



Physicochemical characteristics and nutritional value of fenugreek seeds and seed oil

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Abstract

The aim of this study was to determine the chemical composition of Fenugreek (Yemen and Saudi) seed and characterization of Fenugreek seed oil. Samples were procured from local market in IBB city, Yemen and Riyadh, Saudi Arabia. It was determined the chemical composition of seed (moisture, Ash, Fat, Fiber, Carbohydrate) also the physical and chemical characterization of oil. The composition of fatty acids was done by using HPLC Method. The oil stability was done by using Schaal Oven test. The result showed that the chemical compositions fat, protein, fiber, ash and carbohydrate were high in Yemeni Fenugreek seed oil. The unsaturated fatty acid was high in both samples. The sample of both samples tested for stability till 10 days and the sample of Yemeni Fenugreek seed oil was having high stability compare to Saudi seed. From the results of this study, it could be concluded that the fenugreek under investigation contain appreciable amounts of nutrients which may serve as beneficial health sources if consumed regularly and can be used as food supplements for edible oils.

Keywords: fenugreek, seed, oil, fatty acid, chemical composition

1. Introduction

Spices and herbs are used in foods to improve flavour, pungency and colour. They also have antioxidant, antimicrobial, pharmaceutical and nutritional properties. In addition to the known direct effects, the use of these plants can also lead to complex secondary effects such as salt and sugar reduction, improvement of texture and prevention of food spoilage. The basic effects of spices when used in cooking and confectionery can be for flavouring, deodorizing, masking, pungency and colouring ^[1].

Fenugreek (*Trigonella foenum-graecum* L.), belongs to the family Leguminosae and subfamily papilionaceae. The plant is an aromatic herbaceous annual also it is widely cultivated in mediterranean countries and Asia. It is believed that fenugreek have been originated in southern-eastern Europe or south-western Asian countries ^[2].

Fenugreek seeds yield can be significantly increases in quantity and as well as quality through the suitable management of cultivation, irrigation and harvesting. In this context, fenugreek (*Trigonella foenum graecum* L.), is an annual legume and extensively cultivated in most regions of the world for its medicinal value as well as spices ^[3].

Fenugreek crop is a very useful legume crop that can be used in livestock feed, fixation of nitrogen in soil and increasing fertility ^[4]. Fenugreek seeds have been valued as medicinal material from very early times. Fenugreek is chemurgic crop has a wide use for industrial purposes. Its seeds are considered to be of commercial interest as a source of a steroid diosgenin, which is of importance to the pharmaceutical industry ^[5]. Nowadays, fenugreek is widely cultivated as a drug plant and for spices purpose. The mucilaginous seeds are reputed to have many medicinal virtues, as a tonic, emollient, diuretic,

carminative, demulcent, astringent emmenagogue, restorative, expectorant, aphrodisiac and vermifugal properties and were used to cure mouth ulcers, chapped lips and stomach irritation ^[6].

Fenugreek seeds consist of 45-60% carbohydrates, in which mucilaginous fiber (galactomannans), 20-30% proteins high in tryptophan and lysine, 5 - 10% fixed oils (lipids), pyridine alkaloids, mainly choline (0.5%), trigonelline (0.2 - 0.38%), gentianine and carpaïne, the flavonoids apigenin, orientin, luteolin, quercetin, vitexin and isovitexin, free amino acids, such as 4-hydroxyisoleucine (0.09%), arginine, lysine, and histidine calcium and iron, saponins (0.6 - 1.7%), glycosides yielding steroidal sapogenins on hydrolysis (diosgenin, yamogenin, tigogenin, neotigogenin), cholesterol and sitosterol, vitamins B, A,C and nicotinic acid and 0.015% volatile oils (n-alkanes and sesquiterpenes) ^[5].

The seeds are reported to have restorative and nutritive properties ^[7]. Fenugreek seeds (F.S.) are used in remedies for diabetes and hypercholesterolemia in Indian, Arabic and Chinese medicine ^[8].

2. Materials and methods

2.1 Sample collection

Samples were procured from the local market in IBB city, Republic of Yemen and Riyadh, Saudi Arabia. The Analysis was done in lab of Department of food science and nutrition king Saud University, Saudi Arabia.

2.2 Chemical characterization of Fenugreek seeds

Moisture, crude protein, crude fat, crude fiber, and ash were determined according to the ^[9].

2.3 Extraction of fenugreek oil

The fenugreek seed oil was extracted by n-hexane according to AOCS [10] method using soxhlet apparatus. The experiment was repeated many times until reasonable amount was collected for further tests.

2.4 Physical and chemical characterization of oil

Specific gravity, Refractive index, Viscosity, Total Acidity, Saponification Number, Iodine number, peroxide value were analysis according to [11]. Thiobarbituric Acid (TBA) [11].

2.5 Fatty Acids Analysis

Oil samples were methylated with 14% boron trifluoride in methanol [12]. Analysis of the fatty acids was estimated by using a gas chromatograph (GLC) with Flame Ionization Detector (FID), 2 cm length, 0.32 cm internal diameter stainless steel column, packed with 15% OV-275, chrome P/AW/80-100 mesh stationary phase which operated at 180°C, injection temperature 230°C, detector temperature 250°C with carrier-gas (Helium) at a flow rate of 25 mL/min, hydrogen flow 30 mL/min, and air flow 300 mL/min. calculated of the fatty acid methyl esters was done by comparison of their retention times with that of the standards and the quantities were calculated from the area obtained.

2.6 Accelerated Storage

Oil storage experiments were conducted in an oven according to the Schaal Oven test. Oils were stored in open clear glass jars keeping ratio between surface areas at 65 °C. At fixed intervals oil samples were withdrawn, and peroxide value was determined during (0, 2, 4, 6, 8 and 10 days) according to the AOAC official method [9].

2.7 Statistical Analysis

Samples from three repetitions of each protocol were collected and analyzed in triplicate. Data are presented as mean value \pm SD, Data was analyzed by using SAS programme for single factor analysis of variance (ANOVA).

3. Results & Discussion

3.1 Chemical composition of Fenugreek seeds

The analysis of the proximate composition gives the basic chemical composition of the fenugreek seeds. The composites include moisture, ash, crude protein, crude fat and carbohydrates. These components are essential for the assessment of the nutritive quality of food being analyzed. Chemical composition of Fenugreek seeds (Yemeni and Saudi) are given in Table 1.

The results indicated that moisture 8.91%, fat 5.69%, protein 14.81%, fiber 12.97%, ash 3.53% and carbohydrate 54.09 % in Yemeni Fenugreek seeds and moisture 10.23%, fat 3.54%, protein 15.34%, fiber 11.24%, ash 3.26% and carbohydrate 56.39% in Saudi Fenugreek seed. So the seed of Fenugreek contain high amount of protein and fiber that will be benefit to the human nutrition.

It was reported that [13, 14] fat, protein, and fiber content of fenugreek seeds ranged from 6.53% to 7.1%, 24.4% to 25.8%, and 6.28% to 9.3%, respectively. Also it found the moisture 7.71 %, fat 4.51%, protein 12.91%, fiber 13.14%, ash 4.23% and carbohydrate 57.5% [15].

The moisture content of the fenugreek seeds were

comparatively similar to those reported by Al-Jasass, and Al-Jasser, [15]. The ash content of the fenugreek seeds was found to be 3.26-3.52%. This value was in a close agreement with that reported by Al-Jasass, and Al-Jasser, [13]. The protein and fat contents of the fenugreek seeds was significantly lower than those reported by [11, 12], These differences may be due to climatic condition, temperature, type of vegetation, rainfall or type of cultivation practice of the plant. While the fiber contents of the fenugreek seeds was significantly high than those reported by [13, 14].

There was no significant different ($P < 0.05$) between two samples on fiber and ash but There was significant different on the moisture, fat, protein and total carbohydrate.

Table 1: Composition of Fenugreek seed

Analysis	Yemeni seed	Saudi seed
Moisture %	8.91 \pm 0.30 ^a	10.23 \pm 0.71 ^b
Crude fat %	5.69 \pm 0.08 ^b	3.54 \pm 0.48 ^a
Crude protein %	14.81 \pm 0.20 ^a	15.34 \pm 0.35 ^a
Crude fiber %	12.97 \pm 0.10 ^a	11.24 \pm 0.19 ^a
Ash %	3.53 \pm 0.05 ^a	3.26 \pm 0.41 ^a
Total carbohydrate%	54.09 \pm 0.43 ^a	56.39 \pm 0.53 ^b

** Each value is Mean \pm Standard Deviations (n = 3).

Different superscripts in rows are significantly different ($P < 0.05$).

3.2 Physical and chemical characterization of Fenugreek seed oil

The Physical and chemical characterization of Fenugreek seed oil reported in (Table 2, 3) the results showed that Specific density between 0.910 - 0.920, Refractive index 1.471-1.481, Viscosity 3.452-4.000, Total Acidity 0.337-0.390, Saponification Number 177.443-183.321, Iodine Number 130.938-139.217, peroxide value 8.030-10.063 and TBA 0.480.534.

The oil extract from Yemeni seed was having high viscosity and Specific density, and having low value of Total Acidity, peroxide value and Iodine Number, in comparison to Saudi seed oil.

The Refractive index was similar to Sulieman *et al.* [16] who reported that the Refractive index is 1.4640. The saponification value was found closed (177.443-183.321) to Sulieman *et al.* [16] who reported that the saponification value is 195. The investigated saponification value was similar to the values 177 mentioned by M. Abbas Ali *et al.* [17]. The iodine values obtained in this study indicate that the seed oils contain high level of unsaturated bonds

The physical analysis of the Fenugreek seed oil showed that there is significant different ($P < 0.05$) between samples on viscosity but there was not in Refractive index and Specific density. By using SAS analysis found that the chemical analysis of the Fenugreek seed oil was significantly different between samples.

Table 2: Physical analysis of the Fenugreek seed oil

Analysis	Yemeni seed	Saudi seed
Specific density at 25 °C	0.920 \pm 0.010 ^a	0.910 \pm 0.015 ^a
Refractive index	1.471 \pm 0.001 ^a	1.481 \pm 0.011 ^a
Viscosity	4.000 \pm 0.060 ^b	3.452 \pm 0.043 ^a

** Each value is Mean \pm Standard Deviations (n = 3).

Different superscripts in rows are significantly different ($P < 0.05$).

Table 3: Chemical analysis of the Fenugreek seed oil

Analysis	Yemени seed	Saudi seed
Total Acidity as oleic acid %	0.337±0.055 ^a	0.390±0.021 ^a
Saponification Number	177.443±0.320 ^a	183.321±0.564 ^b
Iodine Number	130.938±1.227 ^a	139.217±1.227 ^b
Peroxide value mg/ kg	8.030 ±0.236 ^a	10.063 ±0.342 ^b
TBA	0.481 ±0.012 ^a	0.534 ±0.009 ^b

** Each value is Mean ± Standard Deviations (n = 3).

Different superscripts in rows are significantly different (P < 0.05).

3.3 Fatty acids composition of fenugreek seed oils

Fatty acids composition of fenugreek seed oils are presented in Table 4. The major fatty acids were found Linoleic Acid C18:2 (34.59-39.38%) also it contains (28.10-28.284%) from linolenic acid. Also the unsaturated fatty acids were found high in Saudi fenugreek seed oils.

The amount of linoleic acid detected in both plant seed oils, was comparable to many seed oils such as *Cucurbita maxima* (43-50.3%), *Cucurbita argyrosperma* (35.6-45.3%) and *Cucurbita argyrosperma* (56%) reported by Applequist *et al.* [18]; it is likely to satisfy the essential fatty acid requirement for humans. The nutritional value of linoleic acid is due to its metabolism at tissue levels, which produce the long chain polyunsaturated fatty acids and prostaglandins [19].

Our result is agreed with M. Abbas Ali *et al* [17] who reported

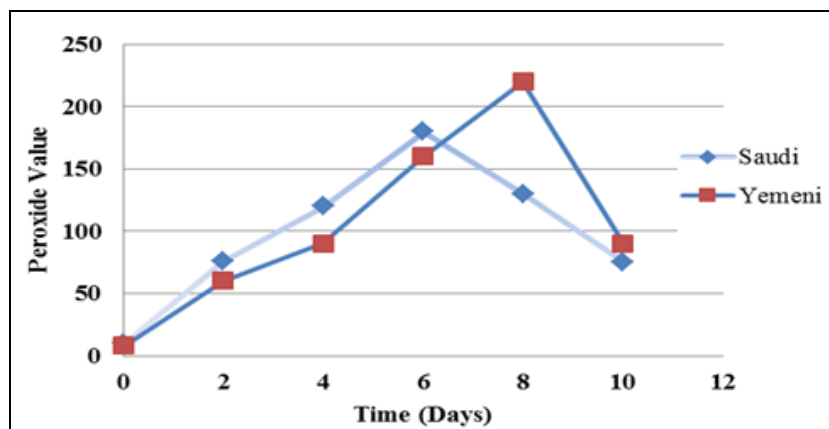
that *T. foenum-graecum* seed oil contained higher amount of linoleic (42.5%) while linolenic acid, oleic acid and palmitic acid contents were found to be 18, 20 and 10.5%, respectively.

Table 4: Fatty acids composition % of Fenugreek seed oil

Fatty acid	Yemени seed	Saudi seed
palmitic acid C16:0	12.44	10.12
Stearic Acid C18:0	0.166	0.108
Oleic Acid C18:1	20.416	18.53
Linoleic Acid C18:2	34.59	39.38
linolenic acid C18:3	28.284	28.10
Arachidic acid C20:0	1.697	1.23
Gadoleic acid C20:1	0.793	0.99
Behenic acid C22:0	1.614	1.743
TSF	15.917	13.198
TUSF	84.083	87.09

3.4 Stability of Oils

Fenugreek seed oil samples were analyzed by Peroxide value mg/ kg (PV) method and the result showed in figure (1). The oil sample extract from Yemeni seed has high stability compare to the Saudi Fenugreek seed oil. The peroxide value starts to increase till day 8 then decrease because the polymers formed start to analysis.

**Fig 1:** Change of peroxide value during storage period at 65 °C

4. Conclusion

From the results of this study, it could be concluded that the fenugreek under investigation contain appreciable amounts of nutrients which may serve as beneficial health sources if consumed regularly and can be used as food supplements for edible oils, these data indicate that fenugreek may provide a meaningful level of protein, fat and fiber when consumed in a variety of foods. The Yemeni fenugreek seed oil had high stability compare to the Saudi fenugreek seed oil.

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6. References

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