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Effect of varieties and processing on nutritional composition of fenugreek seeds

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Abstract

The present study was conducted to study the effects of varieties and processing treatments like roasting, germination and germination then roasting and varieties on nutritional composition of fenugreek seeds. Among different varieties the maximum moisture, crude protein, crude fat, crude fibre, dietary fibre, total ash dry matter, carbohydrates and energy contents was found in NDM-116 (7.53%), NDM-2 (39.20%), NDM-116 and NDM-2 (10.48 & 10.47%), NDM-120 (15.49%), NDM-120 (24.61%), NDM-1 (5.952%), NDM-80 (93.50%), NDM-80 (41%), NDM-116 and NDM-2 (348 Kcal) per 100 g respectively. Among the various treatments the maximum moisture, crude protein, crude fat, crude fibre, dietary fibre, total ash dry matter, carbohydrates and energy contents was recorded in raw (7.96%), germinated then roasted (32.47%), raw (9.23%), germinated then roasted (16.12%), raw (25.67%), germinated then roasted (6.37%), roasted (94.04%), raw (41%), roasted (343 Kcal) per 100 g respectively.

Keywords: Fenugreek seeds, roasting, germination, germination then roasting, nutritional composition, processing

Introduction

Fenugreek has been used as a medicinal plant in various parts of the world (Srinivasan, 2006)^[20] and regarded as the oldest medicinal plant in human history (Lust, 1986 cited in Petropoulos, 2002)^[14]. This spice occupies third place in area and fourth in production among all the major seed spices grown in this country. In India, its cultivation is concentrated mainly in Rajasthan. This state has a share of 83 per cent of the total fenugreek production in the country. Other states cultivating fenugreeks are Gujarat, Tamil Nadu, Uttar Pradesh, Himachal Pradesh, Madhya Pradesh, Andhra Pradesh and Punjab (Spice India, 2012)^[19].

The seeds are golden-yellow in color, small in size, hard and had four-faced stone like structure (Altuntas *et al.*, 2005)^[1, 23]. The average length, width and thickness of fenugreek seeds and single seed mass and diameter ranged from 4.01 to 4.19, 2.35 to 2.61, 1.49 to 1.74 mm, 0.0157 to 0.0164 g and 2.40 to 2.66 mm, respectively (Zgo *et al.*, 2006)^[21].

Fenugreek seeds contain 25.2 to 30.1 per cent protein, 7.2 to 9.3 per cent lipids, 20.1 to 25.3 per cent insoluble fibre, 20.4 to 30.2 per cent galactomannan and 5.3 to 7.3 per cent saponins along with ample amounts of volatile oils, free amino acids, mucilaginous fibre and flavonoids (Raju and Bird, 2006)^[15]. Its seeds can be a good supplement to cereals because of its high protein (25 per cent), lysine (5.7 g/16 g N), soluble (20 per cent) and insoluble (28 per cent) dietary fibre besides being rich in calcium, iron and beta-carotene (NIN, 1987)^[12].

Fenugreek has a beneficial effect on cleansing the blood and as a diaphoretic, it is able to bring a sweat and helps to detox the body. The alkaloid and flavonoid content of fenugreek seeds can be responsible for antinociception and anti-inflammatory effects of the plant respectively (Mandegar *et al.*, 2012)^[8]. Fenugreek is also known for its lymphatic cleansing activity due to its vital role in supplying the cells with many nutrients and removing toxic wastes, trapped proteins and dead cells from the body. Seeds of fenugreek spice have many other medicinal properties such as hypocholesterolemic, antibacterial, gastric stimulant, lactation help, antidiabetic agent, hepatoprotective effect and anticancer (Sharma *et al.*, 1990; Zia *et al.*, 2001)^[18, 22]. These useful physiological effects including the antidiabetic and hypocholesterolemic effects of fenugreek are mainly attributable to the presence of dietary fiber which has promising nutraceutical value (Srinivasan, 2006; Kavirasan *et al.*, 2007; Khorshidian *et al.*, 2016)^[20, 6, 7]. Fenugreek seeds are rich source of gum fibres, alkaloids, flavonoids, volatile compounds, phenolic acids and polysachharides (Petropoulos, 2002)^[14].

Raw fenugreek seeds have maple flavor and bitter taste but by the process of germination and roasting, their bitterness can be reduced and flavor can be enhanced.

Dried seeds are used as condiments (Murlidhar and Goswami, 2012) [11].

It has been possible to debitter fenugreek seeds by employing various processing methods such as soaking, germination, roasting etc. As fenugreek seeds are rich in mucilaginous fibre and other dietary essentials, their use can be exploited as functional and nutritional foods as well as therapeutic agent. Traditional processing methods may affect reduction in the bitterness of the seeds and make its incorporation possible in various recipes. Earlier studies reported that sprouting or overnight soaking; washing of fenugreek seeds in running water and roasting removes the bitterness to a certain extent and makes possible its use in increased quantities for incorporation into various preparations which are commonly consumed. The beneficial effects of processing of fenugreek seeds may be attributed to an increase in low methoxy salts of calcium and magnesium as well as proto-pectin. It is probable that formation of these constituents has a role to play in reducing the blood sugar levels or it may also be likely that an active, hypoglycemic principle might have increased during processing like soaking and germination (Hooda and Jood, 2003) [5].

The present study was undertaken to assess the effect of varieties and processing methods on the nutritional composition of fenugreek seeds.

Materials and Methods

The five varieties of fenugreek seeds namely NDM-1, NDM-2, NDM-80, NDM-116 and NDM-120 released by Narendra Deva University of Agriculture & Technology were collected from Vegetable Seed Farm of Narendra Deva University of Agriculture & Technology, Kumarganj, Ayodhya, Uttar

Pradesh. Seeds were cleaned to remove any extraneous material. Chemical analyses was done by using the standard methods (AOAC, 2000).

Roasting: Fenugreek seeds (50 g) were roasted in an open pan at 130 ± 5 °C for 7 min. It was continuously stirred with ladle for proper and uniform roasting until it became slight brown and had a peculiar aroma.

Soaking: The cleaned seeds (50 g) were soaked in distilled water at the ratio of 1:5 (w/v) at room temperature for 12 h. The water was intermittently changed every 6 h. After 12 h, the excess water was discarded and seeds were dried in hot air oven at 60 °C till moisture free.

Germination: Fenugreek seeds (50 g) were soaked overnight in water at the ratio of 1:5 (w/v). The excess water was drained and seeds were kept in the dark for germination (tied in a muslin cloth) at 27 ± 2 °C temperature for 24 h. The germinated seeds were dried in an oven at 60 °C till moisture free.

Germination then Roasting: Fenugreek seeds (50 g) were soaked overnight in water at the ratio of 1:5 (w/v). The excess water was drained and seeds were kept in the dark for germination (tied in a muslin cloth) at 27 ± 2 °C temperature for 24 h. The germinated seeds were dried in an oven at 60 °C till moisture free then were roasted in an open pan at 130 ± 5 °C for 7 min. It was continuously stirred with ladle for proper and uniform roasting until it became slight brown and left a peculiar aroma.



Plate 1: Processed Fenugreek Seeds

Nutritional analysis

Samples were analyzed for their chemical compositions namely moisture, crude protein, crude fat, crude fibre, dietary fibre, total ash and dry matter using standard methods (AOAC, 2000). Carbohydrate was calculated by calculation method. Formula of carbohydrate is given below

$$\text{Carbohydrate (\%)} = 100 - (\text{Moisture} + \text{Crude protein} + \text{Crude fat} + \text{Crude fibre} + \text{Total ash})$$

Energy was calculated by factorial method. Formula of energy is given below

$$\text{Energy (Kcal)} = 4x \text{ Carbohydrate} + 4x \text{ Crude protein} + 9x \text{ Crude fat}$$

Table 1: Nutritional composition of different varieties of fenugreek seeds per 100 g

S. No.	Parameters	Varieties (V)					C.D. (0.05)
		NDM-120	NDM-116	NDM-80	NDM-2	NDM-1	
1.	Moisture (%)	7.17	7.53	6.50	6.84	6.82	0.18
2.	Crude Protein (%)	25.05	25.60	27.91	39.20	21.97	0.35
3.	Crude Fat (%)	7.42	10.48	5.25	10.47	9.31	0.09
4.	Crude Fibre (%)	15.49	14.82	14.01	15.02	15.10	0.16
5.	Dietary Fibre (%)	24.61	21.87	20.17	20.59	20.86	0.09
6.	Total Ash (%)	5.85	5.91	5.80	5.70	5.95	0.13
7.	Dry Matter (%)	92.81	92.47	93.50	93.17	93.18	0.19
8.	Carbohydrates (%)	39.00	36.00	41.00	23.00	39.00	0.19
9.	Energy (%)	323	341	321	342	333	1.22

Among various varieties maximum crude protein content was found in NDM-2 (39.20%) followed by NDM-80 (27.91%), NDM-116 (25.60%), NDM-120 (25.05%), and NDM-1 (21.97%). Variety NDM-116 and NDM-2 contained maximum fat i.e. 10.48 and 10.47 per cent. It was followed by NDM-1, NDM-120 and NDM-80 and respective values were 9.31, 7.42 and 5.25 per cent. Crude fibre content of NDM-120, NDM-2, NDM-116, NDM-1 and NDM-80 were 15.49, 15.02, 14.82, 14.55 and 14.01 per cent, respectively. Maximum dietary fibre content was found in variety NDM-120 followed by NDM-116, NDM-1, NDM-2 and NDM-80 and respected values were 24.61, 21.87, 20.86, 20.59 and 20.17 per cent, respectively. Maximum ash content was found

Statistical Analysis

Each experiment was replicated three times. The data were analyzed for percentage, mean and single factor Analysis of Variance (ANOVA) was applied to find the appropriate significant difference among the different foods.

Results and Discussion

Data presented in Table 1 depicts the nutritional composition of different varieties of fenugreek seeds. There was significant difference among the different varieties with respect to moisture content. Maximum moisture content was found in NDM-116 (7.53%) and minimum in NDM-80 (6.51%).

in NDM-1 followed by NDM-116, NDM-120, NDM-80 and NDM-2. The respective values were 5.95, 5.91, 5.85, 5.8, and 5.7 per cent. The dry matter content of different varieties of fenugreek seeds varied significantly. The maximum dry matter was found in NDM-80 (93.50%) followed by NDM-1 (93.18%), NDM-2 (93.17%), NDM-120 (92.81%) and NDM-116 (92.47%). The higher carbohydrate content of NDM-80 was 41 per cent followed by NDM-120 and NDM-1 (39%), NDM-116 (36%) and NDM-2 (23%). The energy content of different varieties ranged between 321 to 342 Kcal per 100 g. Data presented in Table 2 shows the effect of processing on nutritional composition of fenugreek seeds.

Table 2: Effect of processing on nutritional composition of fenugreek seeds per 100 g

S. No.	Parameters	Processings				C.D. (0.05)
		Raw	Roasted	Germinated	Germinated + Roasted	
1.	Moisture (%)	7.96	5.96	7.16	6.80	0.16
2.	Crude Protein (%)	23.13	27.48	28.71	32.47	0.31
3.	Crude Fat (%)	9.23	9.01	8.16	7.86	0.08
4.	Crude Fibre (%)	13.65	13.71	15.80	16.12	0.14
5.	Dietary Fibre (%)	25.67	23.24	21.56	17.60	0.08
6.	Total Ash (%)	5.29	5.57	6.17	6.37	0.11
7.	Dry Matter (%)	92.04	94.04	92.64	93.20	0.17
8.	Carbohydrates (%)	41	38	33	30	0.17
9.	Energy (%)	337	343	323	325	1.09

Among the treatments minimum moisture content was found in seeds which were roasted i.e. 5.96 and maximum moisture content i.e. 7.96 was found in raw seeds. Rasheed *et al.* (2015) [16] conducted study on nutritional properties of fenugreek seeds and found that seeds contained 11.21 per cent moisture on dry basis whereas, Buba *et al.* (2015) [3] reported average moisture value of 10.91 ± 0.85 per cent.

Among the various treatments maximum protein content was found in germinated then roasted followed by germinated, roasted and raw seeds and the respective values were 32.47, 28.71, 27.48, 23.13 per cent, respectively. Pandey and

Awasthi (2015) [13] had conducted a study on effect of processing techniques on nutritional composition and antioxidant activity of fenugreek (*Trigonella foenum-graecum*) seed flour and reported that fenugreek seed powder prepared from raw, soaked, germinated and roasted seeds have significant variation in protein content. Increase in protein content of germinated then roasted fenugreek seeds might be due to reduction of seed nitrates into protein and ammonium compounds (Hooda and Jood, 2003) [5]. Whereas increase in protein content of germinated seeds might be attributed to enzymatic synthesis of protein which is in

consent with the finding of (Mansour and El-Adway, 1994 and Mathur and Chaudhary, 2009) ^[9, 10].

Raw fenugreek seeds contained maximum fat having mean value 9.23 per cent followed by roasted (9.01%), germinated (8.16%) and germinated then roasted (7.86%). Sharara (2017) also reported the fat content of raw, boiled and germinated fenugreek seeds. The values were 8.19, 5.32 and 4.72 per cent on dry weight basis. Decrease in fat during germination may be due to its consumption as an energy source in the process of germination (Mansour and El- Adway, 1994). Roasting caused decrease in fat content which may be due to reduction in actual weight with the shrinkage. This may be due to loss of volatile oil on open dry heat treatment (Mathur and Chaudhary, 2009) ^[10].

Among different treatment maximum crude fibre content was found in seeds which were germinated then roasted (16.12%) followed by germinated, roasted and raw and respective value were 15.80, 13.77 and 13.65 per cent, respectively. Sahara (2017) and Pandey and Awasthi (2015) ^[13] also reported higher value of crude fibre in germinated fenugreek seeds. They were in the range of 10.55 (germinated fenugreek seeds), 8.70 (boiled fenugreek seeds) and 7.06 (raw fenugreek seeds) and 8.8 per cent (germinated), 6.2 (roasted), 6.0 (raw and soaked fenugreek seeds).

Raw fenugreek seeds contained maximum dietary fibre and mean value was 25.67 per cent followed by roasted (23.24%), germinated (21.56%) and Germinated then roasted (12.60%), respectively. Increase in crude fibre content on germination might be attributed to the synthesis of structural carbohydrate such as cellulose and hemi-cellulose during germination (<http://en.wikipedia.org/wiki/sprouting>, 2012).

Germinated then roasted seeds had maximum ash content (6.37%) followed by germinated (6.17%), roasted (5.57%) and raw (5.29%). Duhan *et al.* (2002) ^[4] reported that Zinc and Iron decreased whereas, Calcium and Phosphorus increased significantly on germination. Reduction in dietary fibre content after germination may be attributed to enzymatic breakdown of the Galactomannan units during sprouting. Shakuntala *et al.* (2011) ^[17] reported a decrease in soluble dietary fibre content upon germination of fenugreek seeds. This decrease in dietary fibre content may be attributed to their breakdown and utilization by the growing sprouts.

Among different treatments seeds roasted contained the maximum dry matter (94.04%) followed by seeds germinated then roasted (93.20%), germinated (92.64%) and raw (92.04%).

The carbohydrate content of fenugreek seeds given different treatments ranged between 30 to 41 per cent. Pandey and Awasthi (2015) ^[13] reported 46.1, 44.8, 43.9 and 35.7 per cent carbohydrate in raw, soaked, roasted and germinated fenugreek seeds.

Among the various treatments maximum energy value was found in roasted seeds followed by raw, germinated then roasted and germinated seeds with respective mean value 343, 337, 325 and 323 Kcal per 100 g.

Conclusion

The different varieties of fenugreek seeds were found to have variation in their nutritional components. Processing of fenugreek seeds like roasting, germination and germination then roasting increased the crude protein, crude fibre and total ash contents while, fat and dietary fibre value were decreased.

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