



RESEARCH ARTICLE

Development of soya sticks by utilization of fenugreek seeds

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Received: 14.02.2022

Accepted: 08.04.2022

ABSTRACT

The aim of present work was to develop nutritional soya sticks by incorporation of fenugreek seeds. Fenugreek seeds were incorporated in soya sticks in the powder form. As a fenugreek seed was bitter in taste, therefore seeds were debittered by processing like soaking and germination. Fenugreek seeds were soaked for 12hr and then germinated for 48 hr. The germinated seeds were dried and grind into powder form. Chemical properties of raw fenugreek seeds and germinated fenugreek seeds such as moisture, ash content, fat and protein on % dry basis were found to be 4.58%, 3.84%, 6.63%, and 23.56% and 6.36%, 3.25%, 5.70% and 23.20% respectively. The fenugreek seed powder was incorporated at 1%, 2%, 3% and 4% in soya sticks. On the basis of overall analysis, from all samples, sample contains 2% fenugreek seed powder was most acceptable. Sensory attributes like appearance, taste, flavor and overall acceptability were the quality control parameters used for soya sticks evaluation.

Keywords: Fenugreek seed, soaking, germination, oil frying, oven baking and soya sticks

Citation: Mote, G., Khade, S., Udachan, I., Tamboli, F., Lokhande, S., and Sahoo, A. 2022. Development of soya sticks by utilization of fenugreek seeds. *Journal of Postharvest Technology*, 10(2): 92-100.

INTRODUCTION

There is a growing consumer interest in ready-to-eat snack foods mainly due to their convenience, wide availability, appearance, taste and texture. Population-based studies have shown increased food consumption related to the snacking habit (Nicklas et al., 2003). Extruded foods such as snacks have become part of the dietary habits of a great part of the population. They can be prepared with ingredients or components that give them specific functional properties (Huang et al., 2006).

Many extruded products are mostly made from cereals such as corn, rice and wheat. These cereals are rich in carbohydrates and fibers but relatively low in protein content, thus they need to enhance the protein component in the extruded products. Due to consumer demand for healthy extruded snack foods, many industries have increased focus in research and product development to produce products that are nutrient-dense (Omwamba and Mahungu, 2014). Various studies have been carried

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out on the enrichment of snacks with different ingredients, such as soy flour, soy protein isolate, tomato powder, vitamins, carrot and basil powder, yam flour, among other ingredients, such as oats and fibers (Da Costa et al., 2009).

Soybean contains a considerably higher level of protein than other legumes and is known to contain isoflavones which are believed to have anticancer properties (Akaninwor and Okechukwu, 2004). The protein quality of soybean is also comparable to animal protein sources such as meat, poultry, and eggs as soy protein contains essential amino acids limited in other plant protein sources (Beski et al., 2015). Soy protein reduces levels of cholesterol in blood plasma in individuals with high cholesterol levels, reducing the risk of cardiac diseases. It also acts to reduce the risk of breast and prostate cancers and increases bone density, due to the presence of isoflavones and other phytochemicals (Da Costa et al., 2009).

Fenugreek (*Trigonella foenum-graecum*) is an annual plant belongs to the family Leguminosae. It is the famous spices in human food. The seeds and green leaves of fenugreek are used in food as well as in medicinal application that is the old practice of human history. It has been used to increase the flavoring and color, and also modifies the texture of food materials. Seeds of fenugreek spice have medicinal properties such as hypocholesterolemic, lactation aid, antibacterial, gastric stimulant, for anorexia, antidiabetic agent, hepatoprotective effect and anticancer. These beneficial physiological effects including the antidiabetic and hypocholesterolemic effects of fenugreek are mainly attributable to the intrinsic dietary fiber constituents which have promising nutraceutical value. It is well known for its fiber, gum, other chemical constituents and volatile contents. Dietary fiber of fenugreek seed is about 25% which changes the texture of food (Srinivasan, 2006). Dietary fiber from fenugreek blunts glucose after a meal. The mechanisms for these effects have not been fully elucidated. Fenugreek seeds contain 45.4% dietary fiber (32% insoluble and 13.3% soluble), and the gum is composed of galactose and mannose. The latter compounds are associated with reduced glycemic effect. The hypoglycemic effect of fenugreek has been especially documented in humans and animals with type 1 and type 2 diabetes mellitus (Roberts, 2011).

It was found that all parts of the fenugreek plant showed antifungal potential and the magnitude of effect varies with plant parts and species of fungus. It could be suggested that fenugreek is an important source of biologically active compounds useful for developing better and novel antifungal drugs (Haouala et al., 2008). The effectiveness of extracts obtained from fenugreek against *Helicobacter pylori* has been reported by several studies (O'Mahony et al., 2005; Randhir et al., 2004; Randhir and Shetty, 2007). In a study, honey samples with highest antibacterial and *Escherichia coli* show maximum pollens from fenugreek than other plants (Mercan et al., 2007).

MATERIALS AND METHODS

Raw material

Raw materials such as fenugreek seeds, rice flour and defatted soya flour were purchased from the local market of Kolhapur, Maharashtra.

Analysis of proximate composition

Fenugreek leaves (fresh and powder), rice flour and soy flour was analyzed for their proximate analysis such as moisture, crude fat, ash, crude fiber and protein ($N \times 6.25$), etc. contents using standard methods (AOAC, 2000). The samples were analyzed for SDF and IDF according to AOAC Methods.

Preparation of fenugreek seed powder

Fenugreek seeds were first cleaned and then soaked in water for 12hr at room temperature. The seed to water ratio of 1:5 (W/V) was used. After soaking seeds are germinated then dried at 55°C for 10hr. The dried seeds were grind to obtain fine powder and stored in air tight containers for further use.

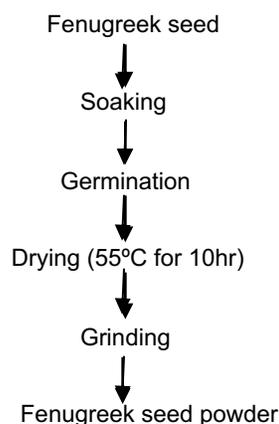


Figure 1: Flow chart of fenugreek seed powder from fenugreek seed

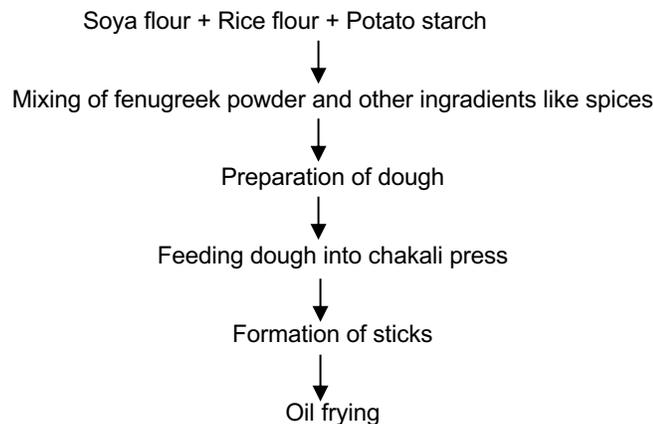


Figure 2: Flow chart of Preparation of soya sticks

RESULTS AND DISCUSSION

Physical characteristics of fenugreek seed

The physical parameters of fenugreek seed is presented in Table 1. The seeds have length ranging from 3.42 mm to 5.13 mm. The average length of fenugreek seeds was 4.35 mm. The seeds have width ranging from 2.64 mm to 3.79 mm. The average width of fenugreek seeds was 3.14 mm. The seeds have thickness ranging from 1.77 mm to 2.34 mm. The average thickness

of fenugreek seeds was 1.93 mm. The Thousand kernel weight of fenugreek seeds was ranging from 18.86 g to 19.78 g. The average weight of thousand seeds was 19.28 g. The bulk density of fenugreek seeds ranged from 0.76 gm/ml to 0.93 gm/ml. The average bulk density of seeds was 0.86 gm/ml. The results obtained of seed dimensions such as length, width and thickness as well as thousand kernel weight and bulk density in corresponding with the findings of Agrawal et al. (2015).

Table 1: Physical characteristics of fenugreek seed

Parameter	Observations
Length (mm)	4.35±0.58
Width (mm)	3.14±0.37
Thickness (mm)	1.93±0.18
Thousand kernel weight (g)	19.28±0.25
Bulk density (gm/ml)	0.86±0.30

Data are expressed as mean ± standard deviation of ten experiments

Chemical characteristics of raw fenugreek seed

Table 2 shows the proximate analysis of germinated fenugreek seeds after germination at different time period. There were significant changes in protein, fat, crude fiber and ash content during germination. The protein content was increased during germination from 23.56 % to 28.22 %, but it slightly reduced after 48hr germination. The protein content was observed during 48hr germination period. The fat content gets reduced during germination process from 6.63 % to 5.90 %. The crude fiber content was getting increased during germination up to 9.12% as compared to raw seeds 7.30 %. The raw fenugreek seeds contained higher total mineral content (3.84%). Soaking and germination shows significant changes in total mineral content. Total mineral content get reduced from 3.84 % to 2.57 %. The results obtained in present analysis were in close agreement with the results reported by Hooda and Jood (2003).

Table 2: Chemical characteristics of raw fenugreek seed

Parameter	Fenugreek seed
Moisture (%)	4.58±0.21
Ash (%)	3.84±0.32
Protein (%)	23.56±0.39
Fat (%)	6.63±1.0
Crude fiber (%)	7.30±0.74
Vitamin C (mg/100gm)	36.46
Iron (mg/100gm)	10.89
Calcium (mg/100gm)	71.58

Data are expressed as mean \pm standard deviation of triplicate experiments

Chemical characteristics of rice flour and soya flour

Table 3 shows the proximate analysis of rice flour and soya flour. It shows that, soya flour having more protein, fat and ash contains than rice flour, 37.58 %, 12.51 % and 3.23 % and 7.3 %, 2.34 % and 1.12 % respectively. Soya flour contains more crude fiber (31.52 %) than rice flour (3.78%).

Table 3: Chemical characteristics of rice flour and soya flour

Parameter	Rice flour	Soya flour
Moisture (%)	13.51 \pm 0.57	10.18 \pm 0.43
Ash (%)	1.12 \pm 0.14	3.23 \pm 0.29
Protein (%)	7.3 \pm 0.30	37.58 \pm 0.20
Fat (%)	2.34 \pm 0.40	12.51 \pm 0.35
Crude fiber (%)	3.78 \pm 0.20	31.52 \pm 0.47

Data are expressed as mean \pm standard deviation of triplicate experiments

Soaking of fenugreek seed

Fenugreek seeds were first cleaned and then soaked in water at room temperature. The seed to water ratio of 1:5 (W/V) was used.

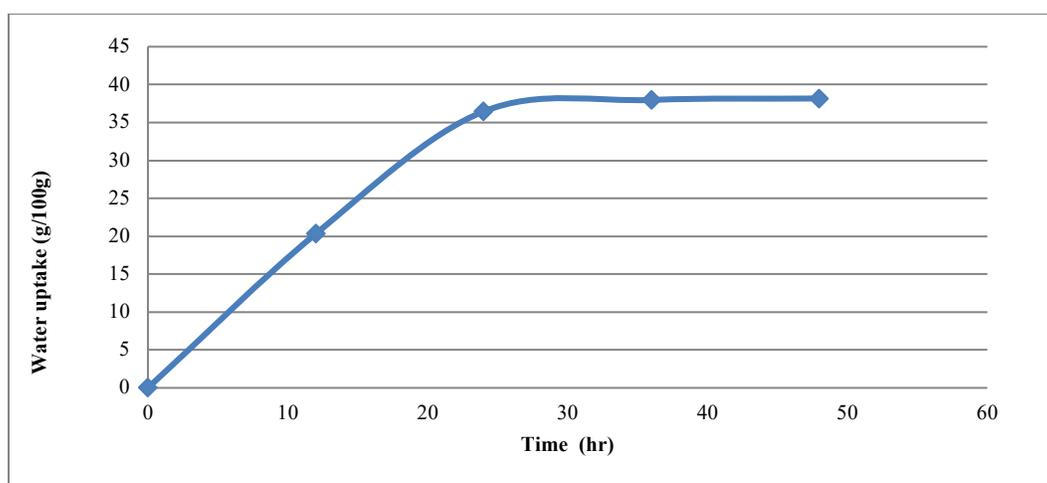


Figure 3: Water uptake of fenugreek seed

Figure 3 illustrates the water uptake of fenugreek seeds. The maximum water was absorbed by seeds during 24hr. After 24hr the rate of water absorption by seeds reduced. The water uptake ratio by seeds after 24hr and after 48hr was almost equal. Therefore the seeds soaked for 12hr and 24hr were taken for further analysis.

3.5 Graphical representation of fenugreek seed sprouting

After soaking for 24hr and 48hr, the soaked seeds were washed with water and germinated in sprout maker at room temperature with frequent watering.

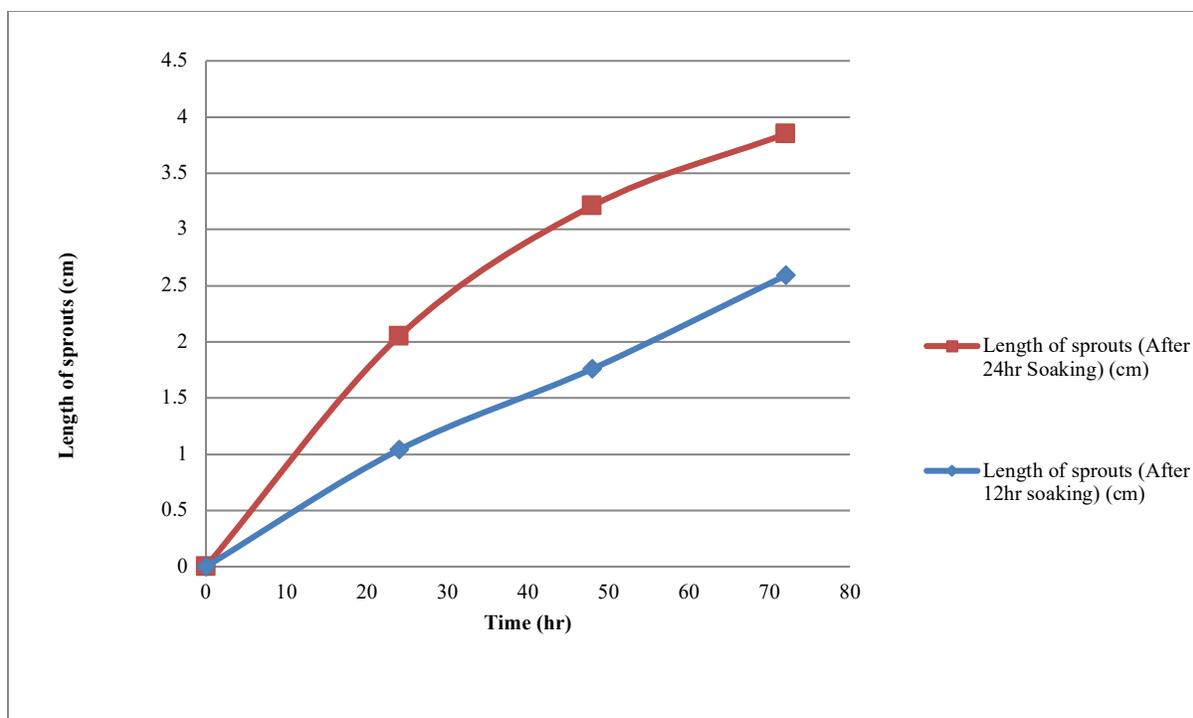


Figure 4: Sprouting of fenugreek seed

Figure 4 illustrates the length of sprouts during germination at different time duration. The seeds soaked for 24hr before germination shows rapid growth of sprouts. Therefore, seeds soaked for 12hr were preferred for further evolution.

Proximate analysis of germinated fenugreek seeds (12hr soaking)

Table 4 shows the proximate analysis of germinated fenugreek seeds after germination. The protein content increased during germination but it slightly reduced after 48hr of germination. The best improvement in protein was observed during 48hr germination period. The fat content reduced during germination process. The crude fiber was increased during germination. Slight changes in the total mineral content were observed during germination.

On the basis of organoleptic characteristics and proximate analysis of germinated seeds during different time period, the seeds germinated for 24hr were selected for incorporation in the soya sticks.

Table 4: Proximate analysis of germinated fenugreek seeds

Parameter	Germination for 24hr	Germination for 48hr	Germination for 72hr
Moisture (%)	3.8±0.15	4.78±0.18	4.81±0.08
Protein (%)	20.15±0.25	28.22±0.20	25.60±0.20
Fat (%)	6.03±0.21	5.90±0.25	5.94±0.26
Crude fiber (%)	7.43±0.55	8.16±0.22	10.12±0.30
Ash (%)	3.15±0.35	2.96±0.25	2.57±0.45
Carbohydrates (%)	62.87±0.21	58.14±0.20	59.56±0.12

Data are expressed as mean ± standard deviation of triplicate experiments

Preparation of soya sticks

Soya sticks was prepared by using chakli press. To prepare soya sticks, all raw ingredients were mixed together to form dough. After formation of dough, it was passed through the chakali press to make sticks. Sticks were then fried in oil as well as baked by using oven. The fenugreek seeds powder was incorporated in soya sticks at different concentrations. Fenugreek seed powder was incorporated in soya sticks at 1%, 2%, 3% and 4% concentrations. The concentrations of fenugreek seed powder was kept same for oil fried as well as oven baked soya sticks. On the basis of sensorial analysis from all samples, sample contains 2% fenugreek seed powder was most acceptable. The sensory evolution was carried out using 9 point hedonic scale from semi-trained panel members.

Proximate analysis of soya sticks

Table 5 shows the proximate analysis of oil fried and oven baked soya sticks. There was no major difference in moisture, crude fiber and mineral content of both oil fried and oven baked soya sticks. The protein content was slightly higher in the oil fried soya sticks. The major difference was observed in the fat content. Oven bake soya sticks contained very less amount of fat as compared with the oil fried soya sticks.

Table 5: Proximate analysis of soya sticks

Parameter	Oil frying	Oven baking
Moisture (%)	5.20±0.40	5.60±0.38
Ash (%)	4.38±0.26	4.07±0.22
Protein (%)	18.21±0.20	14.38±0.12
Fat (%)	21.65±0.12	2.56±0.25
Crude Fiber (%)	2.16±0.16	1.90±0.22
Carbohydrates (%)	50.56±0.12	73.39±0.14
Iron (mg/100gm)	4.70±0.10	2.60±0.20
Calcium (mg/100gm)	136.48±0.26	138.80±0.40

Data are expressed as mean ± standard deviation of triplicate experiments

CONCLUSIONS

The present study it was observed that, soaking and germination process helped to reduce the bitterness of fenugreek seed and to increase the nutritive value. The fenugreek seeds germinated for 48 hrs having good nutritive value. On the basis of sensory evolution, soya sticks containing 2% fenugreek seed powder had higher preference. Soya sticks fortified with fenugreek seeds powder, could be a good source of various nutrients like protein, fat, crude fiber, minerals (esp. iron and calcium) which could address many physiological deficiencies like anemia, osteoporosis, obesity etc.

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