PM Formalization of

Micro Food Processing Enterprises (PMFME) Scheme

HANDBOOK

OF

FENUGREEK PROCESSING

AATMANIRBHAR BHARAT

National Institute of Food Technology Entrepreneurship and Management
Deemed to be University (De-novo Category) under Section 3 of the UGC Act, 1956
An Autonomous Institution under Ministry of Food Processing Industries, Government of India, Sonepat, Haryana, India
Website: www.niftem.ac.in
Email: pmfmecell@niiftem.ac.in
Call: 0130-2281089

TABLE OF CONTENTS

PAGE NO

ABBREVIATIONS

1	PET	Polyethylene terephthalate
2	LDPE	Low-density polyethylene
3	HDPE	High-density polyethylene
4	BIS	Bureau of Indian Standards
5	FSSAI	Food Safety and Standards Authority of India

CHAPTER 1

1. Introduction

Fenugreek (*Trigonella foenum graecum*) is an annual plant belongs to the family Leguminosae. It is the famous spices in human food. Fenugreek is an interesting herb with diverse uses and many potential health benefits. 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.

Fenugreek seeds have a healthy nutritional profile, containing a good amount of fiber and minerals, including iron and magnesium. From fenugreek plant seeds and leaves can be harvested. Fenugreek seeds have long shelf life as they have very low moisture content. Fresh fenugreek leaves have high moisture due to which have limited shelf life of 4-7 days. Drying of leaves helps in reducing the moisture of leaves and extends the shelf-life to 1-2 years if properly packaged in different packaging material. Fenugreek seeds and leaves (fresh and dried) is used in preparation traditional curry. Fresh fenugreek leaves are also utilized to prepare paratha/ chapati after mixing them in wheat flour. Dried fenugreek has several applications in snacks products i.e. khakahara, Bhujiya, chips, extruded products namkeen, for flavouring. They also used for seasoning different baked products.

Apart from increasing the flavor and color, and it also modifies the texture of food materials. 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. These days it is used as food stabilizer, adhesive and emulsifying agent due to its high fiber, protein and gum content. The protein of fenugreek is found to be more soluble at alkaline pH (Meghwal and Goswami, 2012). Fenugreek is having beneficial influence on digestion and also has the ability to modify the food.

Most important fenugreek herb/seed has several medicinal benefits i.e. hypocholesterolemic, lactation aid, antibacterial, gastric stimulant, for anorexia, antidiabetic agent, galactogogue, hepatoprotective effect and anticancer. Research suggests that fenugreek may increase breastmilk production and the rate of weight gain in newborn babies. Initial research suggests that fenugreek can boost testosterone levels and sexual function in men. Evidence supports fenugreek's role in blood sugar control and the treatment of type 1 and 2 diabetes. Although

more research is needed, initial results postulate that fenugreek has several other health benefits. Fenugreek is a unique herb that has long been used in alternative medicine. In humans, fenugreek may cause mild side effects, although it appears relatively safe at the correct dosage.

These beneficial physiological effects including the antidiabetic and hypocholesterolemic effects of fenugreek are mainly attributable to the intrinsic dietary fiber constituent which have promising nutraceutical value (Srinivasan, 2006).

2. Fenugreek Name

Fenugreek's botanical name is *Trigonella foenum-graecum* in the subfamily of Papilioacae of the family of Leguminosae (bean family, Fabaceae)

Table Local name of fenugreek in different part of India

S.No.	Local Name	Language	State
1	Methi	Hindi, Oriya, Bengali, Punjabi and Urdu	Haryana, Odisha, West Bengal, Punjab
2	Methya	Marathi	Maharahtra
3	Menthya	Kannada	Karnataka
4	Vendayam or Venthayam	Tamil	Tamil Nadu
5	Menthulu	Telugu	Andhra Pradesh
6	Uluva	Malayalam	Kerala
7	Medhika or Chandrika	Sanskrit	-

3. History

Fenugreek is a self-pollinated, small-seeded annual legume that is grown as a spice crop. Fenugreek has two areas of origin: the Indian subcontinent and the Eastern Mediterranean Region It is believed that fenugreek was known in the Indian cuisine even 3,000 years ago. Its growth in the wild is reported from Kashmir, Punjab and the Upper Gangetic plains. Its use is also reported in ancient Egypt and India, and later in Greece and Rome. A notable practice reported is its use as fumigant in incense burning in religious ceremonies in Egypt to spread "Holy Smoke". It was also used for embalming. Other countries where it is grown are

Argentina, Egypt and Mediterranean region. Use of its seed as a spice, and its leaves and tender pods as vegetable were also reported. It was also used as cattle feed.

4. **Classification**:

Taxonomical classification (kingdom, division, class, order, family, genus, species) of fenugreek is shown in below figure.

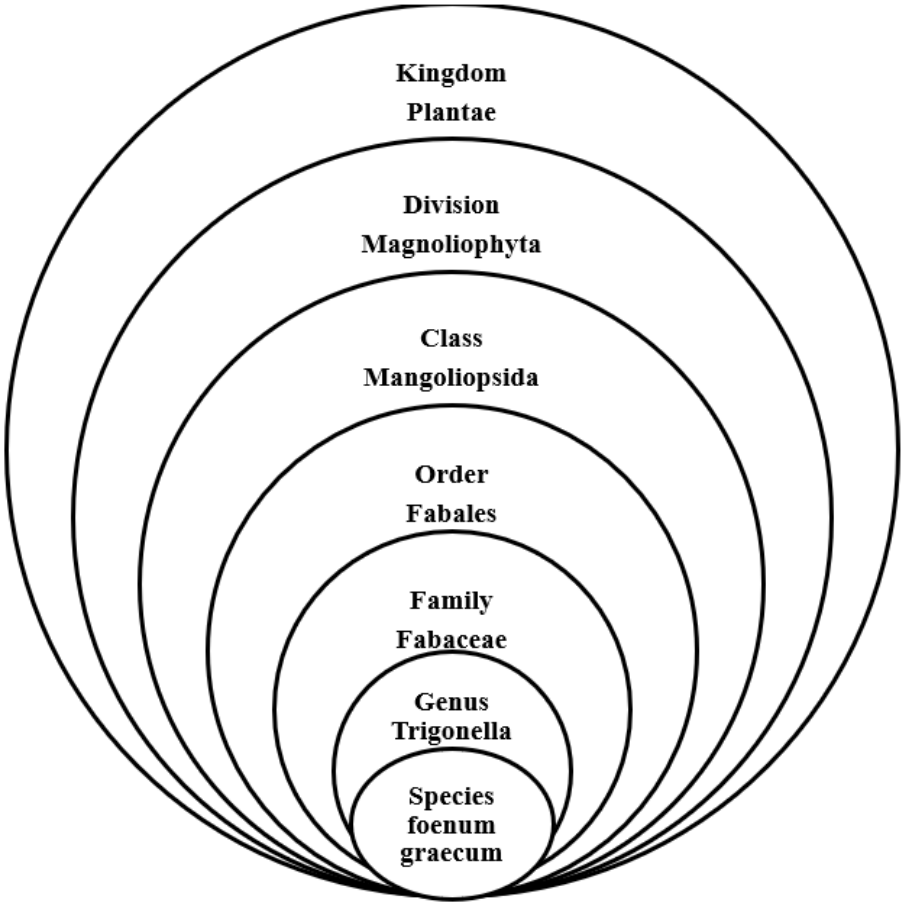


Figure: Taxonomical classification

5. Fenugreek plant

Fenugreek is an annual herb growing to a height of up to 60 cm (20 in). The leaves are pale green and consist of three leaflets with toothed margins. The whitish flowers are produced singly or in pairs in April and May. They are followed by bean-like pods 10 to 15 cm (4 to 6 in) long containing up to twenty smalls, grooved, yellowish-brown seeds. The leaves are rich

in the nutrient's carotene, vitamin A, ascorbic acid, calcium, and iron. The seeds are composed of "protein, starch, sugar, mucilage, minerals, volatile oil, fixed oil, vitamins and enzymes". They smell of curry but are quite bitter and contain coumarin oil. The seeds also contain diosgenin which is used in the manufacture of oral contraceptives.

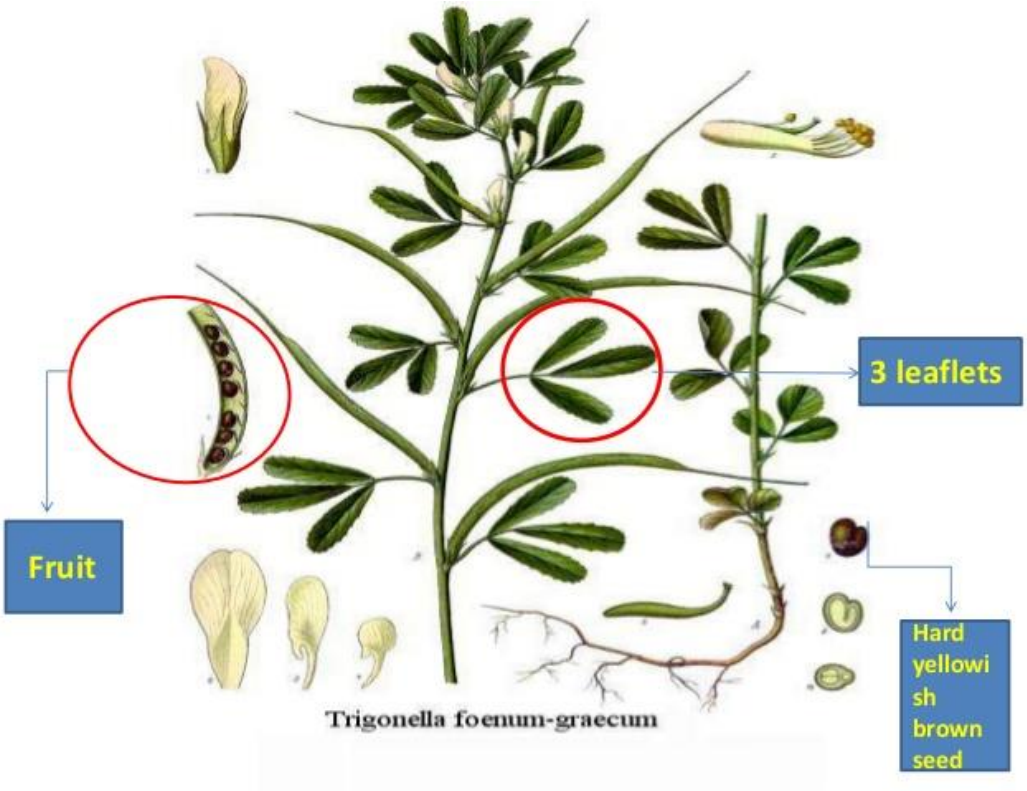


Figure: Part of fenugreek plant

6. Fenugreek composition

Composition of fenugreek plant, leaf and seed are given below in tables.

Table: Composition of fenugreek plant (Wani et al., 2018)

Components	Plant
Carbohydrate	58%
Fat	6-7%
Protein	23-26%
Moisture %	11%
Ash	3%
Fiber	25% of carbohydrates
Iron	33mg/100g

Table: Composition of fenugreek leaves (Wani et al., 2018)

Components	Leaves
Carbohydrate	6%
Fat	0.9%
Protein	4.4%
Moisture %	86.1%
Ash	1.5%
Fiber	1.1%
Ascorbic acid	220.97 mg/100g
b-carotene	19 mg/100g

Table: Composition of fenugreek seeds (Rashid et al., 2018; Buba et al., 2015)

Components	Seed
Carbohydrate	45-60%
Fat	7.5%
Protein	20-30%
Moisture %	5-10%
Ash	3-4%
Vitamin B1	0.1137 mg/g
Vitamin B2	0.0366 mg/g
Vitamin B6	0.0495 mg/g
Vitamin B12	0.8710 mg/g
Vitamin C	10.54 mg/g

6.1 Ptochemistry of fenugreek plant

Fenugreek contains a number of chemical constituents including steroidal sapogenins. Diosgenin component has been found in the oily embryo of fenugreek. There are two furastanol glycosides, F-ring opened precursors of diosgenin that have been reported in fenugreek also as hederagin glycosides. Alkaloids such as trigocoumarin, nicotinic acid,

trimethyl coumarin and trigonelline are present in stem. The mucilage is a standing out constituent of the seeds. There is about 28% mucilage; a volatile oil; 2 alkaloids such as trigonelline and Choline, 5% of a stronger-smelling, bitter fixed oil, 22% proteins and a yellow coloring substance are present in stem. Fenugreek contains 23–26% protein, 6–7% fat and 58% carbohydrates of which about 25% is dietary fiber. Fenugreek is also a rich source of iron, containing 33 mg/100 g dry weight (US Department of Agriculture, 2012).

6.2 Composition of Leaves

The leaves contain seven saponins, known as graecunins. These compounds are glycosides of diosgenin. Leaves contain about 86.1% moisture, 4.4% protein, 0.9% fat, 1.5% minerals 1.1% fiber, and 6% carbohydrates. The mineral and vitamins present in leaves include calcium, zinc iron, phosphorous, riboflavin, carotene, thiamine, niacin and vitamin C. Fresh leaves of fenugreek contain ascorbic acid of about 220.97 mg per 100 g of leaves and b-carotene is present about 19 mg/100 g. On the other side, it was reported that 84.94% and 83.79% ascorbic acid were reduced in sun and oven-dried fenugreek leaves respectively. Fresh leaves are used as vegetables in the diets. It was found that there was a better retention of nutrients in the leaves of fenugreek. The leaves of fenugreek should be stored in either in refrigeration conditions, or dried in oven, or blanched for sometime (about 5 min) and should be cooked in pressure cooker

6.3 Composition of Seeds

Fenugreek is known for its pleasantly bitter, slightly sweet seeds. The seeds are available in any form whether whole or ground form is used to flavor many foods mostly curry powders, teas and spice blend. Fenugreek seed has a central hard and yellow embryo which is surrounded by a corneous and comparatively large layer of white and semi-transparent endosperm. List of chemical constituents is shown in table below. The chemical composition of fenugreek (such as seeds, husk and cotyledons) showed that endosperm had the highest (4.63 g/100 g) saponin and (43.8 g/100 g) protein content. As against this, husk contains higher total polyphenols. The extracts of endosperm husk, and fenugreek seed at about 200 lg concentration exhibited antioxidant activity 72%, 64%, and 56% respectively by free-radical scavenging method.

The seeds of fenugreek contain about 0.1–0.9% of diosgenin and are extracted commercially. The structure of diosgenin is shown in Fig. 1. The plant tissue cultures from seeds of fenugreek when grown under optimal conditions have been found to produce as much as 2% diosgenin with smaller amounts of trigogenin and gitongenin. Seeds also contain the saponin (fenugrin B). Fenugreek seeds have been found to contain several coumarin compounds as well as a number of alkaloids (e.g., trigonelline, gentianine, carpaine). The large amount of trigonelline is degraded to nicotinic acid and related pyridines during roasting. The major bioactive compounds in fenugreek seeds are believed to be polyphenol compounds, such as rhaponticin and isovitexin. Small amount of volatile oils and fixed oil has been found in fenugreek seeds.

7. Production

The major seed producing countries are India, Ethiopia, Egypt and Turkey. India is the largest producer of fenugreek in the world. During 2011–12, production was 121,775 tonnes of seeds from an area of 96,304 hectares (237,970 acres). Its seed is traded as a spice, and in an oil extract form as oleoresin. India consumes most of the seeds. Its export was 799 tonnes in 1960–61, and increased greatly to 15,135 tons by 1995–96 and then to 21,800 tonnes during 2011–12. It was exported to UAE, Sri Lanka, and Japan, and European countries of UK, Netherlands, Germany and France.

The major states growing fenugreek in India are Rajasthan, Madhya Pradesh, Gujarat, Uttar Pradesh, Uttaranchal, Maharashtra, Tamil Nadu and Punjab. Within the country its seed production is the highest in the state of Rajasthan followed by Gujarat, Madhya Pradesh and Uttaranchal. In Rajasthan, which accounts for a significant majority of India's total output, the crop is mainly grown during the winter season. Other states where it is grown in fairly good quantity are Tamil Nadu, Punjab and Uttar Pradesh. Main fenugreek growing district in Rajasthan are Sikar, Jaipur, Nagaur, Kota, Jhalawar, Baran and Chittorgarh.

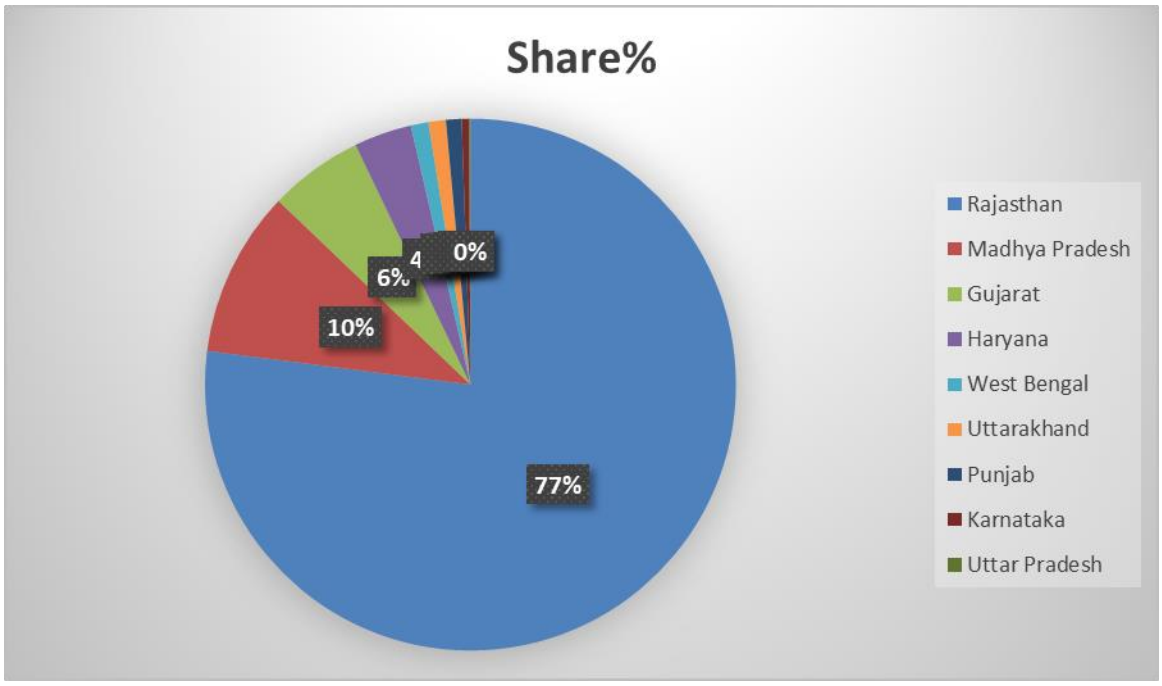


Figure: Shares of different states in fenugreek production (2015-16)

Data Source: National Horticulture Board (NHB)

8. Cultivation method

The plant is generally cultivated throughout the year in areas where the climate is moderately cool, and frost free (particularly during the stage of the plant's "flowering and early grain formation") with clear sky. It is grown in many types of soils which have rich organic content. The preferred soil type is loamy or sandy loam with pH value in the range of 6–7 and with good drainage conditions for better yield.

It is grown in both the cropping seasons of Rabi and Kharif in South India – first fortnight of October during Rabi and second fortnight of June–July during Kharif. The amount of seeds used for sowing during both seasons is generally 25 kg/ha. The yield is more during Rabi season. The average yield is about 10–11 q/ha with 15–20 q/ha achievable with improved varieties and optimal management methods.

9. Variety

There are several varieties of fenugreek grown in the country. There are two species of the genus Trigonella, which are of economic importance viz., *T. foenum graecum*, the **common methi** and *T.corniculata*, the **Kasuri methi**. These two differ in their growth habit and yield.

The latter one is a slow growing type and remains in rosette condition during most of its vegetative growth period.

Commercial varieties of Fenugreek (Methi):

Kasuri, RMt 1, Pusa, RMt 143, Early,Co-1 punching type, Methi No- 47, No- 14, EC-4911,Rajendra Kanti, HM 103, Hissar Sonali are the important varieties of fenugreek (methi). Pusa early commercial crop, it takes about 130 days for its seed maturity. Methi No.14 and Methi No.47 are high yielding varieties of fenugreek in India.Co-1Variety also early bunching crop. its maturity period is 95 days. Many improved cultivars are now available for cultivation. They are briefly described hereunder.

Table 2 Different variety of fenugreek with their salient features

Variety	Parentage	Institution	Salient features
Lam selection 1	selection from germplasm	ANGRAU, AP	tolerant to powdery mildew, root rot, caterpillars and aphids
Pusa Early Bunching	NA	IARI	Resistant to downy mildew, rots
Rajendra Kranti	Pure line selection from Reghunathpur local	COA, Murzhapur	Tolerant to leaf spot, suit for intercropping
Hissar sonali	Pure line selection from local	HAU, Haryana	Moderately tolerant to root rot,aphids
Co.1	Selection from germplasm	TNAU	dual purpose variety evolved at TNAU Tolerant to root rot
RMt- 1	Pure line selection from Naguar local	RAU, Jobner	Moderately resistant to root rot and tolerant to powdey mildew
RMt- 143	Pure line selection from local	-do-	Seeds mature 140-150 days after sowing, Moderately resistant to powdery mildew

10. Harvesting

In about 25 to 30 days, young shoots are nipped off 4 to 5 cm above ground level and subsequent cuttings of leaves may be taken after 15 days. It is advisable to take 1 to 2 cuttings before the crop is allowed for flowering and fruiting.

- **Harvesting of leaf** is done when the lower leaves of the plant start shedding and the pods turn colour. Timely manual harvesting is done by way of cutting using sickles.
- **Drying of leaf**: The harvested plants leaf are tied in bundles and sun dried for 5–7 days.
- **Harvesting of seeds**: When pods are dried, the plants are pulled out, dried in the sun
- **Threshing of seeds:** It can be done by hand or using mechanical methods, is done to separate the seeds from the plants.

- **Drying of seeds** Seeds are winnowed cleaned and dried in the sun.
- A **vacuum gravity separator** or spiral gravity separator is used to clean the seeds which are then graded.
- **Packaging**: Disinfected jute bags are used to store the graded seeds and they are kept in moisture-free and airy chambers. They may be stored in gunny bags lined with paper.

CHAPTER 2

11. Processing of fenugreek

11.1 Post harvest drying of fresh leaves

Fresh leaves have limited shelf life due to high moisture content in them. To relish them throughout the year, and to make it available throughout different places where it is not grown, to reduce the transportation cost and to make the handling easier in industry for using as colorant, flavouring, or for culinary purpose it is suggested to dry the fresh leaves. Dried leaves and properly packed and stored has shelf-life upto 1-2 years. Shelf life depends on the storage condition percentage of moisture removed and type of packaging material. Leaves can be dried using sun but to avoid contamination from environment and during non availability of sunshine it is recommended to use several mechanical electrically operated drying system.

Figure: **Flow diagram for Processing of fresh leaves**

11.2 Industrial post harvest Processing and drying of fenugreek seeds

After removing the dust and straw, the dried and clean grains are filled in bags and stored in aerated storehouses or in moisture and insect proof bins. On a commercial scale, the grains are cleaned with the help of vacuum gravity separator or spiral gravity separator. The seed should be dried to below 12 per cent moisture for safe storage.

- **Destoning** - Reliable removal of high-density impurities such as stones and pieces of metal and glass is achieved on the basis of differences in specific gravity. (Destoner MTSC**)**
- **Combinator-** For the classification of grain into heavy, and removal of light impurities with additional destoning. (MTKB - Combi-Cleaner with air-cycling system)
- **Separation and Classification -** Classifies various products according to size. Excellent separating efficiency. (Buhler Separator Classifier MTRB with aspiration channel MVSH)
-

Post harvest drying of seeds

- Threshing -is a process by which seeds are separated from the plants. Manual threshing is normally done on clean cemented floor
- Cleaning and Grading -Separated seeds are heaped together on the floor which is then cleaned of dust and straw by using winnowing fans.
- Drying – seeds are dried using sun drying or conventional driers
- Packaging: Disinfested jute bags or LDPE are used for packing fenugreek seeds and these bags are stored in damp-free aerated stores.
- Grinding: Seeds are grinded if required and stored airtight packaging material

11.5 Extraction of galactomannan from fenugreek seeds

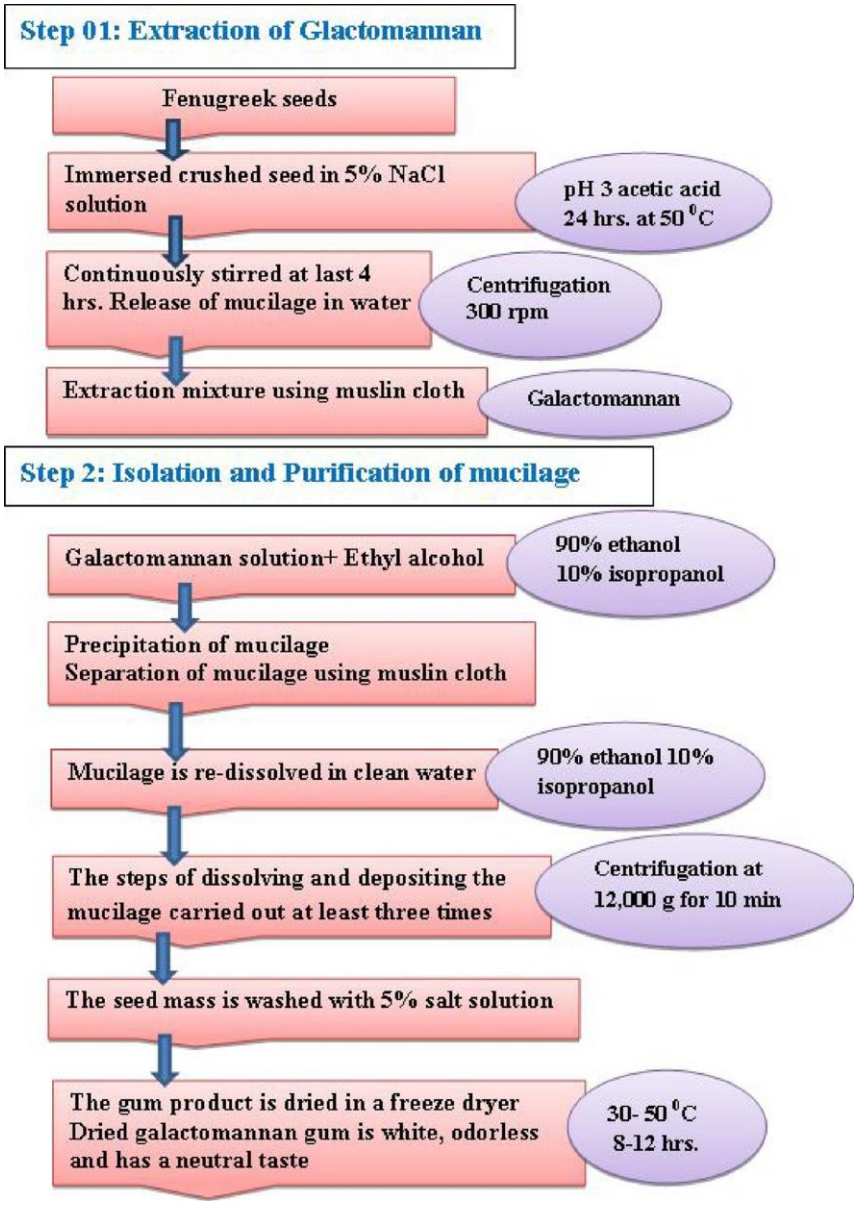


Figure: Extraction of galactomannan (Rashid et al., 2018)

Galactomannan, a water-soluble heteropolysaccharide was isolated and purified from seed of fenugreek locally called as Kasuri Methi. The major bioactive constituents of fenugreek seeds includes 45–60% carbohydrates, most of which is a mucilaginous fiber with a proportion of 30% soluble fiber (galactomannan) and 20% insoluble fiber.

11.6 Processing of fenugreek seed to extract oil

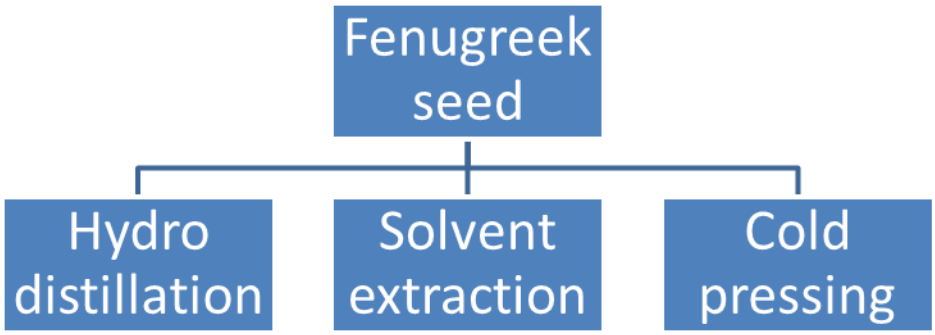
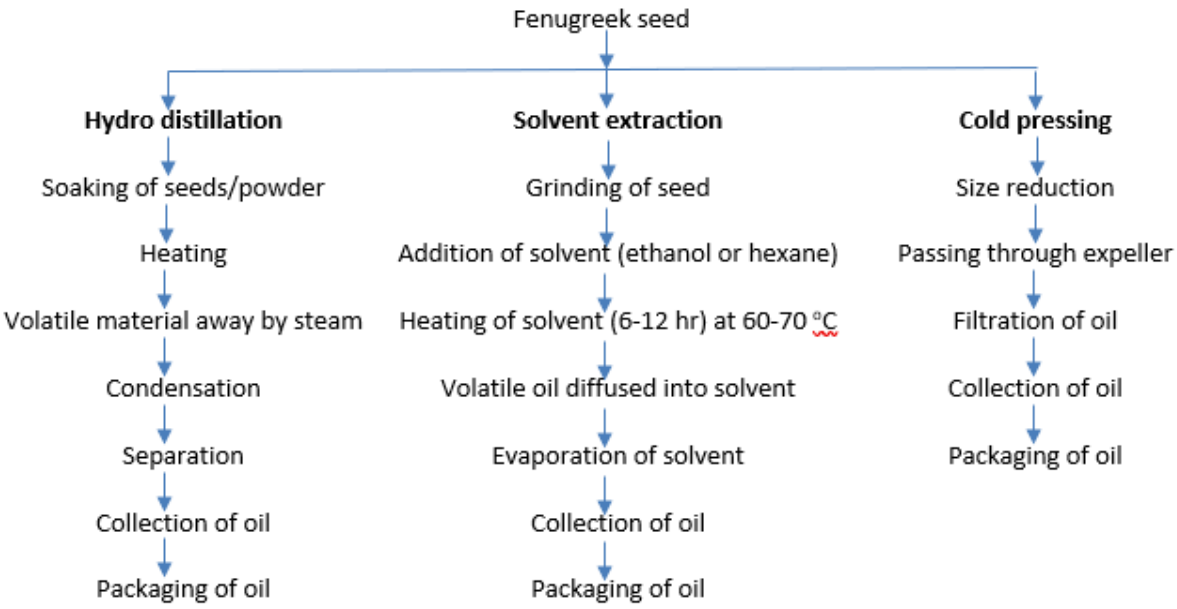


Figure: Method of fenugreek seed oil extraction



Flow chart for extraction of oil from fenugreek seeds

12. Utilisation of fenugreek in various food products

Due to rich source of natural dietary fiber in fenugreek, it has established itself in the modern food ingredient or functional food. Fenugreek as a hydrocolloid, which is fenugreek gum (soluble fiber of fenugreek), gives textural, appeal, thickening, emulsifying, stabilizing, gelling, and encapsulating properties. So the dietary fiber, more importantly soluble fiber can find their way into nutrition and dairy products, cereal bars, yogurts, and nutritional beverages. The powder of soluble fiber or total dietary fiber can be mixed with juices of fruit, seasonings and other spice mixes. Directly it can be used to formulate tablets or capsules along with the other vitamins and nutrients necessarily needed. It can also be used in milk shakes, dressings, soups, candies and sweets. It has been used to fortify bakery flour for pizza, pizza, cake mix, bread, bagel, muffins, flat bread, tortilla and noodles, fried, baked corn chips. Bakery foods such as bread, pizza, cakes and muffins have been prepared by using flour fortified with eight to ten percent soluble dietary fiber. When fiber fortified flour was used for making oil fried snacks, 8–15% of less oil absorption only takes place which is really appreciable in terms of unwanted fat intake.

a. Fenugreek as food satblizer, food adhesive, food emulsifiers and gum

The interaction of fenugreek protein with the food constituents determines its ability to stabilize and emulsify the food constituents. Effect of fenugreek gum on solubility and emulsifying properties of soy protein isolate and it was reported that the emulsifying activity of soy protein isolate with fenugreek gum was four times higher than that of soy protein isolate with fenugreek gum or fenugreek gum alone and the results were to those of bovine serum albumin. The emulsifying stability of soy protein isolate with fenugreek gum dispersions was respectively three times higher than that of soy protein isolate with fenugreek gum and bovine serum albumin. Emulsifying properties and solubility of soy protein isolate with fenugreek gum dispersions were also stable over wide ranges of high temperature, pH and ionic strength. Fenugreek contains higher dietary fiber content which acts as probiotic in functional food. The soluble fiber of fenugreek acts as an excellent substrate for fermentation done by the microorganisms in the large intestine. The dietary fiber of fenugreek has potential for widespread use in the food industry because its galactomannan composition has emulsifying and stabilizing properties. Flour supplemented with a percentage of 8% and 10% of fenugreek dietary fiber has been used in the production of baked goods such as bread,

pizza, muffins, and cakes. This application of fenugreek to flour allows for the production of functional foods that may be widely acceptable to consumers observing western diets.

b. Fenugreek in traditional food

Fenugreek paste, locally termed as ‘‘Cemen” is a popular food in Turkey which is prepared from ground fenugreek seeds. Crushed fenugreek seed or coarse fenugreek powder is used to make ball for making clarified butter.

c. Fenugreek in bakery products

Adding fenugreek fiber to refined flours helps to fortify with a balance of soluble and insoluble fiber. Flour fortified with 8– 10% fenugreek fiber has been used to prepare bakery foods such as pizza, bread, muffins, and cakes with acceptable sensory properties. Fenugreek seed husk is a rich source of dietary fiber and several important minerals.

This fiber-rich functional ingredient can be incorporated in the manufacture of high-fiber muffins. The fiber-rich muffins possessed good volume, soft texture and medium-fine grain with twice the amount of dietry fibre. Reserachers incorporated fenugreek in bread and demonstrated that fenugreek in food helps in reduction of blood sugar but due to its bitterness and strong odor its use is restricted. They did not find significant variation in color, texture, proximate composition, firmness, and flavor intensity between the wheat and fenugreek bread, but level of glucose and insulin was found to be lower in the fenugreek bread. Fenugreek’s functional property of reducing insulin resistance was maintained in the bread. Therefore, it is evident from this study that fenugreek can be incorporated in baked products in acceptable limit which will reduce insulin resistance and treat diabetic patients as well. Fenugreek flour has been incorporated up to a 10% level in the formulation of biscuits without affecting their overall quality.

The physical, sensory and nutritional characteristics generally revealed that biscuits containing 10% germinated fenugreek flour were the best among all the composite fenugreek flour biscuits. Hence, development and utilization of such functional foods will not only improve the nutritional status of the general population but also helps those suffering from degenerative diseases.

In a study incorporation of fenugreek flour up to 10% level has been used in the formulation of biscuits. Baking quality, color attributes and organoleptic evaluation revealed that wheat

flour can be replaced using 10% Soaked Fenugreek and 20% Germinated Fenugreek flours to produce acceptable and high nutritional value biscuits. The study confirmed that fenugreek seed (raw, soaked and germinated) significantly reduced total lipids, serum total cholesterol, and LDLcholesterol but non-significant changes in triglycerides and serum HDL-cholesterol were observed. It can be recommended that fenugreek may be used for lipid lowering purposes. Supplementation of basal diets with fenugreek leaves, seeds (dry and germinated) and wheat flour supplemented with germinated fenugreek powder at 5–10% levels increased the total proteins, fibers, iron, zinc, calcium, vitamin B2, carotene, vitamin E and vitamin C contents.

These dietary supplements also improve the blood picture of anemic rats so they have nutritive and restorative properties. The daily use of fenugreek products as a dietary supplement is proved to be safe and healthy. Therefore, this study recommends that intake of fenugreek products may be beneficial for patients who suffer from iron deficiency anemia owing to their nutritive and restorative values. In the same way 10% germinated fenugreek seed flour has been incorporated into the wheat based biscuits formula resulted in improving their chemical and nutritional quality and additionally also complimented the deficiency of lysine, isoleucine leucine, threonine and valine, and hence neutralizes the amino acid imbalance.

d. Fenugreek in extruded products

Fenugreek seed flour and fenugreek leave powder have been used for the development of extruded snacks. In a study a mixture of about 1.78% fenugreek seed flour and 0.66% fenugreek leave powder with the base material was found to have high preference levels for parameters of physical, functional and color and could be extruded with acceptable quality characteristics.

The effects of fenugreek flour and debittered fenugreek polysaccharide inclusion on the physical and sensory quality characteristics, and glycemic index (GI) of chickpea–rice based extruded products were studied. Due to the distinct bitter taste, inclusion of fenugreek flour was not acceptable at levels more than 2% in extruded chickpea based products. Addition of fenugreek polysaccharide resulted in slight reduction in radial expansion, while longitudinal expansion increased. Water absorption index increased while water solubility index

decreased compared to the control. The mean scores of sensory evaluation indicated that all products containing fenugreek polysaccharide up to 15% were within the acceptable range.

There were no significant differences between products containing 5–15% fenugreek polysaccharide in their color, flavor, texture and overall quality. Fenugreek, in the form of debittered polysaccharide could be incorporated up to a level of 15% in a chickpea–rice blend to develop snack products of acceptable physical and sensory properties with low Glycemic Index.

In another study fenugreek gum was extruded in a twinscrew extruder without an exit die to minimize a decrease in molecular weight of fenugreek gum during extrusion process. Both the steady and dynamic shear rheological tests revealed that extrusion process did not substantially influence the steady and dynamic shear properties of the gum. The power law model was applied to describe the flow behavior of the extruded gum solutions. The extrusion modified fenugreek gum solutions exhibited a shear thinning flow behavior at 25 _C, and the values of consistency index and apparent viscosity increased with an increase in the gum concentration. The magnitudes of storage modulus and loss modulus for the extrusion modified fenugreek gum solutions increased with increasing frequency and with increasing gum concentration. Fenugreek gum (extruded and nonextruded) was substituted for wheat flour at 0%, 5% and 10% (w/w) and the rheological effects and bread making characteristics were determined. Bread containing fenugreek gum (FG) at 5% and 10% showed volumes and texture comparable with control bread. Extruding FG also improved its solubility in bread. Fenugreek gum resulted in an increase in dough farinograph water absorption compared with the control, but extruding the gum caused an even greater increase in water absorption when compared with the non-extruded gum. The addition of FG to bread dough caused an increase in storage modulus (G0) and loss modulus (G00). Starch pasting using RVA showed an increase in peak viscosity, final viscosity, breakdown and setback in a dose-related response when compared with a control.

Another study showed the addition of fenugreek gum (FG) to the extruded pea–rice snack products. In addition to fenugreek gum, two more gums (guar gum and locust bean gum) were added to it. When these three gums were added to the formulations at levels of up to 20%, good expansion of the products occurred. The WAI of the extrudates containing FG increased with increasing inclusion levels. In addition to the high contents of starch that serve to provide energy, these snacks are good sources of protein and dietary fiber, and are low in

fat, qualifying them as low Glycemic Index snack products. In particular, the reduction in Glycemic Index was the greatest with fenugreek gum extrudates.

Table: application of fenugreek in different food items

S.No.	Application	Functions	Usage level (%)
1	Baked goods and breads	Provides texture , retains moisture	0.15-0.45
2	Gravies and soups	Adds viscosity and suspension	0.20-0.50
3	Dressing, sauces , dips	Adds viscosity , suspension and stabilizers emulsions	0.20-0.50
4	Nutritional Beverages	Adds mouthfeel, viscosity and suspension	0.10-0.25
5	Frozen products	Increases freeze/thaw stability	0.05-0.45
6	Nutritional bars	Retains moisture	0.05-0.25
7	Meal replacement systems	Adds texture	0.05-0.50

13. Nutraceutical properties of fenugreek

Fenugreek has a beneficial effect on cleansing the blood and as a diaphoretic it is able to bring on a sweat and to help detox the body. Due to pungent aroma of fenugreek, that is smelt on the skin and in under-arm perspiration. Fenugreek is also known for its lymphatic cleansing activity though its vital role is to irrigate the cells with nutrients and to remove toxic wastes, dead cells and trapped proteins from the body. Block in the lymphatic system can mean poor circulation of fluid, fluid retention, pain, energy loss and disease, anywhere in the body of a person. Fenugreek maintains mucus conditions of the body, mostly the lungs, by helping to clear congestion. It also acts as a throat cleanser and mucus solvent that also eases the urge to cough. Drinking water in which seeds of fenugreek have soaked helps in softening and dissolving, accumulating and hardening the masses of cellular debris. Fenugreek has been used to relieve colds, bronchial complaints, influenza, asthma, catarrh, constipation, sinusitis, pleurisy, pneumonia, sore throat, laryngitis, hay fever tuberculosis and emphysema.

a. Lactation aid
b. Immunological activity
c. Hypoglycemic effect
d. Hypocholesterolemic effect
e. Antioxidant activity

f. Anticancer effect
g. Antibacterial and antifungal effect
h. Aids in digestion

CHAPTER 3

14.Packaging

The selection of packaging materials should take care of functional as well as market requirements.

LDPE, HDPE, Platic bottles, glass bottles are generally used for retail purpose. Bulk packaging can be done gunny bags

Packaging of dried fenugreek leaf

Generally it is done paper box and Low density polyethlene (LDPE). High density polyethlene (HDPE) and Aluminum Laminated Pouch can also be used. Glass bottles and plastic bottles are also used for packaging of dried leaves or powder

Packaging of dried fenugreek seed

Generally it is done Low density polyethlene (LDPE). High density polyethlene (HDPE) and Aluminum Laminated Pouch can also be used. Glass bottles and plastic bottles are also used for packaging of dried leaves or powder

Specification Details for Whole and Ground Spices – Consumer Packs Flexible Pouch Systems:

Laminates / Co-extruded films (up to 500 grams capacity)	**Laminates / Co-extruded films (up to 1000 grams capacity)**
50µ HD – LD	50µ HD – LD 62.5µ HD – LD
50µ HD – LD – HD	62.5µ HD – LD – HD
12µ PET / 37.5µ LD	12µ Polyester / 50µ LD
25µ BOPP / 37.5µ LD	25µ BOPP / 50µ LD
12µ PET / 37.5µ PP	12µ PET / 50µ PP
25µ LD – 7.5µ Tie – 25µ PA – 7.5µ Tie – 25µ LD	30µ LD – 7.5µ Tie – 25µ PA – 7.5µ Tie – 30µ LD
The LDPE Inner and Outer layers could also	The LDPE Inner and Outer layers could also

be LLDPE or EAA or LD-HD	be LLDPE or EAA or LD-HD

Source: (ICPE)Packaging of Spices, Indian Centre for Plastic in the Environment

Packaging materials used for fenugreek seeds

According to Food Safety and Standards (Packaging) Regulation, 2018, the following packaging materials are recommended for spices:

- Glass bottle with metal lid or plastic (polypropylene (PP) or High density polyethylene (HDPE) caps
- Plastic based rigid container with Plastic cap (Polyethylene terephthalate (PET) and High-density polyethylene (HDPE) Containers)
- Paper & Paper board or Aluminium foil or Plastic Film based Composite Container
- Folding cartons with Plastic based flexible laminated structure (heat sealed) pouch placed inside
- Plastic based multi-layered layered laminated pouch (heat sealed) (FSSAI, 2018).

Storage of fenugreek

Fenugreek seeds when properly stored may last more than a year under room temperature.

Following steps needs to be taken care while storing Fenugreek dried leaves and seeds:

- Containers should be kept away from sun, rain and moist conditions in covered premises.
- The room where the fennel is to be stored should have dry atmosphere, free from unwanted odour as well as proofed against insects and vermin entry.

The room should have controllable ventilation where it could be able to give good ventilation in dry conditions and should have fully closed ventilation in damp conditions. Fumigation facilities should also be there.

CHAPTER 4

15.FSSAI Regulations

Regulations for Fenugreek

Fenugreek (Methi) Whole means the dried mature seeds of Trigonella foenum graecum L. The seeds shall be free from any off flavour, mustiness and rancidity. It shall be free from mould, living and dead insects, insect fragments, rodent contamination. The product shall be free from added colour, and other harmful substances.

- **It shall conform to the following standards:-**

It shall conform to the following standards:-

(i)	Extraneous matter	Not more than 2.0 percent by weight
(ii)	Moisture	Not more than 10.0 percent by weight
(iii)	Total ash on dry basis	Not more than 5.0 percent by weight
(iv)	Ash insoluble in dilute HCL on dry basis	Not more than 1.5 percent by weight
(v)	Cold water soluble extract on dry basis	Not less than 30.0 percent by weight
(vii)	Edible seeds other than fenugreek	Not more than 2.0 percent by weight
(viii)	Insect damaged matter	Not more than 1.0 percent by weight

Regulations for Fenugreek Powder

Fenugreek (Methi) powder means the powder obtained by grinding the dried mature seeds of Trigonella foenum graecum L. It shall be free from mould, living and dead insects, insect fragments, rodent contamination. The powder shall be free from added colour and other harmful substances

It shall conform to the following standards:-

(i)	Moisture	Not more than 10.0 percent by weight
(ii)	Total ash on dry basis	Not more than 5.0 percent by weight
(iii)	Ash insoluble in dilute HCL on dry basis.	Not more than 1.5 percent by weight
(iv)	Cold water soluble extract on dry basis	Not less than 30.0 percent by weight

Microbiological Parameters

S.No.	Requirements	Load
1	Total Plate Count	-
2	Coliform Count	-
3	E. Coli	-
4	Salmonella	Absent in 25 gm
5	Shigella	-
6	Staphylococcus aureus	-
7	Yeast and Mould Count	-
8	Anaerobic Spore Count	-
9	Listeria monocytogen	-

Labelling

For labelling the information of the product, ingredient list, Name and complete address of the manufacturer, FSSAI License number, best before date, vegetarian sign, net weight, customer care information should be provided

Registration and Licensing of Food Business

All Food Business Operators in the country will be registered or licensed in accordance with the procedures laid down

Registration of Petty Food Business

a. Every petty Food Business Operator shall register themselves with the Registering Authority by submitting
b. An application for registration in Form A under Schedule 2 of these Regulations along with a fee as provided in Schedule 3.
c. The petty food manufacturer shall follow the basic hygiene and safety requirements provided in Part I of Schedule 4 of these Regulations and provide a self-attested declaration of adherence to these requirements with the application in the format provided in Annexure-1 under Schedule 2.
d. The Registering Authority shall consider the application and may either grant registration or reject it with reasons to be recorded in writing or issue notice for inspection, within 7 days of receipt of an application for registration.
e. In the event of an inspection being ordered, the registration shall be granted by the Registering Authority after being satisfied with the safety, hygiene and sanitary conditions of the premises as contained in Part II of Schedule 4 within a period of 30 days.
f. If registration is not granted, or denied, or inspection not ordered within 7 days as provided in above sub regulation (3) or no decision is communicated within 30 days as provided in above sub regulation (4), the petty food manufacturer may start its business, provided that it will be incumbent on the Food Business Operator to comply with any improvement suggested by the Registering Authority even later.
g. Provided that registration shall not be refused without giving the applicant an opportunity of being heard and for reasons to be recorded in writing.
h. The Registering Authority shall issue a registration certificate and a photo identity card, which shall be displayed at a prominent place at all times within the premises or vehicle or cart or any other place where the person carries on sale/manufacture of food in case of Petty Food Business.
i. The Registering Authority or any officer or agency specifically authorized for this purpose shall carry out food safety inspection of the registered establishments at least

once in a year. Provided that a producer of milk who is a registered member of a dairy Cooperative Society registered under Cooperative Societies Act and supplies or sells the entire milk to the Society shall be exempted from this provision for registration.

Hygienic, sanitary and good manufacturing practices (GMP/GHP) and haccp

Cleaning and Sanitation

i. Cleaning and sanitizing programmes shall be established at facility to ensure that the food-processing equipment and environment are maintained in a hygienic condition to prevent contamination of food, such as from metal shards, flaking plaster, food debris and chemicals and records of the same shall be maintained. The programme should ensure that all parts of the establishment are appropriately clean, and shall include the cleaning of cleaning equipment.

ii. Master sanitation schedule shall be maintained for overall facility through checklists

which includes:

- Areas, items of equipment and utensils to be cleaned;
- Responsibility for particular tasks;
- Cleaning method and frequency of cleaning; and
- Monitoring arrangements for checking effectiveness of cleaning
- Person responsible for cleaning
- Persons responsible for monitoring & verification of effectiveness of cleaning
- In case of any deviation what correction & corrective actions being taken.
- Where ever chances of microbial risk with product air count & swab test being recommended.

iii. Cleaning and disinfection chemicals shall be food grade wherever chances of it may come in direct or indirect contact through equipment's or plant surfaces, handled and used carefully and in accordance with manufacturers' instructions, for example, using the correct dilutions, and stored, where necessary, separated from food, in clearly identified containers to avoid the risk of contaminating food.

iv. Cleaning shall remove food residues and dirt and it can be carried out by the separate or the combined use of physical methods, such as heat, scrubbing, turbulent flow

and vacuum cleaning or other methods that avoid the use of water, and chemical methods using appropriate cleaning agents.

v. These facilities should be constructed of corrosion resistant materials, be easy to clean and shall have adequate supply of hot and cold potable water, where appropriate. It is recommended to have different colour for hot and cold pipes. A validation mechanism should be in place for all cleaning programme.

Cleaning procedure should generally involve;

- -Removing gross visible debris from surfaces.
- Applying a detergent solution to loosen soil and bacterial film (cleaning)
- Rinsing with water (hot water where possible) to remove loosened soil and residues of detergent.
- Dry cleaning or other appropriate methods for removing and collecting residues and debris and
- Where necessary, cleaning should be followed by disinfection with subsequent rinsing.

Designated area with lock & key provision should be allocated for cleaning equipment's &

chemicals. Where ever necessary & applicable CIP procedure should be defined for equipment's cleaning.

House keeping

i. A housekeeping schedule covering manufacturing and storage areas shall be maintained.

ii. The surrounding areas including roads, parking lots and drains should be well maintained.

iii. Walls and floors should be maintained neat and clean. Ceilings and light fixtures should be easy to clean.

iv. Drains should be sufficiently sized and well sloped. Drains should have removable grates installed for ease of cleaning.

v. For 3rd party (contract) cleaning companies, the supplier should define clear scope, details of services and responsibilities.

vi. Waste storage areas should be clearly marked and waste shall be disposed of in a timely manner.

HACCP PROCEDURE

Appropriate to the nature and size of the operation and sufficient to assist the business to verify that the HACCP controls are in place and being maintained.

Documentation shall include (as a minimum) the following:

- HACCP team composition;
- Product description;
- Intended use;
- Flow chart;
- Hazard analysis;
- CCP determination;
- Critical limit determination;
- Validation process; and
- HACCP plan

The HACCP plan shall include the following information for each identified CCP:

- Food safety hazard(s) to be controlled at the CCP;
- Control measure(s);
- Critical limit(s);
- Monitoring procedure(s);
- Corrections and corrective action(s) to be taken if critical limits are exceeded;
- Responsibilities and authorities for monitoring, corrective action and verification;
- Record(s) of monitoring.

Records to include

- CCP monitoring activities;
- Deviations and associated corrective actions;
- Disposition of non-conforming products;

- Verification procedures performed;
- Modifications to the HACCP plan;
- Validation record;Product release recordsand Testing records.

General Requirements for Packaging

1. A utensil or container made of the following materials or metals, when used in the preparation, packaging and storing of food shall be deemed to render it unfit for human consumption:
   a) containers which are rusty;
   b) enameled containers which have become chipped and rusty;
   c) copper or brass containers which are not properly tinned
   d) containers made of aluminium not conforming in chemical composition to IS:20 specification for Cast Aluminium & Aluminium Alloy for utensils or IS:21 specification for Wrought Aluminium and Aluminium Alloy for utensils.
2. Containers made of plastic materials should conform to the following Indian Standards Specification, used as appliances or receptacles for packing or storing whether partly or wholly, food articles namely;
   i. IS : 10146 (Specification for Polyethylene in contact with foodstuffs)
   ii. IS : 10142 (Specification for Styrene Polymers in contact with foodstuffs);
   iii. IS : 10151 (Specification for Polyvinyl Chloride (PVC), in contact with foodstuffs);
   iv. IS : 10910 (Specification for Polypropylene in contact with foodstuffs);
   v. IS : 11434 (Specification for Ionomer Resins in contact with foodstuffs); (vi) IS: 11704 Specification for Ethylene Acrylic Acid (EAA) copolymer. (vii) IS: 12252 - Specification for Poly alkylene terephathalates (PET).
   vi. IS: 12247 - Specification for Nylon 6 Polymer; (ix) IS: 13601 - Ethylene Vinyl Acetate (EVA);
   vii. IS: 13576 - Ethylene Metha Acrylic Acid (EMAA);
   viii. Tin and plastic containers once used, shall not be re-used for packaging of edible oils and fats;

Provided that utensils or containers made of copper though not properly tinned, may be used for the preparation of sugar confectionery or essential oils and mere use of such utensils or

containers shall not be deemed to render sugar confectionery or essential oils unfit for human consumption.

General packaging requirements for Canned products,

i. All containers shall be securely packed and sealed.
ii. The exterior of the cans shall be free from major dents, rust, perforations and seam distortions.
iii. Cans shall be free from leaks.

General Requirements for Labelling

1. Every prepackaged food shall carry a label containing information as required here under unless otherwise provided, namely;
2. The particulars of declaration required under these Regulations to be specified on the label shall be in English or Hindi in Devnagri script: Provided that nothing herein contained shall prevent the use of any other language in addition to the language required under this regulation.
3. Pre-packaged food shall not be described or presented on any label or in any labelling manner that is false, misleading or deceptive or is likely to create an erroneous impression regarding its character in any respect;
4. Label in pre-packaged foods shall be applied in such a manner that they will not become separated from the container;
5. Contents on the label shall be clear, prominent, indelible and readily legible by the consumer under normal conditions of purchase and use;
6. Where the container is covered by a wrapper, the wrapper shall carry the necessary information or the label on the container shall be readily legible through the outer wrapper and not obscured by it;

License number shall be displayed on the principal display panel in the following format, namely:-

Declaration regarding Food Additives-

i. For food additives falling in the respective classes and appearing in lists of food additives permitted for use in foods generally, the following class titles shall be

used together with the specific names or recognized international numerical identifications:

Acidity Regulator, Acids, Anticaking Agent, Antifoaming Agent, Antioxidant, Bulking Agent, Colour, Colour Retention Agent, Emulsifier, Emulsifying Salt, Firming Agent, Flour Treatment Agent, Flavour Enhancer, Foaming Agent, Gelling Agent, Glazing Agent, Humectant, Preservative, Propellant, Raising Agent, Stabilizer, Sweetener, Thickener:

ii. Addition of colours and/or Flavours—

a. Extraneous addition of colouring matter to be mentioned on the label – Where an extraneous colouring matter has been added to any article of food, there shall be displayed one of the following statements in capital letters, just beneath the list of the ingredients on the label attached to any package of food so coloured, namely:

CONTAINS PERMITTED NATURAL COLOUR(S)

OR

CONTAINS PERMITTED SYNTHETIC FOOD COLOUR(S)

OR

CONTAINS PERMITTED NATURAL AND SYNTHETIC FOOD COLOUR(S)

Provided that where such a statement is displayed along with the name or INS no of the food colour, the colour used in the product need not be mentioned in the list of ingredients.

b) Extraneous addition of flavouring agents to be mentioned on the label.

Where an extraneous flavouring agent has been added to any article of food, there shall be written just beneath the list of ingredients on the label attached to any package of food so flavoured, a statement in capital letters as below:

CONTAINS ADDED FLAVOUR (specify type of flavouring agent as per Regulation 3.1.10(1) of Food Safety and Standards (Food product standards and food additive) Regulation, 2011

c) In case both colour and flavour are used in the product, one of the following combined statements in capital letters shall be displayed, just beneath the list of ingredients on the label attached to any package of food so coloured and flavoured, namely:

CONTAINS PERMITTED NATURAL COLOUR(S) AND ADDED FLAVOUR(S)

OR

CONTAINS PERMITTED SYNTHETIC FOOD COLOUR(S) AND ADDED FLAVOUR(S)

OR

CONTAINS PERMITTED NATURAL AND SYNTHETIC FOOD COLOUR(S) AND ADDED FLAVOUR(S)

Provided that in case of artificial flavouring substances, the label shall declare the common name of the flavours, but in case of the natural flavouring substances or nature identical flavouring substances, the class name of flavours shall be mentioned on the label and it shall comply with the requirement of label declaration as specified under the regulation 2.2.2 (5) (ii)

Note: — When statement regarding addition of colours and/or flavours is displayed on the label in accordance with regulation 2.2.2(5)(ii) and regulation 3.2.1 of Food Safety and Standards (Food Product Standards and Food Additive) Regulation, 2011, addition of such colours and/or flavours need not be mentioned in the list of ingredients. Also, in addition to above statement, the common name or

Name and complete address of the manufacturer

(i) The name and complete address of the manufacturer and the manufacturing unit if these are located at different places and in case the manufacturer is not the packer or bottler, the name and complete address of the packing or bottling unit as the case may be shall be declared on every package of food;

(ii) Where an article of food is manufactured or packed or bottled by a person or a company under the written authority of some other manufacturer or company, under his or its brand name, the label shall carry the name and complete address of the manufacturing or packing or

bottling unit as the case may be, and also the name and complete address of the manufacturer or the company, for and on whose behalf, it is manufactured or packed or bottled;

(iii) Where an article of food is imported into India, the package of food shall also carry the name and complete address of the importer in India.

Provided further that where any food article manufactured outside India is packed or bottled in India, the package containing such food article shall also bear on the label, the name of the country of origin of the food article and the name and complete address of the importer and the premises of packing or bottling in India.

Net quantity

i. Net quantity by weight or volume or number, as the case may be, shall be declared on every package of food; and
ii. In addition to the declaration of net quantity, a food packed in a liquid medium shall carry a declaration of the drained weight of the food.

Explanation – 1: For the purposes of this requirement the expression "liquid medium" include water, aqueous solutions of sugar and salt, fruit and vegetable juices or vinegar, either singly or in combination.

Explanation – 2: In declaring the net quantity of the commodity contained in the package, the weight of the wrappers and packaging materials shall be excluded:

iii. Where a package contains a large number of small items of confectionery, each of which is separately wrapped and it is not reasonably practicable to exclude from the net weight of the commodity, the weight of such immediate wrappers of all the items of the confectionery contained in the package, the net weight declared on the package containing such confectionary or on the label thereof may include the weight of such immediate wrapper if the total weight of such immediate wrapper does not exceed –

a) eight per cent, Where such immediate wrapper is a waxed paper or other paper with wax or aluminium foil under strip; or

b) six per cent. In case of other paper of the total net weight of all the items of confectionery contained in the package minus the weight of immediate wrapper.

Exemptions from labelling requirements

Where the surface area of the package is not more than 100 square centimetres, the label of such package shall be exempted from the requirements of list of ingredients, Lot Number or Batch Number or Code Number, nutritional information and instructions for use, but this information shall be given on the wholesale packages or multi piece packages, as the case may be.

1. The date of manufacture' or 'best before date' or 'expiry date' may not be required to be mentioned on the package having surface area of less than 30 square centimetres but this information shall be given on the wholesale packages or multipiece packages, as the case may be;
2. In case of liquid products marketed in bottles, if such bottle is intended to be reused for refilling, the requirement of list of ingredients shall be exempted, but the nutritional information specified in regulation.
3. “To make a fluid not below the composition of toned milk or skimmed milk (as the case may be) with the contents of this package, add (here insert the number of parts) of water by volume to one part by volume of this condensed milk or desiccated (dried) milk”.
4. In case of food with shelf-life of not more than seven days, the 'date of manufacture may not be required to be mentioned on the label of packaged food articles, but the 'use by date' shall be mentioned on the label by the manufacturer or packer.
5. In case of multi piece packages the particulars regarding list of ingredients, nutritional information, Date of manufacture/ packing, best before, expiry date labelling of irradiated food and, vegetarian logo/non vegetarian logo, may not be specified.

Date of manufacture or packing

The date, month and year in which the commodity is manufactured, packed or pre-packed, shall be given on the label:

Provided that the month and the year of manufacture, packing or pre-packing shall be given if the “Best Before Date” of the products is more than three months:

Provided further that in case any package contains commodity which has a short shelf life of less than three months, the date, month and year in which the commodity is manufactured or prepared or pre-packed shall be mentioned on the label.

Best Before and Use By Date

i) the month and year in capital letters upto which the product is best for consumption, in the following manner, namely:

"BEST BEFORE ..... MONTHS AND YEAR

OR

"BEST BEFORE ..... MONTHS FROM PACKAGING

OR

"BEST BEFORE .....MONTHS FROM MANUFACTURE

(Note: — blank be filled up)

ii) In case of package or bottle containing sterilised or Ultra High Temperature treated milk, soya milk, flavoured milk, any package containing bread, dhokla, bhelpuri, pizza, doughnuts, khoa, paneer, or any uncanned package of fruits, vegetable, meat, fish or any other like commodity, the declaration be made as follows

"BEST BEFORE ……DATE/MONTH/YEAR"

OR

"BEST BEFORE.....DAYS FROM PACKAGING"

OR

"BEST BEFORE ……..DAYS FROM MANUFACTURE"

Note:

a) blanks be filled up

b) Month and year may be used in numerals

c) Year may be given in two digits

iii. On packages of Aspartame, instead of Best Before date, Use by date/recommended last consumption date/expiry date shall be given, which shall not be more than three years from the date of packing;

iv. In case of infant milk substitute and infant foods instead of Best Before date, Use by date/ recommended last consumption date/expiry date shall be given, Provided further that the declaration of best before date for consumption shall not be applicable

Documentation and Record Keeping

Every organization has to maintain records of raw material procurement, production processes, and sales. This is to ensure that the business runs effectively and is profitable. Listed below are some reasons why there is a need for documentation:

1. It gives detailed knowledge about running the business.
2. It helps to control product quality.
3. It helps to keep track of the money invested in the business.
4. It helps to identify the separate costs of raw material or product ingredients.
5. It helps to identify the production cost of a particular process.
6. It helps to make sure that all the quality assurance practices were followed during the production.
7. It helps to make sure that the production equipment is running smoothly/effectively.
8. It works as an evidence for legal procedures.
9. It helps to set an appropriate product price.
10. It helps to take corrective measures at the right time.

How to Keep Records?

Every food processing organization follows a more or less similar way of keeping records. Production records keep a log of the following:

- The quantity and type of raw materials received
- The quantity and type of ingredients used during processing

- The processing conditions in which production took place (e.g. the temperature set or the air pressure applied)
- The product quality produced

Product quality can be maintained only when:

- The same quantity and quality of ingredients and raw materials are mixed in every batch
- A standard formulation is used for every batch
- Standard process parameters are applied for every batch

Every batch of food is given a batch number. This number is recorded in:

- Stock control books (where raw material procurement is noted)
- Processing logbooks (where production process is noted)
- Product sales records (where sales and distribution is noted)

The batch number must correlate with the product code number, which is printed on labels. This helps the processor to trace any fault found in a batch back to the raw material used or the production process.

16. Conclusions

Fenugreek having antidiabetic, antifertility, anticancer, antimicrobial, antiparasitic, lactation stimulant and hypocholesterolemic effects has been discussed in this review. Fenugreek has been found to have important bioactive compounds. It was observed that fenugreek has been used as food stabilizer, food adhesive, food emulsifier and gum. Fenugreek has been used to produce various types of bakery products and extruded product. Based on these several health usefulness as discussed in review, based on various past reported scientific findings, fenugreek can be recommended and must be taken as a part of our daily diet as its liberal use is safe and various health benefits can be drawn from this natural herb. The above-mentioned studies on fenugreek suggest that the functional, nutritional and therapeutic characteristics of fenugreek can be exploited further in the development of healthy products.

17. References

- https://www.healthline.com/nutrition/fenugreek
- https://www.nccih.nih.gov/health/fenugreek
- https://en.wikipedia.org/wiki/Fenugreek_production_in_India#:~:text=and%20airy%20chambers.-,Uses,is%20used%20in%20culinary%20dishes.
- https://www.indiaagronet.com/horticulture/CONTENTS/fenugreek.htm
- http://apeda.in/agriexchange/India%20Production/India_Productions.aspx?cat=Spices&hscode=1105
- Sajad Ahmad Wani and Pradyuman Kumar Fenugreek: A review on its nutraceutical properties and utilization in various food products. Journal of the Saudi Society of Agricultural Sciences (2018) 17, 97–106.
- Farhat Rashid, Sarfraz Hussain and Zaheer Ahmed. Extraction purification and characterization of galactomannan from fenugreek for industrial utilization. Carbohydrate Polymers (2018) 180, 88–95.
- K Srinivasan. Fenugreek (Trigonella foenum-graecum): A review of health beneficial physiological effects. Food Reviews Int. (2006) 22, 203–224