



RESEARCH PAPER

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Assessment of minerals from fenugreek seed (*Trigonella foenum-graecum* L.) obtained from markets of District Naushehro Feroze, Sindh

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Abstract

Five markets of District Naushehro Feroz were selected for fenugreek seed collection. Markets included Mehrabpur, Bhirya, Kandiaro, Naushehro Feroz and Moro. Triplicate samples of seed were bought from each mentioned market for mineral analysis. Atomic Absorption Spectrophotometer was used for analysis of minerals i.e., Ca, Mg, Na, K, Fe, Zn and Cu. The concentration range of selected minerals was found as, Ca (5979.00-7675.00 mg/kg), Mg (3468.00-4179.00 mg/kg), Na (1846.00-2058.00 mg/kg), K (11988.00-14043.00 mg/kg), Fe (288.00-366.00 mg/kg), Zn (27.57-33.65 mg/kg) and Cu (21.36-33.14 mg/kg). Since the average concentration of these minerals was observed as, Ca (6814.60 mg/kg), Mg (3814.00 mg/kg), Na (1924.80 mg/kg), K (13067.80 mg/kg), Fe (320.20 mg/kg), Zn (30.27 mg/kg) and Cu (28.95 mg/kg). As is evident from the results that high amounts of potassium and calcium is present in fenugreek seeds, therefore these may be beneficial to human health.

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Introduction

The history of herbs and spices is as long as the history of mankind. People have used these plants since earliest times (Giannenas *et al.*, 2020). Some herbs have the power to change our physiological functioning, they have revolutionized medicine, and created fortunes for those who grow, process and treat them, and in many cases have assumed social and religious significance. Herbs have changed the course of history and in economic term have greater importance as ingredients in food, medicine, perfumery, cosmetics and garden plants (Singh, 2020). Many medicinal herbs are also grown for a range of purposes (Abubakar and Haque, 2020).

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 (Ganie *et al.*, 2022). The basic effects of spices when used in cooking and confectionery can be for flavouring, deodorizing, masking, pungency and colouring (Nair and Nair, 2020). Some spices such as turmeric and paprika are used more for imparting an attractive colour than for enhancing taste (Ganie *et al.*, 2022). Fenugreek (*Trigonella foenum-graecum*) belongs to the family fabaceae. Fenugreek is used both as an herb (the leaves) and as a spice (the seed). It is cultivated worldwide as semi-arid crop (Camlica and Yaldiz, 2021).

Clinical characteristic properties seeds of fenugreek have been more valuable. According to the biological research it has been observed that seeds of fenugreek have various antibacterial properties to fight against bacterial diseases (Singh *et al.*, 2022). It has been observed through water extraction of various parts such as grain, stem and root of fenugreek that it keeps also anti fungal characteristics (Rashad *et al.*, 2022). Medicinally seeds of fenugreek are used for treatment of stomach and indigestion problems. Fenugreek extract and oil is useful in the treatment of

E. coli bacterial infection of stomach (Pal and Mukherjee, 2020), colorectal tumor is also treated with the help of fenugreek it acts as an anti-cancer compound too (Almutairi, 2022). It is determined that fenugreek keeps hepatoprotective, antioxidant, anti-inflammatory, anticancer properties just like flavonolignan protective agent (Sarkar *et al.*, 2023).

Some types of cheese may be flavoured using fenugreek seeds, such as parmesan. Salads and cottage cheese spreads may be mixed by crushed or powdered fenugreek seeds, which increase the aroma and flavour of dishes. Fenugreek seeds are also mixed with curry sauce and are a conventional component of the Bulgarian spice chubritza. For coffee and vanilla extracts seeds are utilized to enhance flavour (Zuk-Golaszewska. and Wierzbowska, 2017). These seeds and their extracts are used to help in digestion and increase absorption of nutrients especially amino acids. They possess strengthening as well as nourishment properties; contribute to body mass and muscle growth. Fenugreek used as food supplements therefore contain hypoglycaemic properties and are suggested for diabetic patients. Seeds may be used to tea and broth, roasted seeds also consumed directly (Khorshidian *et al.*, 2016). The main purpose of this work is to determine and compare the nutrient content of fenugreek seeds collected from different markets of district Naushehro Feroz, Sindh and to educate the local people for its beneficial effects.

Material and methods

Study area

Naushahro Feroze belongs to Sindh province Pakistan. Naushahro Feroze city is its capital. It is subdivided in 51 UCs and five Talukas governmentally. Talukas include Moro, Mehrabpur, Naushahro-Feroze, Kandiaro and Bhirya (Fig. 1). Its population was 1,612,373 according to census of 201. On 15 November 1989, Naushahro Feroze was given the status of district. Prior to this it was Taluka of district Nawabshah (Shaheed Benazirabad). After giving status of district, Naushahro Feroze was placed under Sukkur Division administratively, although during 2011 it was placed under Shaheed Benazirabad Division.

Total area of district Naushahro Feroze is 750000 acres. District Naushahro Feroze is located at middle of the Sindh province, Nawabshah district is in its west, district Larkana is situated in its north west, district Khairpur is located in its east and north whereas, district Dadu is found in west. District Naushahro Feroze is located in a subtropical area; it is cold in winter and hot in summer. The maximum average temperature of 46°C is observed between May and August, while lowest average temperature of 2°C is found between December and January. The annual average rainfall is about 230 mm found during June and September. The south-westerly monsoon wind is observed to blow from mid – February to ending of September, while in winter months of October – January cool northerly wind starts to blow.



Fig. 1. Map of study area

Sample collection

Samples of fenugreek seeds were purchased from local markets of district Naushahro-Feroze. Samples were obtained from retailers' stores of five markets which include; Moro town, Mehrabpur town, Kandiaro town, Bhirya town, and Naushahro-Feroze city. The 500g of samples were collected and placed in plastic bags till analysis in such a way to protect colour, loss of odour, dirt and dust, which may take place as a result of contact of the direct daylight.

Reagents

All chemicals and reagents used in present work were of analytical grade reagent and purchased from pharmaceutical company E. Merck, (Germany). De-ionized water was used throughout the work. Reagents used for preparation of standard solutions were bought from Varian Inc, USA having percent purity of 99.98%.

Samples digestion and analysis

The dilute hydrochloric acid (0.10 M) was used to clean beakers and flasks so as to keep away from bacterial feat which may vary the strength of mineral present in the sample. Fenugreek seed samples were kept in an oven at the temperature of 40°C to remove the water content. The dried seed sample was minced to produce powder and kept in air tight vessel for analysis of minerals. Some acids mixture (H_2O_2 , H_2SO_4 , and HNO_3) was used to digest the powdered mass of the sample, 10 mL of the digested material was taken into measuring flask of 250 mL and de-ionized water was used to make up the volume and sent to MA Kazi Institute of Chemistry, University of Sindh, Jamshoro for analysis of the minerals as, Ca, Mg, Na, K, Fe, Zn and Cu using Atomic Absorption Spectrophotometer employing different cathode lamps for the metal of interest to be determined. Results of analyzed samples were set in mg/kg.

Results and discussion

The rate of estrogen – induced kidney tumors in Syrian hamsters as well as carcinogen – induced mammary tumors in rats may be enhanced due absorption of large amounts of iron. Iron sufficiency also causes so many estrogen-induced cancers in human beings (Satue *et al.*, 2023). Iron acts as catalytic centre for wide range of metabolic functions. So many functions of iron may be found in enzymes like, for immune system use and cytochromes in production of energy, although anaemia may be observed due to iron deficiency (Cappellini *et al.*, 2020). Indications of iron deficiency include; impaired reactivity and coordination, eating pica, failure to adjust body temperature, impaired cognitive function, itching, increased distractibility, reduced learning ability, weakness, fatigue, lack of physical fitness, and reduced work efficiency. Minimum iron content of 288 mg/kg was measured from markets of Merabpur while, maximum iron content of 366 mg/kg was found from fenugreek seeds collected from market of Bhirya town (Table 1).

Copper is important nutrient of various metallo-enzymes, which are involved in production of haemoglobin, antioxidant defence mechanism,

elastin, hair keratin, the cross linking of collagen, catecholamine biosynthesis, carbohydrate metabolism and drug/xenobiotic metabolism. Copper based enzymes may be used to reduce activated or molecular oxygen. Copper deficiency may cause normocytic, osteoporosis, normocytic, hypochromic anaemia and leukopenia (Camaschella, 2019). The maximum and minimum copper content of 33.14 mg/kg and 21.36 mg/kg from samples of fenugreek purchased from markets of Kandiaro and Bhrya respectively. While samples bought from markets of Mehrabpur, Naushahro Feroze and Moro showed copper content in this range (Table 1).

Zinc is important nutrient for proper functioning of various metallo-enzymes and is essential element in animals and human beings. Examples of some enzymes are; DNA, RNA, alcohol dehydrogenase, superoxide dismutase, carbonic anhydrase, leucine aminopeptidase and alkaline phosphatase. Acute oral dose of zinc symptoms include, pancreatitis, damage of hepatic parenchyma, vomiting, diarrhoea, vascular shock, tachycardia and dyspeptic nausea (Hongfang *et al.*, 2020). Maximum and minimum zinc content of 33.646 mg/kg and 27.566 mg/kg were measured from fenugreek seeds bought from local markets of Bhrya and Kandiaro respectively. Samples purchased from Naushahro Feroze, Mehrabpur and Moro showed zinc content in between this range (Table 1).

Vital role is played by sodium in circulation of fluids present in body and is considered the main cation of extracellular fluid. In plasma the level of around 130-145 mmolL⁻¹ of sodium ions is found. Sodium

sufficiency may cause hypernatremia while deficiency of sodium may cause hyponatremia. Adverse effect of high intake of sodium and potassium may cause cardiac, renal circulation problems, or hypertension (Godswill *et al.*, 2020). Samples of fenugreek seed purchased from local market of Bhrya showed the highest sodium content of 2058 mg/kg while the lowest sodium level of 1846 mg/kg sodium was observed from samples seeds obtained from Kandiaro. Samples bought from other local markets showed sodium content between 2058 – 1846 mg/kg (Table 1, Fig. 2).

Potassium is extremely important cation and is found inside of the cells. For normal functioning of the cell suitable amount of potassium is very necessary. Both conditions such as, deficiency (hypokalemia) and sufficiency (hyperkalemia) of potassium are very unfavorable for cardio and nervous system and occasionally it may be lethal. About 3.5 – 5.0 mmolL⁻¹ of potassium is present in blood. Potassium plays various functions for instance blood pressure regulation, protein dissolution, and nerve stimulus and muscle contractions. Potassium can defend heart and blood vessels and may stop heart diseases (Zoroddu *et al.*, 2019). Samples obtained from local markets of Bhrya showed maximum potassium content of 14043 mg/kg whereas, fenugreek seed samples obtained from market of Mehrabpur displayed minimum potassium content of 11988 mg/kg. Local markets of Kandiaro, Moro, and Naushahro Feroze showed potassium content of 13668 mg/kg, 13155 mg/kg and 12485 mg/kg respectively (Table 1, Fig. 2).

Table 1. Concentration (mg/kg) of minerals obtained from various markets of district Naushahro Feroze

Code No	Ca ±SD	Mg ±SD	Na ±SD	K ±SD	Fe ±SD	Zn ±SD	Cu ±SD
M – 01	6375±2.23	3571±1.6	1884±1.94	13155±1.68	309±1.38	29.166±1.04	32.156±2.14
B – 02	6787±2.11	4179±0.7	1934±1.04	12485±1.56	326±0.48	32.534±0.14	28.642±1.24
K – 03	7257±1.34	3998±1.8	1846±2.14	13668±0.79	312±1.58	27.566±1.24	33.143±2.34
N – 04	5979±2.15	3468±1.6	2058±1.94	14043±1.6	366±1.38	33.646±1.04	21.356±2.14
M – 05	7675±2.82	3854±2	1902±2.34	11988±2.27	288±1.78	28.454±1.44	29.459±2.54

Key: M-01= Mehrabpur, B-02= Bhrya, K-03= Kandiaro, N-04= Naushahro Feroze, M-05= Moro.

Large amount of magnesium is present in mantle and crust of Earth and is extremely significant for life. Magnesium ion may be used as signaling, enzyme

activation, and catalysis. Magnesium flow can be made possible by transport proteins inside and outside of cells and intracellular partitions because of

its impermeable biological membranes. Just like water is changed to oxygen by chlorophyll in plants, similarly oxygen molecule is transferred in the blood of vertebrate animals by haemoglobin. Haemoglobin and chlorophyll are exceptionally similar to each other; however iron and magnesium are at the centre of haemoglobin and chlorophyll molecule respectively (Prasad *et al.*, 2022). Because of this practice oxygen and carbon dioxide levels are maintained in our environment and life survives without difficulty. Various diseases may be caused due to magnesium deficiency for instance, cerebral breach, cardiovascular disease, osteoporosis, diabetes, migraines, and high blood pressure and anxiety disorders (Kostov, 2019). Pharmaceutical synthesis with magnesium can be used for magnesium deficiency, Hypomagnesemia and eclampsia, which are mostly found in the nature of magnesium sulphate or magnesium chloride (Van Laecke, 2019). Fenugreek seed samples obtained from Naushehro Feroz market showed the highest Mg content of 4179 mg/kg while, those bought from Bhirya market displayed the lowest Mg level of 3468 mg/kg. Seed samples obtained from Mehrabpur, Kandiaro and Moro showed Mg level of 3854, 3998 and 3571 mg/kg respectively (Table 1, Fig. 2).

Table 2. Descriptive statistics of minerals in Fenugreek seeds collected from District Naushehro Feroz

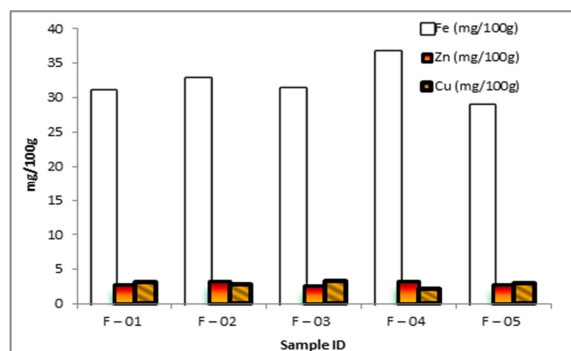
Minerals	Min.	Max.	Mean	Std. Deviation
Ca	5979	63753	18290	25422.28
Mg	3468	4179	3814	294.72
Na	1846	2058	1924.8	80.96
K	11988	14043	13067.8	840.31
Fe	288	366	320.2	28.98
Zn	27.57	33.65	30.27	2.66
Cu	21.36	33.14	28.95	4.63

Table 3. Correlations of minerals in Fenugreek seeds collected from District Naushehro Feroz

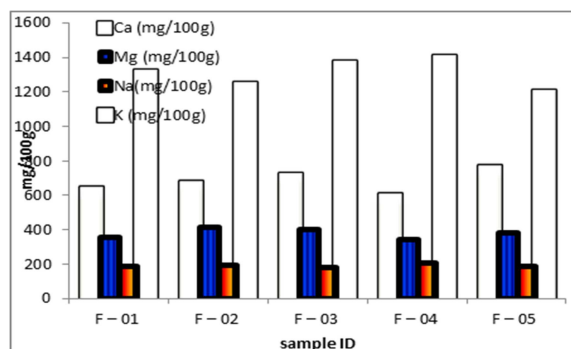
	Ca	Mg	Na	K	Fe	Zn	Cu
Ca	1						
Mg	-.448	1					
Na	-.302	-.505	1				
K	.041	-.509	.361	1			
Fe	-.240	-.404	.851	.720	1		
Zn	-.254	-.205	.893*	.247	.845	1	
Cu	.406	.463	-.991**	-.320	-.812	-.854	1

*= sig. at 0.05 level

**= sig at 0.01 level



(a) Concentration of Fe, Zn & Cu



(b) Concentration of Ca, Mg, Na & K

Fig. 2. Concentration of mineral elements.

Very important role is played by calcium ions in physiology and biochemistry of organisms and therefore are very important for life. Vital role is played by them in signal transduction (Pirayesh *et al.*, 2021), while their other functions include release of neurotransmitter from neurons, second messenger, in fertilization and in contraction of all muscle cell types. Ca^{++} ions are needed as cofactors for different enzymes like blood clotting and cascade. Extracellular Ca^{++} is very important for appropriate development of bones and sustaining potential difference. The major storage place of minerals in mammals is the bone where Calcium is accumulated and transported to blood flow controlled conditions (Lin *et al.*, 2020). The highest Ca content of 7675 mg/kg was observed from fenugreek seed samples obtained from market of Mehrabpur, while the lowest level of 5979 mg/kg of calcium was determined from samples purchased from Bhirya market. Fenugreek seed samples purchased from markets of Kandiaro, Naushahro Feroze and Moro showed the Calcium content of 7257 mg/kg, 6787 mg/kg and 6375 mg/kg respectively (Table 1, Fig. 2).

Table 4. Comparison of concentration of minerals in Fenugreek seeds collected from District Naushehro Feroz

SL	Mineral element	Present work (mg/kg)	Reported work (mg/kg)	References
1	Ca	681.46	330 403	(Singh <i>et al.</i> , 2013) (Pasricha and Gupta, 2014)
2	Mg	381.4	1550	(<i>Foenum-graecum</i> L., 2014)
3	Na	192.48	140	(Singh <i>et al.</i> , 2013)
4	K	1306.78	1306	(<i>Foenum-graecum</i> L., 2014)
5	Fe	32.02	30.96	(Singh <i>et al.</i> , 2013)
6	Zn	30.2732	39.94 0.961	(Singh <i>et al.</i> , 2013) (Pasricha and Gupta, 2014)
7	Cu	28.9512	13.98 0.734	(Singh <i>et al.</i> , 2013) (Pasricha and Gupta, 2014)

Descriptive statistics and correlation coefficient are presented in Table 2 and Table 3, which shows minimum, maximum, mean and standard deviation of various parameters (Table 2). Zinc and Sodium shows strong positive Correlation of 0.893* at significance level of 0.05, while strong negative correlation of -0.991** was also displayed by Copper and Sodium at significance level of 0.01 (Table 3). Comparison of present work and reported work is given in Table 4.

Conclusion

From present study it was concluded that ranges. Concentration of metals was found in the range of Na (1846-2058 mg/kg), K (11988-14043 mg/kg), Ca (5979-7675 mg/kg), Mg (3468-4179 mg/kg), Fe (288-366 mg/kg), Cu (21.36-33.14 mg/kg) and Zn (27.57-33.65 mg/kg). It was found that these seeds are found to be rich sources of potassium, calcium and iron. They are a good source of protein, fat and carbohydrates but with different contents. Thereby, it was concluded that the fenugreek is beneficial to health and to nutrition for consumers of these plant seeds.

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