and resolution of ground,the farmer wants to survey. Therefore, drones basically collect data, which can later be used for yield prediction, plant counting, measurement of plant height and health indices, drainage mapping and canopy cover mapping, in addition to many others.

Agriculture has been recognised as the core of the Union budget for the year 2019-20. The Government of India has planned to invest widely in agriculture infrastructure to provide assured income to small and marginal farmers. It has made **NitiAayog** a national think tank to establish and conduct programmes and research on technologies of the future namely, machine learning and **artificial intelligence (AI)** to facilitate the economic development of our country.

Uzhavan app, Ag mobile, CCMobile app, IFFCO Kisanare some of the applications developed keeping in mind the need of the hour requirements in farming. Several notable initiatives like e-choupal, Agri market, **KisanSuvidha** and the more recent **e-NAM** had long been trying to place agriculture as the forerunner.The current budget has outlined setting up of 20 technology business incubators to develop at least 75,000 skilled entrepreneurs in the agro-rural industry.

Further, Rs 805 crore has also been allocated to **PradhanMantriMatsyaSampadaYojana (PMMSY)** to address critical gaps in the value chain including infrastructure, modernisation, traceability, production, productivity, post-harvest management and quality control through integration of latest technology.This will eventually pave way to achieving long-term sustainable agriculture goals of environmental health, economic profitability and social and economic equity.

In a research, conducted in China in 2013 on agriculture-based on cloud computing and IoT (Internet of Things), the integration of IoT in farming mainly facilitated soilless culture, solution control technology, artificial photosynthesis technology, growing environment control technology (carbon dioxide density, humidity, wind pressure and speed) and intelligent irrigation technology.

After several years of intense work, **China's industry** and information ministry has achieved remarkable success in projects like ‘Every village project’, ‘**Golden Agricultural Project’**, ‘The three **Dian project** (Computer, Television and Telephone network coverage in rural area)’.

However, as more emphasis was laid on hardware than software, there was a lack of communication of right information to the farmers. This led to the development of an agricultural information cloud with integration of IoT and **RFID (radio frequency identification)** technology. Also, the agriculture sector, has, in recent times visualised the integration of IoT and farming practices in development and conceptualisation of plant factory technology. For example, a lighting sensor and a video sensor can show the distribution of the intensity of light in real time and monitor the size of the plant. This would help determine the stage of the plant growth. The health condition of plants, thus, could be obtained in real-time by the spectral analysis of the images of the plant.

Data from the **global positioning systems (GPS) and wireless sensor nodes (WSN)** also served as powerful monitoring tools to supervise parameters and correlate between them. Geo-referencing methods that employed the use of unmanned aerial vehicles and drones were observed to have a positive impact on crop cultivation and pesticide control.

Data stored in these sensors and farm equipment and machinery was shared periodically to the farmers through a mobile phone connected to GPRS. The farmers could remotely monitor and control on-field sensors like switching on/off a pump/valve when water level in the field reaches a specific threshold value or take important decisions with the help of deep learning algorithms involving crop management.

In **Brazil, a Smart Farming project** was studied intensively. It involved digital revolution, AI, mobility with intelligent sensors. It led to the identification of more innovative products, process optimisation and managing effective agricultural production.

The project was, in 2014, executed as collaboration between **Dutch research institutes,** Dutch industry and Dutch agricultural businesses. The collaboration led the Smart Farming consortium to investigate the possibility of using remote sensing solutions in the cultivation process. The trend in variables like sunlight, humidity, temperature, rain was obtained from the archives of Royal Netherlands Meteorological Institute to gain prior knowledge on deviations in seasons in comparison with previous years.

From the satellite images, the **Normalised Difference Vegetation Index (NDVI)** values were deduced, which served as an indication of the amount of photo-synthetically active vegetation on the region.Using historical analysis, the variety specific NDVI curve was established and its relationship between the variables was identified. This information was observed to be crucial in formulation of data driven models.

In the year 1980-1983, a global study on vegetation types were conducted using satellite images. It was observed that the NDVI highly correlated with vegetation parameters such as green-leaf biomass and green-leaf area.

Incidentally, India was found to have high NDVI values. This could potentially serve as a key driver to increase sustainable farming practices in India.

NextOn, a South Korean company in 2018, successfully built the country's largest smart farm inside an abandoned road tunnel. The indoor farm provided ideal conditions with a steady temperature and the right amount of artificial light and rest of the factors were controlled by IoT. The company signed an agreement with the South Korea government to develop an indoor vertical farm as an alternate solution to prevent damages to crops due to extreme weather conditions. It successfully cultivated more than 60 different types of fruits and vegetables. Foods produced from the farm were found to be healthier as they had reduced insect infestations being in a closed environment.

In India, the Union Ministry of Earth Sciences and Agricultural Meteorology Division of the **India Meteorological Department (IMD)** have in their mission 2030, proposed the formation of an integrated unit involving the IMD, **Indian Council of Agricultural Research (ICAR)** in collaboration with the different institutions like agricultural universities, ICAR Institutes, state department of agriculture, department of information technology, department of space, MS Swaminathan Research Foundation and non-governmental organisations,etc in a phased manner.

The inter-institutional collaboration could be further strengthened at national and international level in the field of agro-meteorological activities. The **National Mission on Agricultural Extension and Technology (NMAET)** as a part of sustainable development group aims to strengthen and restructure mechanisation and plant protection to enable delivery of improved agronomic practices to farmers.

This was planned to be achieved through interactive methods, using **information and communication technology (ICT)**, which includes messaging services, web-based applications, capacity building, institutional strengthening, encouragement of public-private partnership and training services to guide farmers. Our government, thus, has acknowledged the role of ICT in agriculture for sustainable intensive farming; and the newly established farmer producer organisations ensure to provide a conducive atmosphere between the central and state government enabling farmers to get fair price for their produce and understand the ease of doing business.

5. **Farm Management Systems**

A number of IoT devices can be installed on the premises for measuring different farm parameters for collecting data. Analytics are performed on this data and reported via a dashboard. These systems are also referred to as farm productivity management systems. Logistics, storage management and vehicle tracking are some of the best examples of this use case. Commercially available solutions belonging to this category include **Cropio and FarmLogs.**

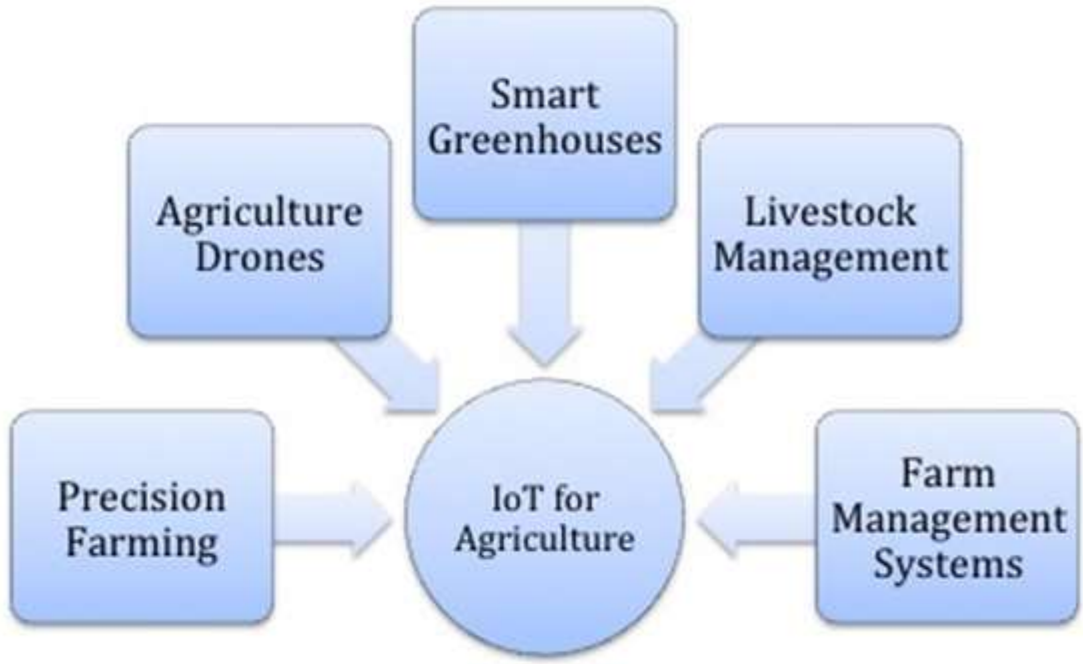


Figure – IoT for Agriculture Use Cases

***OpenCube, a Bengaluru based organization**, has been actively involved in the development of an open-source IoT-based agricultural products. They are focused towards development of a handheld, farmer friendly device, based on Raspberry Pi and Arduino, which shall be able to perform livestock management, irrigation management and assess crop and soil health, on real-time basis. A valuation of crop and soil health will allow farmers to make informed decisions about the type and quantity of fertilizers required.

Precision farming is cited as the top agendas of smart agriculture. **AgNext Technologies is a Punjab-based organization** that has recently launched satellite combinations and drones for smart agriculture. One of the their recent solutions uses satellite imagery, IoT, weather forecasting and artificial intelligence – based image processing for evaluating the presence of diseases and pests in large areas. Moreover, predictive analytics related to the same are also provided. However, these failed to address specific farmer-centric issues.

While the aforementioned solutions only focus on crop and soil health for analytics, **Energy Bots Private Limited, a Gurugram-based organization**, has come up with a smart watering system. The developed IoT device, which makes use of GSM and allows farmers to control the switching on and off of the motor pump from their mobile phones, use the humidity and moisture sensors to get data for the microcontroller and controller. They can send a SMS or missed call for switching the pump on/off or schedule the on/off timings. Moreover, whenever an action is performed, the famer is notified via a message.

Benefits and Challenges

IoT has the capability to modernize agriculture and initiate exponential growth in the sector. It is all set to **change the way cultivation and warehousing** is done. Moreover, it is expected to **reduce wastage and improve profit margins** remarkably. In view of the fact that agro-based economies like India heavily depend on agriculture for growth, **IoT-based initiatives can contribute to national growth in a massive way.**

The benefits of using IoT in agriculture include –

- The effective use of inputs helps in reducing wastage and thus, decreases costs incurred.
- Losses due to diseases and infections can be reduced, by continuous and real-time crop monitoring.
- The use of water can be optimized, which in turn shall reduce water wastage.
- The use of IoT-based devices allows better management of farm activities.

With that said, adoption and implementation of **IoT-based smart agriculture** solutions in countries like India has its own set of unique challenges and limitations. Firstly, there is a lack of awareness in farmers as far as technology-based farming solutions and their applicability are concerned. This, also, stems from the lack of knowledge and fear of upgrading to a technology of higher level. In order to develop commercially viable solutions, it is critical to keep these factors in mind. The solution must function in local languages and have interfaces that are easy to understand for laymen.

In addition to the above-mentioned, **some technological challenges** also act as roadblocks in the widespread usage of IoT.

Most of the products available in the **market suffer from vendor lock-in**; therefore, the customer is completely dependent on the vendor for products as well as services. Any changes desired by the customer require him or her to switch between vendors, which can prove to be costly.

Besides this, developers recommend the use of high quality sensors in view of their better life and durability. Such sensors are expensive and may or may not fit into the budget requirements of farmers. **Moreover, solutions offered to the Indian market must be scalable considering the variable size of farms in India.** Therefore, organizations must be able to offer solutions that are scalable and cost-effective, both at the same time.

Conclusion

IoT can best be described as an ecosystem that integrates technologies of different domains to solve specific problems. **With almost 70% of the Indian population depending on agriculture and its services and around 75% of the population residing in rural areas, agro-based economies like India** are typical realm for applicability of smart agriculture. The combined efforts of the **Government and industry** shall kick-start this journey of rural development and steer the country towards socio-economic equality.

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