

Physico-Chemical Properties of Fenugreek (*Trigonella Foenum-Graceum L.*) Seeds

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Abstract: Fenugreek (*Trigonella foenum-graceum L.*) is used as a spice, vegetable and medicinal plant. Fenugreek seeds are rich source of minerals, vitamins and dietary fiber. Fenugreek seeds have anti-diabetic action. In the present study, Some physical properties i.e length, width, thickness, seed mass, geometric mean diameter, sphericity, thousand seed mass, bulk density, kernel density, porosity & angle of repose and some chemical properties i.e. moisture, fat, protein and ash content of fenugreek seeds were evaluated. Physical properties were evaluated for storage and equipment design whereas chemical properties were evaluated for nutritional study and product development. The seeds have a length ranging from 3.02 mm to 4.09 mm, width ranging from 2.02 mm to 2.09 mm, thickness ranging from 1.03 mm to 1.15 mm and a seed mass ranging from 0.01 g to 0.023 g. The average geometric mean, sphericity, thousand seed mass, bulk density, kernel density, porosity and angle of repose of fenugreek seeds were 1.86 to 2.10 mm and 49.99% to 63.09%, 14.05 to 14.85 g, 6.21 to 6.98 g/ml, 1.121 to 1.230 g/ml, 42.56 to 42.73% and 13.23° to 13.86° respectively. The moisture, fat, protein and ash content of raw fenugreek (%db) seeds were 11.21%, 07%, 23.30% and 03% respectively and moisture, fat, protein and ash content of germinated fenugreek (%db) seeds were 13.50%, 6.24%, 24.12% and 3.14% respectively. It was found that germinated fenugreek (%db) seeds have higher moisture, protein and ash content as compared to raw fenugreek (%db) seeds but the fat content of germinated fenugreek (%db) seeds was lower as compared to raw fenugreek seeds.

Key words: Fenugreek seeds, Nutritive value, physical properties and chemical properties.

I. INTRODUCTION

Fenugreek (*Trigonella foenum-graceum L.*) is one of the well known spices in human food. Its seeds and green leaves are used in food as well as in medicinal application which is an old practice in human history. It provides natural food fibre and other nutrients required in human body. Fenugreek has strong spicy and seasoning type sweet flavour. Aromatic and flavourful fenugreek is a popular spice and is widely used for well recognized culinary and medicinal properties. "Kasuri Methi" is very famous for its appetizing fragrance and it is used for

culinary preparations. In recent trends, fenugreek is also used as spice adjunct. India is a major producer of fenugreek and also a major consumer of it for culinary uses and medicinal applications. It is used in functional food, traditional food, nutraceuticals as well as in physiological utilization such as antibacterial, anticancer, antiulcer, anthelmintic, hypocholesterolemic, hypoglycaemic, antioxidant and antidiabetic agent. It has beneficial influence on digestion and also has the ability to modify food texture. Fenugreek seeds are traditionally used for the treatment of many diseases. Studies show that the seeds have antioxidant properties. Many medicinal properties are attributed to fenugreek seed and leaves. Fenugreek is a leguminous plant that helps in nitrogen fixation and soil enrichment [7].

The fenugreek seeds are the most important and useful part of fenugreek plant. These seeds are golden-yellow in colour, small in size, hard and have four- faced stone like structure [3].

Raw fenugreek seeds have maple flavour and bitter taste but by the process of germination and roasting, their bitterness can be reduced and flavour can be enhanced. The whole seeds or its ground powder is used in pickles, vegetables dishes and spice powder. Dried seeds are used as condiments. Fenugreek seeds are gummy, fibrous and sticky in nature. Biologically, its seeds are endospermic in nature [7].

Fenugreek seeds are rich in vitamins, minerals and phyto-nutrients, as it is a legume; it is high in protein [5]. 100 gm seeds provide 323 calories. The seeds are a very good source of soluble dietary fibre. 100 gm seeds provide 24.6 gm or over 65% of dietary fibre [4]

Fenugreek is an annual herb to the countries bordering on the eastern shores of the Meditarian and largely cultivated in India, Egypt, Pakistan, Afganistan, Iran, Nepal, France, Spain, Turkey and Morocco [6]. Over 80% of the total world's production of this seed is

contributed by India, one of the major producers and exporters of fenugreek legume in the world [9].

Fenugreek is stated to possess mucilaginous demulcent, laxative, nutritive, expectorant and orexigenic and vulnerary properties. In addition to its use in flavouring foods, the antifungal and antibacterial properties of fenugreek are now being applied to food preservation. This plant is used in folk medicine as an expectorant, anti-inflammatory and antispasmodic for the treatment of oral-dental infections. It is employed as a mouth wash and gargle and in West Africa the gum of fenugreek resin is boiled for the treatment of inflammation of the eyes by holding the face over the steaming pot [2].

In India fenugreek is cultivated as a spice since a long time. The cultivation area and production of fenugreek is given in table 1.

Table 1: Year wise area and production of fenugreek seeds in India

Year	Area in Hectares	Production in Tonnes
2008-09	74512	97533
2009-10	71985	88979
2010-11	94760	127850
2011-12	96304	121775
2012-13	93110	112870

SOURCE: STATE AGRI/HORTI DEPT. DSDA, CALICUT

The objective of this study was to determine the physical properties of fenugreek seeds namely size dimensions (length, width, thickness, seed mass and geometric mean diameter), thousand seed mass, sphericity, kernel density, bulk density, porosity and angle of repose. And the chemical properties of fenugreek seeds namely moisture, fat, protein and ash content. Physical properties were evaluated for storage and equipment design whereas chemical properties were evaluated for nutritional study and product development.

II. MATERIALS AND METHODS

A. Physical properties of fenugreek

The fenugreek seeds used in this study were obtained from a local market in Aurangabad city of India. The samples were cleaned manually to remove all foreign matter, dust and dirt, broken and immature seeds.

The physical properties of the seeds were evaluated by measuring the length, width, thickness and seed mass of randomly selected 20 fenugreek seeds.

Length

The length of seeds was measured by a vernier calliper with an accuracy of 0.01 mm [8].

Width

The width of seeds was measured by a vernier calliper with an accuracy of 0.01 mm [8].

Thickness

The thickness of seeds was measured by a vernier calliper with an accuracy of 0.01 mm [8].



Fig 1.Raw fenugreek seeds

Seed Mass

To obtain the unit mass of seed, 1000 seed mass were measured by an electronic balance to an accuracy of 0.001 g [8].

Geometric Mean Diameter

The geometric mean diameter D_g of fenugreek seeds were calculated according to [8].

$$D_g = (LWT)^{1/3} \quad (1)$$

Where, L is length, W is width, and T is thickness in cm.

Sphericity

The sphericity ϕ of fenugreek seeds was calculated by using the following formulae [8].

$$\phi = \{(LWT)^{1/3}/L\} \times 100 \quad (2)$$

Where, L is the length, W is the width and T is the thickness in mm.

Thousand seed mass

To evaluate 1000 seed mass, 100 randomly selected seeds were selected from bulk and were averaged [3].

Kernel Density

The kernel density of a seed is defined as the ratio of the mass of a sample of a seed to the solid volume occupied by the sample. The kernel density of fenugreek seeds was

determined using the liquid displacement method. Fluids typically used include alcohol, toluene and tetrachloethylene. Toluene was used in place of water because it is absorbed by the seeds to a lesser extent [3].

Bulk Density

The bulk density is the ratio of the mass of a sample of a seed to its total volume [8].

Porosity

The porosity ϵ of bulk seed was calculated from bulk and kernel densities using the relationship [8].

$$\epsilon = \{(pk - pb)/pk\} \times 100 \tag{3}$$

Where pk is the kernel density in g/ml and pb is bulk density in g/ml.

Angle of Repose

The angle of repose is the angle with the horizontal at which the material will stand when piled. This was determined by using a topless and bottomless cylinder of 300 mm diameter and 500 mm height. The cylinder was placed at the centre of a raised circular plate and filled with fenugreek seeds. The cylinder was raised slowly until it formed a cone on a circular plate. The angle of repose was calculated from the measurement of height of the cone and diameter of the cone [3].

A. Chemical properties of fenugreek

The chemical properties of raw and germinated fenugreek seeds (%d/b) the seeds inclusive moisture content, fat content, protein content, ash content and carbohydrate content were analyzed [1].



Fig 2. Germinated fenugreek seeds

III. RESULT AND DISCUSSION

A. Physical properties

Length

The seeds have length ranging from 3.02 mm to 4.09 mm. The average length of fenugreek seeds was 3.461 mm.

Width

The seeds have width ranging from 2.02 mm to 2.09 mm. The average width of fenugreek seeds was 2.061 mm.

Thickness

The seeds have a thickness ranging from 1.03 mm to 1.15 mm. The average thickness of fenugreek seeds was 1.067 mm.

Seed Mass

The seeds have unit mass ranging from 0.01 g to 0.023 g. The average seed mass of fenugreek seeds was 0.0177 g.

Geometric Mean Diameter

The geometric mean diameter of fenugreek seeds ranged from 1.86 to 2.10 mm. The average geometric mean diameter was 1.990 mm.

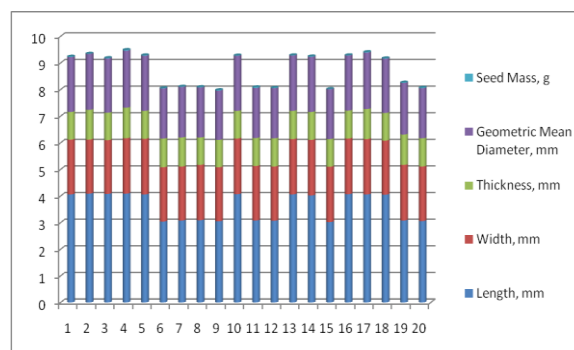


Fig 3. Dimensions of fenugreek seeds

Sphericity

The sphericity was calculated by using the data on geometric mean diameter of fenugreek seed and results were obtained. The sphericity of fenugreek seeds ranged from 49.99% to 63.09%. The average sphericity of fenugreek seeds was 55.81 %. Similar results have been reported [3].

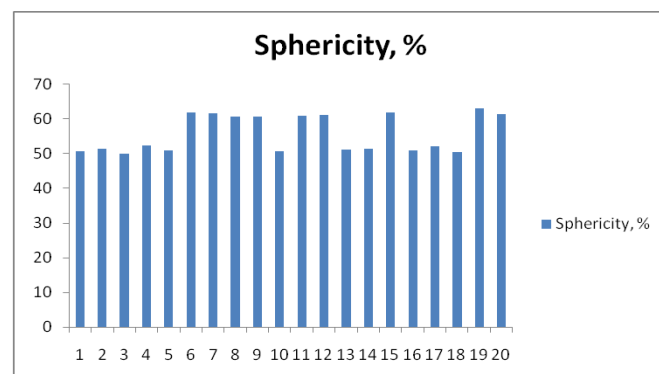


Fig 4. Sphericity of fenugreek seeds

Thousand Seed Mass

The 1000 seed mass of fenugreek seeds ranged from 14.05 to 14.85 g. The average weight of thousand seeds was 14.45 g. similar results have been reported [3].

Bulk density

The bulk density of fenugreek seeds ranged from 6.21 to 6.98 g/ml. The average bulk density of fenugreek seeds was 6.59 g/ml. similar results have been reported [3].

Kernel density

The kernel density of fenugreek seeds ranged from 1.121 to 1.230 g/ml. The average kernel density of fenugreek seed was 1.175 g/ml. similar results have been reported [3].

Porosity

The porosity was calculated by using the data on bulk and kernel densities of fenugreek seeds. The porosity of fenugreek seeds were 42.56 to 42.73%. The average porosity of fenugreek seeds was 42.64 %. Similar results have been reported [3].

Angle of repose

The angle of repose of fenugreek seeds were 13.23° to 13.86°. The average angle of repose of fenugreek seeds was 13.54°. Similar results have been reported [3].

Table 2: Physical properties of fenugreek seeds

1000 seed Mass, g	Bulk Density, g/ml	Kernel Density, g/ml	Porosity, %	Angle of Repose, °
14.40 g	6.51 g	1.190 g	42.51%	13.53°

A. Chemical Properties

Moisture content

The moisture content of raw fenugreek seed (%db) sample was 11.21 % and moisture content of germinated fenugreek (%db) seed sample was 13.50 %.

Fat Content

The fat content of raw fenugreek (%db) seed sample was 7 % and fat content of germinated fenugreek (%db) seed sample was 6.24 %. The extracts of seeds of fenugreek have been shown to possess hypoglycaemic activity and are nontoxic.

Protein Content

The protein content of raw fenugreek (%db) seed sample was 23.30 % and protein content of germinated fenugreek (%db) seed sample was 24.12 %. Fenugreek seed contains 20-30 % of proteins as well as amino acid 4-hydroxyisoleucine in particular, which has high potential for insulin-stimulating activity. The basic element of biomolecules is proteins in addition to their roles in connectivity process and in all of biochemical reactions.

Ash Content

The ash content of raw fenugreek (%db) seed sample was 3 % and ash content of germinated fenugreek (%db) seed powder was 3.14 %, the presence of ash in such quantities are satisfying, because of the high importance of minerals for health maintenance and development.

Carbohydrate content

The carbohydrate content of raw fenugreek (%db) seed sample was 55.49 % and carbohydrate content of germinated fenugreek (%db) seed powder was 53 %.

Table 3. Nutritive value of fenugreek seeds

Name of sample	Moisture %	Fat %	Protein %	Ash %	Carbohydrate %
Raw fenugreek (%db) seed sample	11.21	7	23.30	3	55.49
Germinated fenugreek (%db) seed sample	13.50	6.24	24.12	3.14	53

IV. CONCLUSIONS

The following conclusions are drawn from investigation on physical and chemical properties of fenugreek seeds.

- The average length, width, thickness, seed mass and geometric mean diameter of fenugreek seeds was 3.461 mm, 2.061 mm, 1.067 mm, 0.0177 g and 1.990 mm respectively.
- The average sphericity, thousand seed mass, bulk density, kernel density, porosity and angle of repose of fenugreek seeds was 55.81 %, 14.45 g, 6.59 g/ml, 1.175 g/ml, 42.64 % and 13.54° respectively.
- The average moisture, fat, protein, ash and carbohydrate content of raw fenugreek (%db) seeds was 11.21%, 7%, 23.30%, 3% and 55.49% respectively and moisture, fat, protein, ash and carbohydrate content of germinated fenugreek (%db) seeds were 13.50%, 6.24%, 24.12%, 3.14% and 53% respectively. Results show that fenugreek seeds contain a highest percentage of proteins and lowest percentage of ash. The germinated fenugreek (%db) seed sample showed higher moisture, protein and ash content as compared to raw fenugreek) seed sample but the fat content of germinated fenugreek (%db)

seed sample was lower as compared to raw fenugreek (%db) seed sample.

- iv. Physical properties were evaluated for storage and equipment design whereas chemical properties were evaluated for nutritional study and product development.

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