

DEVELOPMENT OF ENERGY BAR USING COCONUT AND GINGER

Aditya Deshmukh, Aaryan D'Souza, Aditya Kirwale, Yash Kand , PT Dhanush, Abhishek Marathe,
Dr Kavita Mane

MIT School of Food Technology , MIT Art, Design and Technology University, Loni Kalbhori Pune
Email id: Corresponding Author :- adityadeshmukh28301@gmail.com

Abstract—In today's society, there is a heightened awareness regarding health, prompting individuals to scrutinize the nutritional value of their food choices. This has led to an increased demand for healthy products such as chips, cookies, and energy bars. Energy bars are particularly popular as they provide essential nutrients, including carbohydrates, healthy fats, protein, vitamins, and minerals, making them an ideal pre-workout option for athletes and sports enthusiasts.

This study focused on developing an energy bar using ingredients such as desiccated coconut (25%), jaggery powder (45%), amaranth (5-15%), oats (5-15%), ginger powder (3%), flaxseed (2.5%), almonds (2.5%), and raisins (2.5%). Various formulations were tested to improve the physical and sensory characteristics, with the formulation containing equal proportions of amaranth and oats (10% each) achieving the highest consumer acceptability. The finalized coconut-ginger energy bar exhibited a moisture content of 10.20%, ash content of 1.76%, fat content of 18.03%, crude protein of 5.23%, crude fiber of 2.30%, and carbohydrate content of 64g, confirming its nutritional adequacy as an energy bar.

Introduction

The realm of snack consumption is perpetually expanding, encompassing a diverse spectrum of tantalizing options including crisps, crackers, cookies, biscuits, and bars. Presently, health-conscious individuals prioritize the nutritional value of their snacks, recognizing their pivotal role in daily sustenance (Abd El-Salam, 2017). Amidst this array, nutrient-rich snack bars, often dubbed as food bars, stand out for their convenience, typically crafted from grains and other high-energy constituents such as carbohydrates, lipids, proteins, and essential minerals. These bars not only provide sensory gratification but also offer commendable nutritional benefits. Driven by evolving lifestyles and dietary inclinations, coupled with an escalating awareness of wholesome eating habits and heightened physical activity, energy bars have emerged as a favored source of sustenance (Padmashree et al., 2018). Esteemed for their nutritional density, bars are esteemed for their compactness, gustatory allure, and convenience, with their minimal moisture content extending their shelf life and curbing spoilage. These grab-and-go snacks are harnessed for their functional nutrients, often enriched with assorted proteins, fibers, or energy-boosting constituents (Siddique et al., 2018). The burgeoning emphasis on health consciousness, evolving socio-economic

dynamics, and time constraints associated with preparing balanced meals have propelled a substantial surge in demand for processed and convenient edibles. Nutrient-packed energy bars, emblematic of balanced nourishment, have witnessed significant popularity since the 1980s (Mridula et al., 2011; Yadav and Bhatnagar, 2015).

Conventional energy bars, typically laden with sugar and reliant on binding agents, markedly contrast with the innovative energy bar developed in this study, which employs jaggery as a binding agent, thereby eliminating the necessity for sugar or supplementary binding agents.

The bars also include ginger powder, which offers numerous health benefits. Ginger powder can heal irritated skin and may help protect against cancer. It contributes to a youthful appearance and aids in quicker digestion after meals. Additionally, ginger powder is known to reduce nausea and lower bad cholesterol levels, while also helping to ward off cardiovascular disease.

Although flaxseed contains a variety of healthy components, its primary health benefits are attributed to three key elements. First, it is rich in omega-3 essential fatty acids, "good" fats that have been shown to promote heart health, with each tablespoon of ground flaxseed containing approximately 1.8 grams of plant-based omega-3s. Second, flaxseed is an exceptional source of lignans, containing 75 to 800 times more lignans than other plant foods. Finally, flaxseed is high in fiber, offering both soluble and insoluble types.

The benefits of amaranth stem from it being a complete protein with anti-inflammatory and antioxidant properties. It is also rich in fiber and has been shown to combat heart disease and digestive issues. Incorporating popped amaranth into your daily diet can thus offer significant health advantages.

Coconut, being low in carbohydrates and high in fiber and fat, is an excellent choice for those on a low-carb, paleo, or gluten-free diet. It can help promote blood sugar control, contains powerful antioxidants, and has antibacterial effects. Traditionally, coconut has been used in medicine to counteract poisons, ease inflammation, kill bacteria, treat diarrhea, kidney diseases, reduce pain, and address menstrual issues. Research has demonstrated that coconut husk-fiber extracts reduce pain and inflammation in mice, while coconut water exhibits antidiabetic effects and lowers blood pressure

in hypertensive rats. However, it remains uncertain if these benefits are transferable to humans. Additionally, coconut extracts have shown antimicrobial properties effective against various bacteria, fungi, and viruses in lab tests. The endocarp and virgin coconut oil of coconuts also possess high antioxidant activity, which helps resist harmful molecules in the body.

Oats are a valuable source of protein and carbohydrates, enhancing the texture of the bars. Their health benefits include being highly nutritious, rich in antioxidants, and containing a powerful soluble fiber. Oats can lower cholesterol levels, improve blood sugar control, and are very filling, which may aid in weight loss.

Jaggery, utilized as a binding agent in these bars, imparts numerous health benefits, making them a wholesome choice. Abundant in antioxidants, jaggery aids in neutralizing harmful free radicals, thereby reducing the risk of chronic diseases such as cancer and heart disease. Moreover, it supports digestive health by enhancing enzyme activity, improving digestion, and preventing gastrointestinal discomfort like indigestion, constipation, and bloating. Acting as a natural detoxifier, jaggery assists in purifying the liver, eliminating toxins and promoting its optimal function.

Furthermore, jaggery's complex carbohydrates provide sustained energy release, ensuring vitality throughout the day. Its iron and folate content facilitate proper blood circulation and may alleviate menstrual discomfort. Particularly beneficial for individuals with iron deficiency anemia, jaggery's iron richness helps elevate hemoglobin levels. Loaded with essential minerals and vitamins, jaggery strengthens the immune system, bolstering resistance against infections, colds, and coughs. Its anti-allergic properties may alleviate respiratory issues such as asthma and bronchitis. Additionally, by purifying the blood, jaggery promotes healthier skin and may prevent skin conditions like acne and pimples. Lastly, jaggery aids in weight management by curbing sweet cravings, moderating calorie intake, improving digestion, and boosting metabolism.

I. MATERIALS AND METHODS

A. Raw material

In this study, an energy bar was developed using raw materials such as desiccated coconut, jaggery powder, amaranth, oats, ginger powder, flaxseed, almonds, and raisins, all procured from the local market in Pune.

B. Methodology

The amaranth seeds underwent popping through roasting in a pan at a temperature of $240^{\circ} \pm 3^{\circ} \text{C}$. For the binding syrup, jaggery powder (45g/100g) was caramelized with water (15g/100g), then heated at $145^{\circ} \pm 5^{\circ} \text{C}$ for 12-15 minutes until a uniform mixture was achieved. The dry ingredients, comprising desiccated coconut, jaggery powder, ginger powder, oats, flaxseeds, popped amaranth, almonds, and raisins, were weighed according to the specifications outlined in Table 1. These ingredients were then added to the binding

syrup while continuously stirring. The amalgamated mixture was poured into a greased tray and leveled with a rolling pin. Bars of approximately $30 \pm 3 \text{g}$ were cut using a mold and allowed to cool at room temperature. Subsequently, the finalized bars were packaged in silver-laminated aluminum pouches, labeled, and stored at room temperature ($20^{\circ} \pm 5^{\circ} \text{C}$).

Fig. 1 Process Flowchart Of Coconut Ginger Energy Bars

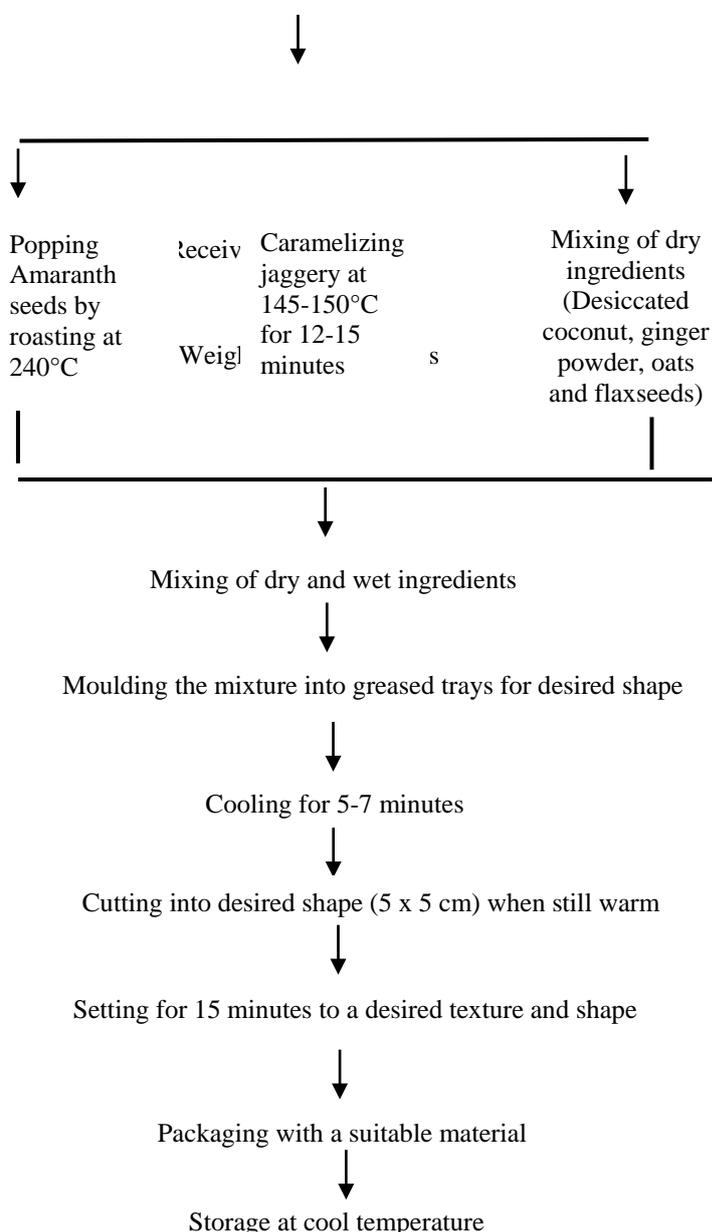


Table 1. Ingredient formulation of energy bars

Ingredients (g)	Sample 1	Sample 2	Sample 3
Desiccated coconut	25	25	25
Jaggery syrup	45	45	45

Oats	15	10	5
Popped Amaranth	5	10	15
Ginger powder	3	3	3
Flax seeds	2.5	2.5	2.5
Raisins	2.5	2.5	2.5
Almonds	2.5	2.5	2.5

C. Sensory Analysis

Trained, semi-trained, and untrained panelists conducted sensory evaluations using a 9-point Hedonic Scale to determine the preferred sample. Three formulations were employed to enhance the physical and sensory attributes, and the product with the highest acceptability and scores was selected for subsequent proximate analysis. Sample 2 received the highest scores across all parameters and was chosen for further proximate analysis.

D. Determination Of Moisture Content

Moisture content of the bar was determined by the method given by Thimmaiah (2016)

$$\text{Moisture Content (\%)} = \frac{\text{Weight of fresh Bar} - \text{Weight of dry Bar}}{\text{Weight of Fresh Bar}} \times 100$$

E. Determination Of Ash Content

Ash content of the bar was determined by following method by Thimmaiah (2016).

$$\text{Ash (\%)} = \frac{\text{Weight of ash}}{\text{Weight of sample}} \times 100$$

F. Determination Of Fat Content

Fat of the bar content was measured by using soxtron apparatus following procedure = by Ranganna (2015). Amount of fat present in the bar was calculated by

$$\text{Fat content (\%)} = \frac{W_2 - W_1}{W} \times 100$$

G. Determination Of Protein Content

Protein content of the bar was estimated by the kjeldahl method (Ranganna, 2015)

$$\% \text{ of Nitrogen} = \frac{14 \times \text{Normality of acid} \times \text{Actual titre value}}{\text{Sample weight} \times 1000} \times 100$$

$$\text{Protein content (\%)} = \% \text{ of Nitrogen} \times 6.25$$

H. Determination of crude fiber content

Crude fiber content of the bar was obtained by using FibroTRON (FRB-2) automatic system and method given by Ranganna (2015). Fiber content was estimated by the formula

$$\text{Crude fiber (\%)} = \frac{W_1 - W_2}{W} \times 100$$

I. Determination Of Carbohydrate Content

The carbohydrate content of the bar was determined by difference method given by Ranganna (2015).

$$\text{Carbohydrate content} = 100 - [\% (\text{Protein} + \text{fat} + \text{moisture} + \text{ash} + \text{crude fibre})]$$

II. RESULT AND CONCLUSION

A. Proximate Composition of Raw Materials

The proximate composition analysis of the raw materials presented in Table 2 reveals significant nutritional attributes. Flax seeds and amaranth emerge as notable sources of protein, while jaggery powder, oats, and raisins exhibit high carbohydrate content. Desiccated coconut, flaxseeds, and almonds stand out as rich sources of fats. These findings underscore the considerable energy potential offered by the analyzed raw materials, making them valuable contributors to the human diet.

Table 2. Proximate composition of raw materials

Raw material	Moisture (%)	Ash (%)	Fat (%)	Protein (%)	Crude fiber (%)	Carbohydrates (%)
Desiccated coconut	2.50 ± 0.52	2.25 ± 0.05	65.3 ± 0.32	3.45 ± 0.35	2.34 ± 0.04	6.52 ± 0.58
Jaggery powder	1.36 ± 0.04	1.85 ± 0.34	1.03 ± 0.26	1.91 ± 0.47	2.07 ± 0.03	88.53 ± 0.82
Ginger powder	3.55 ± 0.21	1.28 ± 0.04	1.81 ± 0.48	5.25 ± 0.23	4.97 ± 0.05	3.85 ± 0.37
Oats	9.76 ± 0.34	1.53 ± 0.08	5.04 ± 0.38	11.72 ± 0.44	9.99 ± 0.04	59.98 ± 0.76
Flax seeds	6.05 ± 0.42	1.96 ± 0.03	38.86 ± 0.44	21.00 ± 0.74	20.23 ± 0.47	15.54 ± 0.68
Amaranth	10.08 ± 0.27	2.57 ± 0.06	1.86 ± 0.22	12.84 ± 0.56	2.28 ± 0.08	21.32 ± 0.43
Almonds	4.54 ± 0.48	2.47 ± 0.02	14.84 ± 0.41	21.25 ± 0.28	3.82 ± 0.07	13.41 ± 0.24
Raisins	11.58 ± 0.62	2.38 ± 0.07	9.82 ± 0.38	16.62 ± 0.32	4.73 ± 0.02	72.67 ± 0.31

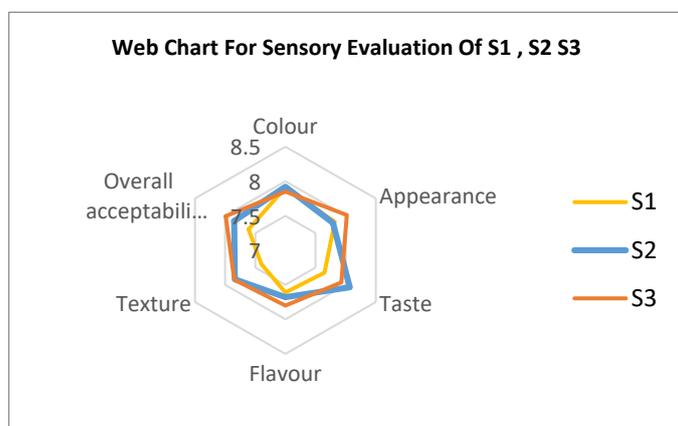
B. Organoleptic Characteristics Of Energy Bars

Data on the organoleptic characteristics—color and appearance, flavor, taste, texture, and overall acceptability—of the energy bars, as shown in Table 3, highlight the influence of formulation adjustments, specifically the variations in oats and amaranth proportions. The highest scores for flavor, taste, and overall acceptability were observed in sample 2 (7.88), which contained equal proportions of amaranth and oats (10% each). Conversely, sample 3, with a higher proportion of amaranth (15%) and a lower proportion of oats (5%), received the lowest scores.

In sample 3, the disproportionate amounts of oats and amaranth negatively affected the overall flavor and taste, leading to an undesirable texture and flavor profile. In contrast, sample 2, with equal proportions of oats and amaranth, achieved a balanced blend of ingredients, resulting in an optimal flavor and higher acceptability. This balance and blend led to the finalization of the formulation.

Table 3. Sensory properties of coconut-ginger energy bar

Sample	Colour And Appearance	Flavour	Taste	Texture	Overall Acceptability
S1	7.91	7.61	7.65	7.40	7.64
S2	7.95	7.80	7.93	7.85	7.88
S3	7.92	7.40	7.07	7.84	7.55



C. Physical characteristics of Energy Bar

There was no noticeable variation observed in the size, shape, or weight of the energy bars. The size of the energy bars ranged between 3cm to 3.5cm in width and 13.5cm to 14.0cm in length, with a consistent weight of $30.0 \pm 1g$ for each bar. All samples were rectangular in shape and displayed a bright golden brown coloration.

Table 4. Physical Characteristics of Energy Bar

Physical Properties	S1	S2	S3
Size [cm]	3.2 X 13.3 Cm	3.1 x 13.2 Cm	3.4 X 13.4 Cm
Shape	Rectangular	Rectangular	Rectangular
Weight	30.02g	30.38g	30.79g
Colour	Golden Brown	Golden Brown	Golden Brown

D. Nutritional characteristics of Energy bars

Table 4 provides an overview of the nutritional characteristics of the Energy Bar. Following the Sensory Evaluation, the sample that received the highest score (Sample 2) was selected for further analysis. The readings were taken in triplicate, and the mean value was utilized for analysis.

Table No 5. Nutritional Characteristics of Energy Bar

PARAMETER	S ₂
Moisture (%)	10.20
Fat (%)	18.03
Ash (%)	1.76
Protein (%)	5.23
Crude Fibre (%)	2.30

III. CONCLUSION

In conclusion, the research findings demonstrate the successful development and evaluation of coconut ginger energy bars with three distinct formulations. Through comprehensive sensory evaluation, one formulation emerged with the highest acceptance score, warranting further investigation. Subsequent proximate analysis proved that the developed product has a proper blend of nutrition without compromising the taste. This study underscores the potential of utilizing natural ingredients to create innovative and palatable energy bar options, catering to diverse consumer preferences and nutritional needs.

IV. REFERENCES

Ahmed, J., Thomas, L., & Taher, A. (2013). Influence of ingredients on texture and antioxidant properties of date bars. *Journal of Food Science and Technology*, 50(1), 147-153.

Kumar, K. R. A., Semwal, A. D., & Sharma, G. K. (2018). Development and quality evaluation of choco quinoa nutri bars during storage. *Food and Nutrition Sciences*, 9(7), 899–914.

Mridula, D., Singh, K. K., & Barnwal, P. (2011). Development of omega-3 rich energy bars with flaxseed. *Journal of Food Science and Technology*, 50(5), 950–957.

Padmashree, A., Negi, N., Haridas, S., Govindaraj, T., Yadav, L., & Bhatnagar, V. (2015). Optimization of ingredients in cereal bars. *Food Science Research Journal*, 6(02), 273-278.

Doiphode, S. S., & Mane, K. A. (2019). Development of protein-rich snack bars using spirulina. *JETIR*, 6(1).

Chitkara, M., Kohli, R., Sandhu, I. S., Singh, D., & Sindhu, R. K. (2017). Development and nutritional, sensory, and biochemical analysis of a polyherbal energy bar (stevia, banana, cocoa butter, oats). *Journal of Advances in Food Science and Technology*, 4(2), 62-66.