

Original Research Article

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Comparative Study of Different Drying Methods for Drying of Blanched Fenugreek Leaves

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ABSTRACT

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In this study the different methods of drying methods were compared for drying of blanched fenugreek leaves. The drying methods were used as tray drying 40, 50, 60°C, fluidized bed drying 40, 50, 60°C, shade drying and open sun drying. Tray drying at 60°C took minimum time 4 h, followed by fluidized bed drying at 60°C took 6 h, open sun drying took 8 h followed by shade drying was 12 h in blanched treatment sample. There was non-significant difference in overall acceptability organoleptic score of dehydrated sample of fenugreek leaves by different methods while there was an effect of storage time. The maximum score was obtained in case of tray-dried sample at 60°C. Tray drying is independent of weather conditions for drying, quality of tray-dried product is good, but tray drying is costly.

Introduction

Fenugreek is one of the oldest cultivated spice crops of the world and grown for its medicinal value and forage in India (Sweta *et al.*, 2017). Fenugreek is also known as 'Kasuri Methi'. It is a very ancient spice which is used for flavouring various dishes. These leaves are bitter in taste, when added to any recipe it will surely titillate your taste bud. They are also known as protective food, which reflect their significance in supply of vital nutrients, essential for our health. In addition, they provide dietary fibres which aids in proper digestive function. Green leafy vegetables are

rich source of vitamin A and C and mineral such as calcium, iron, phosphorus and potassium. The Fenugreek (*Trigonella foenumgraecum L.*) is mainly grown in Northern India. The leaves and young pods are used as vegetables and the seed as condiments. It has also some medicinal value which prevents constipation, removes indigestion, stimulates the spleen and the liver, and is appetizing and diuretic. The leaves are quite rich in protein, minerals and vitamin C. Fenugreek is considered to be a native of Eastern Europe and Ethiopia and is also found growing wild in North-Western India. It belongs to the family Leguminosae, genus

Trigonella and species *foenum-graceum*. The Kasuri or Chama methi belongs to the same genus but species *corniculata*. These two differ in their growth habits. The common methi is quick growing and produces upright shorts and the Kasuri methi, is slow growing initially, and remain in a rosette condition during most of its vegetative growth period. Kinetics of fenugreek drying on different trays of an indirect solar dryer was examined so as to increase its shelf life (Shrivastava, 2017).

Fenugreek is a popular green leafy vegetable in India. Being a seasonal crop, it is available in plenty at lower cost during winter season (Patil *et al.*, 1978) and therefore, can be dehydrated to make it available in off-season. It produced the quality of dehydrated product is maintained to be acceptable. In fact dehydration is the method of choice for vegetables (Mandhyan *et al.*, 1988). Green leafy vegetables are highly perishable due to their high moisture content ranges from (80-92% w.b) and available for very short period of time. This creates a considerable gap between demand and non-availability. The storage life of green fenugreek is extremely short and varies from few hours to 2-3 days depending upon the temperature and the relative humidity of the storage condition. In proper post harvest handling leads to the loss of large amount (around 32%) of vegetables. Due to its high perishability and round the year demand almost it needs to be processed into dehydrated form. The various methods of dehydrated green leafy vegetables are sun drying shade drying, fluidized bed drying and tray drying etc. These drying methods need to be evaluated for drying of different vegetable so that there is a minimum damage to the vegetables in terms of quality. The moisture content and drying rate were affected by drying air temperature. Increase in drying air temperature caused decrease in drying time and an increase in drying rate (Kaur *et al.*,

2018). Keeping this in view the above facts in mind the present study is carried out to standardise different drying methods for drying of fenugreek leaves (Methi) and study the storability of the dried product at ambient temperature.

Materials and Methods

The leaves of Kasuri fenugreek (*Trigonella foenum graecum L.*) were procured from the Arya Agricultural farm, Balsamand for conducting the present studies. The experiments were conducted in the Department of Processing and Food Engineering, COAE&T, CS HAU Hisar, experiment to dry fenugreek leaves in different dryers and methods. The quality analysis of dried fenugreek in terms of chlorophyll content, Ca, Fe, ascorbic acid, colour, taste and appearance was performed as per standard procedure. Pre-drying treatment, blanching was carried using solution of 0.5% KMS + 0.1 percent Mgo + 0.1 percent NaHCO₃ was heated at 800C and the leaves of fenugreek were dipped in it for 3-4 min. Free water was removed by blotting.

Moisture content of freshly harvested fenugreek leaves was measured just before the start of the experiment. Standard hot air oven method used for the leafy vegetables (AOAC, 1970 and ASAE Standard, 1991) was employed for moisture content determination of the fenugreek leaves. The percent moisture content was determined using following equations.

$$\text{Moisture content (wb)} = \frac{W_1 - W_2}{W_2} \times 100$$

Where, W₁ and W₂= Initial and final weight of the samples, g

Chlorophyll content of fenugreek leaves was determined as per method of Arnon (1949)

and AOAC (1990). Available iron was extracted by D.T.P.A. as suggested by Lindsay 1978. Ascorbic acid was determined by the method of AOAC (1990). Rehydration ratio of dried leaves was measured by method described by Pruthi *et al.*, (1976). Fenugreek leaves stems and soil was removed by washing in clean water. Initial moisture content of prepared samples of fenugreek leaves was determined before the drying studies by standard hot air oven method. Sun drying, shade drying, fluidized bed 40, 50, 60°C drying, tray drying at 40, 50, 60°C were conducted. The drying experiments were replicated thrice. The observation of weight loss was taken at a regular interval of 1 hrs. The samples were dried till the moisture content comes to 6-12% (d.b). After drying, the sample was cooled in desiccators and then sealed in a polyethylene bags for quality analysis and storage. The dried fenugreek leaves were evaluated to determine quality characteristics in terms of colour, appearance, taste and overall acceptability. Sensory evolution was carried out using 6-point hedonic scale (Amerine *et al.*, 1985).

Results and Discussion

Fenugreek (*Trigonella foenum graecum* L.) is an important green leafy vegetable commonly grown in many part of India. Fresh fenugreek contains very high moisture content (80-92% wb). To increase the storability of fenugreek leaves, it was to be dried to safe moisture content of 8-12% (d.b). The chlorophyll content was (0.70 mg/100g) ascorbic acid (0.54 mg/100g), calcium and iron content (360 mg/100g), (17.2 mg/100g). Several methods were used for drying fenugreek leaves. Different drying methods affect the quality of the dried products. Several parameters influence the time required to dry the product to the desired moisture content in different methods of drying. These include initial moisture content, final moisture content of the

product, type of dryer, drying method, ambient atmospheric conditions and drying air temperature. In the present study experiments were conducted to evaluate different types of dryers and drying methods such as open sun drying, drying in shade, drying in fluidized bed and drying in tray drier. The effect of dryer and drying method on the chemical quality i.e. chlorophyll content, ascorbic acid content, calcium and iron content and physical qualities such as colour, taste, appearance and over all acceptability was investigated. Time taken to bring the moisture content of dehydrated fenugreek leaves to storage moisture content in different drying methods and dryer was also determined.

Dehydration characteristics of blanched treatment of fenugreek leaves

The data with respect to chlorophyll were reached and presented in table 1. The data reveals that open sun dried sample had significantly lower chlorophyll content (0.38mg/100g) was compared to shade dried (0.43mg/100g) and fluidized bed dried sample at different temperature 40, 50, 60°C, (0.35mg/100g), (0.36mg/100g), (0.35mg/100g), and tray dried sample was (0.40mg/100g), (0.40mg/100g), (0.40mg/100g). During storage, that total chlorophyll was significantly reduced from 0th (0.41mg/100g) to 60th (0.36mg/100g) days. The maximum total chlorophyll was obtained in case of shade-dried sample. The data on ascorbic acid content of dehydrated fenugreek leaves are presented in table 2. The result indicates that the open sun dried sample had significantly lower ascorbic acid content (0.32mg/100g) as compared to shade dried (0.36mg/100g), fluidized bed dried sample at 40, 50, 60°C was at (0.29mg/100g), (0.29mg/100g), (0.28mg/100g) and tray dried sample at 40, 50, 60°C was (0.31mg/100g), (0.32mg/100g), (0.36mg/100g).

Table.1 Effect of drying method and storage time on the chlorophyll content the dehydrated fenugreek leaves

S. No.	Drying methods	Storage period (days)		Over all mean
		0	60	
1.	Sun Drying	0.41	0.36	0.38
2.	Shade Drying	0.45	0.42	0.43
3.	Fluidized bed drying at 40°C	0.39	0.32	0.35
4.	Fluidized bed drying at 50°C	0.35	0.34	0.36
5.	Fluidized bed drying at 60°C	0.36	0.34	0.35
6.	Tray drying at 40°C	0.42	0.38	0.40
7.	Tray drying at 50°C	0.43	0.40	0.40
8.	Tray drying at 60°C	0.43	0.38	0.40
Over all mean		0.41	0.36	

Table.2 Effect of drying methods and storage time on the ascorbic acid content (mg/100g of dehydrated fenugreek leaves

S. No.	Drying methods	Storage period (days)		Over all mean
		0	60	
1.	Sun Drying	0.35	0.29	0.32
2.	Shade Drying	0.38	0.35	0.36
3.	Fluidized bed drying at 40°C	0.32	0.27	0.29
4.	Fluidized bed drying at 50°C	0.32	0.26	0.29
5.	Fluidized bed drying at 60°C	0.30	0.26	0.28
6.	Tray drying at 40°C	0.34	0.28	0.31
7.	Tray drying at 50°C	0.35	0.30	0.32
8.	Tray drying at 60°C	0.34	0.28	0.36
Over all mean		0.34	0.29	

Table.3 Effect of drying methods and storage time on the calcium content (mg/100g) of the dehydrated fenugreek leaves

S. No.	Drying methods	Storage period (days)		Over all mean
		0	60	
1.	Sun Drying	252	250	251
2.	Shade Drying	257	257	257
3.	Fluidized bed drying at 400C	256	254	255
4.	Fluidized bed drying at 500C	256	256	256
5.	Fluidized bed drying at 600C	255	254	254
6.	Tray drying at 400C	254	254	254
7.	Tray drying at 500C	253	252	252
8.	Tray drying at 600C	252	260	256
Over all mean		254.3	254.6	

Table.4 Effect of drying methods and storage time on the iron content (mg/100g) of the dehydrated fenugreek leaves

S. No.	Drying methods	Storage period (days)		Over all mean
		0	60	
1.	Sun Drying	9.8	9.6	9.7
2.	Shade Drying	9.6	9.6	9.6
3.	Fluidized bed drying at 40°C	9.4	9.2	9.3
4.	Fluidized bed drying at 50°C	9.0	9.0	9.0
5.	Fluidized bed drying at 60°C	9.0	8.8	8.9
6.	Tray drying at 40°C	10.2	10.0	10.1
7.	Tray drying at 50°C	10.8	10.0	20.4
8.	Tray drying at 60°C	10.8	10.4	10.5
Over all mean		9.8	9.5	

Table.5 Effect of drying methods and storage time on rehydration ratio of dehydrated fenugreek leaves

S. No.	Drying methods	Storage period (days)		Over all mean
		0	60	
1.	Sun Drying	5.2	3.6	4.4
2.	Shade Drying	5.0	3.0	4.0
3.	Fluidized bed drying at 40°C	5.3	3.6	4.4
4.	Fluidized bed drying at 50°C	5.2	4.0	4.6
5.	Fluidized bed drying at 60°C	5.2	3.6	4.4
6.	Tray drying at 40°C	5.4	3.8	4.6
7.	Tray drying at 50°C	5.6	4.2	4.4
8.	Tray drying at 60°C	5.6	3.8	4.7
Over all mean		5.3	3.9	

Table.6 Effect of Drying method and storage time on the overall acceptability of dehydrated fenugreek leaves

S. No.	Drying methods	Storage period (days)		Over all mean
		0	60	
1.	Sun Drying	5.0	4.4	4.7
2.	Shade Drying	4.4	4.0	4.2
3.	Fluidized bed drying at 40°C	5.1	4.3	4.7
4.	Fluidized bed drying at 50°C	5.0	4.8	4.9
5.	Fluidized bed drying at 60°C	5.0	4.7	4.8
6.	Tray drying at 40°C	4.8	4.2	4.5
7.	Tray drying at 50°C	5.1	4.4	4.7
8.	Tray drying at 60°C	5.2	5.1	5.1
Over all mean		5.0	4.5	

During storage, there was significant reduction of ascorbic acid. Maximum ascorbic acid content was obtained in case of shade-dried sample (0.36mg/100g). Maximum loss of ascorbic acid in fenugreek leaves was during washing after cutting. Ascorbic acid decreases the length of storage of 60 days. This might be because of leaching of ascorbic acid in washing and blanching, which lead to distraction of ascorbic acid (Khader, 1988).

The data on calcium content of dehydrated fenugreek leaves are presented in table 3. The results indicate that the method of open sun drying had non-significant effect on calcium content of fenugreek leaves. During storage, there was non-significant reduction of calcium content. Maximum calcium content was obtained in case of shade-dried fenugreek (257mg/100g).

The data on iron content of dehydrated leaves are presented in table 4. The results indicate that the method of drying was significant effect on iron content of fenugreek leaves. During storage, there was non-significant effect on iron content was found. Maximum iron content was obtained in case of tray-dried fenugreek at 60°C (10.5mg/100g).

Rehydration ratio of dehydrated fenugreek leaves presented in table 5 showed that the drying methods had non-significant effect on the rehydration ratio of fenugreek leaves. During storage period, the rehydration ratio was significantly reduced.

Sensory evaluation of dried fenugreek leaves (blanched treatment)

The dried fenugreek leaves from different drying methods was subjected to sensory evaluation by a panel of 8 judges following hedonic rating (6 points scale as described by Ranganna, 1981) test. Sensory score table 6

indicates that significant difference were observed in score of tray drier, shade drying, fluidized bed drying. In general, tray dried samples were superior to the other drying samples in terms of colour, taste, flavour and overall acceptability.

In conclusion, moisture content of fenugreek leaves from 6 to 12% (db) was suitable for storability. Tray drying at 60°C took minimum time 4 h, followed by fluidized bed drying at 60°C took 6 h, open sun drying took 8 h followed by shade drying was 12 h in blanched treatment sample. The dehydrated product was stored for 60 days and the effect of storage was also studied. The total chlorophyll content and ascorbic acid of the fenugreek leaves were significantly affected by drying methods as well as storage time. But there was non-significantly effect on drying methods and storage time on the calcium and iron content. There was no effect of drying methods on the rehydration ratio.

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