

# Shelf-Life Assessment of Minimally Processed Fresh Fenugreek using Different Packaging and Storage Conditions

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**Abstract**— Fenugreek, also referred to as methi, is a nutritional dense a vegetable with green leaves. India is a prime fenugreek producer. Fresh fenugreek has a short shelf life at room temperature due to its high moisture content. There is a significant difference between total fenugreek production and utilization due to insufficient packing and storage facilities. The new generation need-based research project "shelf-life assessment of minimally processed fresh fenugreek using different packaging and storage conditions" aimed to increase the shelf life of fresh produce fenugreek using various packaging materials such as polypropylene, LDPE, brown paper bag with an unpacked control sample at refrigerator and room temperature. The fresh fenugreek was packed and stored under refrigerator conditions (temperature  $6\pm 10$  and relative humidity  $95\pm 2\%$ ) and room temperature (temperature  $28\pm 10$  and relative humidity  $55\pm 2\%$ ) and was tested at regular intervals for quality attributes such as chlorophyll content, PLW, microbial, and sensory analysis. The packaging material was found to have a significant effect on, chlorophyll, PLW, microbial, and sensory analysis. Lower PLW was observed that 1.1% to 8.9% in polypropylene material respectively chlorophyll content decreases such as 176.1 mg/100g to 47.5 mg/100g in polypropylene package. It was observed that polypropylene found best suitable packaging material followed by LDPE. The maximum possible life span for fresh fenugreek as it was observed 17 days and 4 days when stored in polypropylene with 2% perforation at refrigerator and room temperature respectively.

**Keywords**— Fenugreek, packaging material, temperature.

## Introduction

Fenugreek (*Trigonella foenum-graecum* L.) is an annual herb which belong to family fabaceae. Trigonella, which known as "little triangle," refers to the shape of the leaflets. There are over 50 species in the genus Trigonella. Fenugreek, amaranth, and spinach are among the most nutritious vegetables in terms of fresh weight and a very good source of minerals, vitamins, antioxidants, and bioactive compounds (Gupta *et al.*, 2013). Fenugreek can be considered as important constituent in a well-balanced diet. Green Leafy Vegetables (GLV) are

expected to serve a small influence in micronutrient supply such as  $\beta$  carotene, iron, calcium, magnesium, phosphorus, potassium, fibre, folic acid, vitamin K, C, and E (Mukherjee *et al.*, 2010). The intrinsic dietary fibre element of fenugreek, which has promise nutraceutical value, is responsible for the favourable physiological benefits of fenugreek, including its anti-diabetic qualities. The losses caused by incorrect harvesting and post-harvest techniques can be significant enough to result in a total loss of millions of food commodities per year.

Minimal procedure is a traditional strategy for reducing losses and keeping food quality as fresh as possible from farm to customer. Work done on minimal processing of various green leafy crops revealed that employing LDPE bags at cold storage can extend the shelf life of spinach from 3 days to 14 days (Kakade *et al.*, 2015). Minimally processed vegetables are becoming more popular these days. For producing mustard greens, housewives prefer to buy clean and pre-cut spinach, mustard, and fenugreek leaves. It is critical to provide minimally processed food in appealing forms that are cost effective, versatile, communicative, and convenient. Minimally processed vegetables have become an easy solution for those who want to incorporate more fresh vegetables into their regular diet. Limited research has been reported on the life span enhancement of fresh fenugreek leaves as well as bunch under refrigerated condition, the present investigation has been planned of form of fenugreek and packing material on keeping standard of fenugreek and to select the best form of fenugreek and packaging material for shelf-life enhancement under refrigerated and room temperature condition.

## I. MATERIAL AND METHODS

### A. Preparation of Sample

Fresh fenugreek harvested from the local farm of Pune was washed to remove foreign material such as mud, sand, dust, etc. it was then soaked in water containing 2.5 percent sodium hypochlorite for 1 minute to avoid microorganisms contaminating followed by dried for 15 minutes. Manual sorting and grading were used to remove uneven and damaged fresh fenugreek leaves.

**B. Material**

The materials needed for the experiment, such as fenugreek, sodium hypochlorite, polypropylene, LDPE and brown paper bag, were obtained from the Pune local market.

**C. Methodology**

**Flow chart of fresh fenugreek leaves packet**

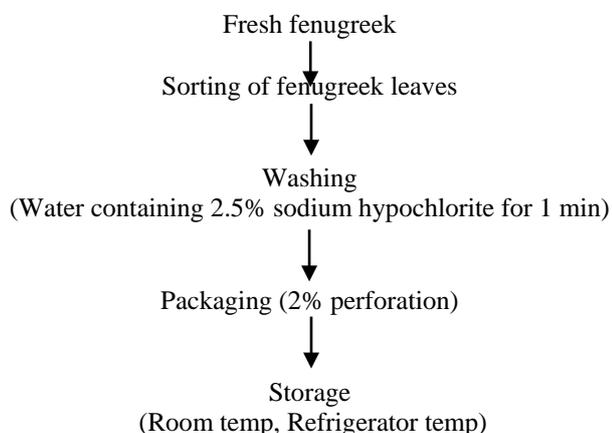


Fig. 1 Process Standardization of minimally processed fenugreek packaging

**II. RESULT AND DISCUSSION**

**A. Impact of packaging material on PLW (%) of fresh fenugreek leaves kept at refrigerated and room condition**

Table 1 and 2. shows the effect of packaging material on physiological weight loss (PLW) of fresh fenugreek leaves packed in various packaging materials and stored at refrigerated conditions. At the 5% level of significance, the effect of packaging materials on PLW (%) of fresh fenugreek leaves maintained in refrigerated and room conditions was found to be statistically significant. The physiological weight loss ranges from 1.16 to 11.2 percent overall. In polypropylene package, It can be shown that at the end of the storage period, treatment P1 had the lowest weight loss, followed by treatment P2. Weight loss increased as storage time increased for all packaging materials. These findings are consistent with of the PLW in control samples was significantly higher, whereas the polypropylene package best kept the sample weight. It can be shown that at the end of the storage period, treatment P1 had the lowest weight loss, followed by treatment P2. The similar trend observed in (Kakade *et al.*, 2015).

Table 1 : Impact of packaging material on PLW (%) of fresh fenugreek leaves kept at room temperature.

Sample/ Storage days	P0 Control	P1 Poly-propylene	P2 LDPE	P3 Paper bag
0	0	0	0	0
1	12.56±0.15	3.36±0.22	3.90±0.22	4.10±0.08
2	NE	6.86±0.15	7.13±0.35	12.13±0.50
3	NE	8.60±0.25	11.30±0.04	NE
4	NE	10.26±0.28	NE	NE
<b>Analysis of Variance</b>				

Source	D.F.	F value	S.E.	C.D.
Treatment (P)	5	146.94	0.10	0.30
Storage Interval (D)	4	1,130.35	0.09	0.27
P × D	20	342.17	0.23	0.67

Significant at 5 % Level NE-Not estimated due to loss of freshness

Table 2 : Impact of packaging material on PLW (%) of fresh fenugreek leaves kept at refrigerated temperature

Sample / Storage days	P0 Control	P1 Poly-propylene	P2 LDPE	P5 Paper bag
0	0	0	0	0
1	4.16±0.04	1.16±0.15	1.20±0.18	2.40±0.12
2	11.2±0.25	1.23±0.18	1.50±0.31	6.20±0.29
3	NE	1.60±0.30	2.10±0.23	10.2±0.22
4	NE	1.56±0.02	2.86±0.11	NE
5	NE	1.66±0.38	3.46±0.19	NE
6	NE	1.83±0.40	3.87±0.08	NE
7	NE	2.20±0.12	4.40±0.04	NE
8	NE	2.80±0.25	5.30±0.35	NE
9	NE	3.30±0.27	5.66±0.26	NE
10	NE	3.86±0.31	6.60±0.18	NE
11	NE	4.43±0.31	7.13±0.31	NE
12	NE	4.80±0.18	8.46±0.10	NE
13	NE	5.30±0.30	9.70±0.18	NE
14	NE	6.50±0.21	NE	NE
15	NE	7.13±0.26	NE	NE
16	NE	8.13±0.25	NE	NE
17	NE	8.93±0.22	NE	NE

**Analysis of Variance**

	D.F.	F value	S.E.	C.D.
Treatment (P)	4	14.692	0.01	0.03
Storage Interval (D)	17	3,494.5	0.02	0.05
P × D	68	4,590.5	0.04	0.13

Significant at 5 % Level NE-Not estimated due to loss of freshness

**B. Impact of packaging material on Chlorophyll content of fresh fenugreek leaves kept at refrigerated and room condition**

The effect of packaging materials on the chlorophyll content of fresh fenugreek leaves stored in the refrigerator and room was shown to be statistically significant at the 5% level of significance. The table 3 and 4 shows at the end of the storage period, P1 had the highest total chlorophyll content, while P0 had the lowest total chlorophyll content (35.1 mg/100 g). Initially, total chlorophyll was measured as 180 mg/100 g in all storage circumstances, and it was discovered to steadily decrease throughout storage. The chlorophyll was most well preserved in a polypropylene container. decrease in chlorophyll content in the unpacked and paper bag samples could be attributed to increased water loss. The full barrier to moisture in the polypropylene bags resulted in the deterioration of stored samples. Similar trend and values are reported in (Narang *et al.*, 2016).

Table 3 : Impact of packaging material on Chlorophyll content of fresh fenugreek leaves kept at room temperature.

Sample/ Storage days	P0 Control	P1 Poly-propylene	P2 LDPE	P3 Paper bag
0	183±0.02	183±0.04	183±0.05	183±0.04
1	55.4±0.24	135.3±0.18	124.3±0.18	106.±0.12

2	NE	110.0±0.12	93.0±0.31	59.8±0.33
3	NE	84.9±0.33	63.9±0.16	NE
4	NE	65.1±0.12	NE	NE
Analysis of Variance				
Source	D.F.	F value	S.E.	C.D.
Treatment (P)	4	14,055	0.21	0.61
Storage Interval (D)	4	12,647	0.19	0.56
P × D	16	4,363.3	0.48	1.37

Significant at 5 % Level NE-Not estimated due to loss of freshness

Table 4 : Impact of packaging material on Chlorophyll content of fresh fenugreek leaves kept at refrigerated temperature

Sample / Storage days	P0 Control	P1 Poly-propylene	P2 LDPE	P3 Paper bag
0	183±0.02	183±0.04	183±0.05	183±0.04
1	180±0.05	180±0.04	180±0.04	180±0.04
2	103±0.11	176.1±0.52	168.4±0.13	122.3±0.12
3	35.1±0.30	171.7±0.12	160.5±0.32	101.2±0.16
4	NE	163.5±0.22	149.3±0.14	46.0±0.08
5	NE	159.8±0.31	137.9±0.18	NE
6	NE	151.3±0.25	131.2±0.08	NE
7	NE	142.2±0.35	120.6±0.06	NE
8	NE	138.9±0.23	112.5±0.11	NE
9	NE	131.3±0.11	101.1±0.35	NE
10	NE	119.4±0.28	93.6±0.25	NE
11	NE	106.1±0.12	85.3±0.18	NE
12	NE	98.6±0.30	70.7±0.14	NE
13	NE	93.4±0.38	62.1±0.22	NE
14	NE	84.8±0.31	42.0±0.31	NE
15	NE	72.3±0.05	NE	NE
16	NE	61.4±0.08	NE	NE
17	NE	54.1±0.11	NE	NE
Analysis of Variance				
	D.F.	F value	S.E.	C.D.
Treatment (P)	4	2,497.7	0.77	2.15
Storage Interval (D)	17	1,552.4	1.33	3.72
P*D	68	89.013	3.27	9.12

Significant at 5 % Level NE-Not estimated due to loss of freshness

**C. Impact of packaging material on Total microbial count (log CFU/g) of fenugreek leaves kept at refrigerator and room condition**

Table 5 and 6. shows increasing trend was observed almost each day. The largest variation was observed in the control sample, P0, and the smallest variation was found in the polypropylene package, followed by the LDPE packaging material of microbial under refrigerator and room conditions. Table 5 : Impact of packaging material on Total microbial count (log CFU/g) of fresh fenugreek leaves kept at room temperature.

Sample/ Storage days	P0 Control	P1 Poly-propylene	P2 LDPE	P3 Paper bag
0	2.20±0.10	2.20±0.06	2.20±0.04	2.20±0.06
1	7.93±0.14	3.69±0.18	3.89±0.20	4.55±0.31
2	NE	4.80±0.28	5.57±0.24	7.80±0.38
3	NE	6.69±0.38	7.47±0.45	NE
4	NE	7.20±0.25	NE	NE
Analysis of Variance				

Source	D.F.	F value	S.E.	C.D.
Treatment (P)	4	13,05.5	0.21	0.61
Storage Interval (D)	4	12,64.7	0.19	0.56
P × D	16	4,56.3	0.48	1.37

Significant at 5 % Level NE-Not estimated due to loss of freshness

Storage conditions had significant effect on total microbial count in present investigation. Total microbial count shows minimum variation in polypropylene. Increasing trend in total microbial count was observed in all the fenugreek package in refrigeration storage conditions. Initial total plate counts on fresh fenugreek leaves were 2.29 log CFU/g. This is really minimal negligible (Garande *et al.*, 2019). It was evident from observation that treatment P1 was superior to all packing treatments during the refrigeration and room condition.

Table 6 : Impact of packaging material on Total microbial count (log CFU/g) of fenugreek leaves kept at refrigerator condition

Sample / Storage days	P0 Control	P1 Poly-propylene	P2 LDPE	P3 Paper bag
0	0	0	0	0
1	2.29±0.02	2.29±0.02	2.29±0.04	2.29±0.04
2	4.14±0.38	2.34±0.19	2.58±0.42	3.94±0.19
3	7.60±0.10	2.39±0.25	2.73±0.22	5.72±0.12
4	NE	2.44±0.14	2.84±0.12	7.49±0.28
5	NE	2.50±0.18	3.02±0.22	NE
6	NE	2.57±0.25	3.21±0.35	NE
7	NE	2.66±0.45	3.37±0.50	NE
8	NE	2.71±0.12	3.80±0.25	NE
9	NE	2.79±0.25	4.31±0.19	NE
10	NE	2.87±0.38	5.17±0.16	NE
11	47.5±0.14	NE	2.96±0.30	6.34±0.13
12	NE	3.24±0.12	7.01±0.34	NE
13	NE	3.64±0.19	7.09±0.09	NE
14	NE	4.29±0.26	7.20±0.18	NE
15	NE	4.87±0.34	NE	NE
16	NE	5.31±0.11	NE	NE
17	NE	6.09±0.08	NE	NE
Analysis of Variance				
	D.F.	F value	S.E.	C.D.
Treatment (P)	4	2,497.7	0.07	1.15
Storage Interval (D)	17	1,552.4	1.03	2.72
P×D	68	89.013	2.27	4.12

Significant at 5 % Level NE-Not estimated due to loss of freshness

**D. Impact of packaging material on sensory properties (overall acceptability) of fresh fenugreek leaves kept at refrigerated and room condition**

Life span assessment of minimally processed fresh fenugreek using different packaging and storage condition were analysed in the colour, texture and aroma employing a 9-point hedonic scale, a semi-trained panel evaluated overall acceptance and results are reported in table 7 and 8. According to Fig. 10, the overall acceptability of fresh fenugreek leaves packed in various packaging materials declined as the kept period increased. Visual observations for colour, texture, aroma and overall acceptance of treatment P1 were discovered to be better in terms of having the highest

overall score during room and refrigerated storage. The same pattern was noticed by (Garande et al., 2019).

Table 7: Impact of packaging material on sensory properties (overall acceptability) of fenugreek leaves kept at room condition

Sample/ Storage days	P0 Control	P1 Poly-propylene	P2 LDPE	P3 Paper bag
0	8.76±0.10	8.71±0.12	8.71±0.06	8.71±0.14
1	7.60±0.12	8.43±0.25	8.31±0.21	7.85±0.14
2	6.09±0.26	7.99±0.23	7.69±0.15	7.23±0.38
3	NE	7.31±0.18	7.13±0.31	5.32±0.23
4	NE	7.04±0.08	5.46±0.26	NE
5	NE	5.70±0.11	NE	NE
Analysis of Variance				
Source	D.F.	F value	S.E.	C.D.
Treatment (P)	4	561.206	0.07	0.21
Storage Interval (D)	5	930.309	0.09	0.25
P × D	20	121.159	0.18	0.51

Table 8: Impact of packaging material on sensory properties (overall acceptability) of fenugreek leaves kept at refrigerated condition

Sample / Storage days	P0 Control	P1 Poly-propylene	P2 LDPE	P3 Paper bag
0	0	0	0	0
1	8.85±0.04	8.85±0.02	8.85±0.04	8.85±0.02
2	8.14±0.16	8.70±0.32	8.61±0.22	8.39±0.18
3	7.43±0.25	8.61±0.13	8.5±0.18	7.94±0.02
4	4.70±0.02	8.47±0.14	8.43±0.12	7.46±0.18
5	NE	8.36±0.19	8.28±0.10	5.43±0.13
6	NE	8.24±0.11	8.15±0.09	NE
7	NE	8.16±0.12	8.11±0.11	NE
8	NE	8.03±0.21	7.96±0.17	NE
9	NE	7.96±0.07	7.89±0.33	NE
10	NE	7.81±0.04	7.75±0.45	NE
11	NE	7.79±0.08	7.67±0.40	NE
12	NE	7.58±0.22	7.58±0.40	NE
13	NE	7.54±0.17	7.45±0.25	NE
14	NE	7.50±0.29	7.31±0.12	NE
15	NE	7.46±0.12	5.56±0.13	NE
16	NE	7.40±0.13	NE	NE
17	NE	7.36±0.14	NE	NE
18	NE	6.06±0.18	NE	NE
Analysis of Variance				
		7.12±0.18	NE	NE

Source	D.F.	F value	S.E.	C.D.
Treatment (P)	4	2,619.4	0.08	0.12
Storage Interval (D)	18	998.49	0.08	0.22
P×D	72	130.60	0.19	0.55

### III. CONCLUSION

Quality attributes like weight loss (%), chlorophyll the microbiological load and sensorial properties of minimally processed fresh fenugreek leaves were shown to be excellent in packed inside polypropylene followed by packed in LDPE bag with 2% vent for both refrigerator and room temperature conditions.

Polypropylene was determined to be the most suited material for packing minimally processed fresh fenugreek leaves. The maximum life span for minimally processed fresh fenugreek it was seen as 17 days and 4 days when stored in polypropylene at refrigerator and room temperature respectively.

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