

ATOMIC ABSORPTION SPECTROMETRIC ANALYSIS OF TRIGONELLA FOENUM-GRAECUM L. SEEDS CULTIVATED IN TURKEY

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Abstract

Trigonella foenum-graecum L. (Fenugreek) is a well-known leguminous herb grown extensively in Turkey and has been used as a cooking spice, for preparing "Çemen" and folk remedy for thousand of years. The seeds are reported to have nutritive properties and to stimulate digestive process.

In this study, several nutritionally important minerals (Al, Ca, Cd, Co, Cr, Cu, Fe, Mg, Mn, Ni, Pb and Zn) were measured by AAS in the different seeds of Trigonella foenum-graecum which are cultivated in different conditions.

Key Words: Fenugreek, AAS, Mineral contents, Trigonella foenum-graecum

Türkiye’de Kültüre Alınmış *Trigonella foenum-graecum* L. Bitkisinin Tohumlarının Atomik Absorbsiyon Spektrometrik Analizi

Trigonella foenum-graecum L. (Çemen) bitkisi Türkiye’de yaygın olarak yetişen iyi bilinen bir Leguminosae familyası bitkisidir ve bin yıldır baharat olarak, Çemen hazırlamada ve halk ilacı olarak kullanılmaktadır. Tohumların besleyici özelliklerinin olduğu ve sindirimi kolaylaştırdığı rapor edilmiştir.

Bu çalışmada, farklı şartlarda kültüre alınmış Trigonella foenum-graecum bitkisinin tohumlarında bazı önemli mineraller (Al, Ca, Cd, Co, Cr, Cu, Fe, Mg, Mn, Ni, Pb and Zn) Atomik Absorbsiyon Spektrometri yöntemi ile ölçülmüştür.

Anahtar Kelimeler: Çemen, AAS, Mineral içerikleri, Trigonella foenum-graecum

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INTRODUCTION

The seeds of *Trigonella foenum-graecum* L. have been used specially for preparing “Çemen” in Turkey. Çemen is composed of crushed classical fenugreek seeds, garlic and chilli pepper mixed to a paste with a little water. The çemen paste covering the slabs of pastırma is both an important factor in the flavour, and protects the meat from drying and spoiling by contact with the air, which would cause the fat in the pastırma to oxidise and give a bitter flavour. Çemen paste is also sold separately as a savory paste for spreading on bread (1). The seeds may be irregularly rhomboidal, oblong or square in outline, and yellow, olive-green or yellowish-brown to dark brown in colour (2). The material of commerce comes exclusively from cultivated plants mainly from Morocco, Turkey, India and China (3). Seed of *T. foenum-graecum* contains 45-60 % carbohydrates, mainly mucilaginous fiber galactomannans; 20-30 % proteins high in lysine and tryptophan; 5-10 % fixed oil (lipids); pyridine-type alkaloids, mainly trigonelline (0.2-0.36 %), choline 0.5 %, gentianine and carpaine; the flavonoids apigenin, luteolin, orientin, quercetin, vitexin and isovitexin; free amino acids, such as 4-hydroxyisoleucine, arginine, histidine, and lysine; saponins (0.6-1.7 %), glycosides yielding steroidal sapogenins on hydrolysis (diosgenin, yamogenin, tigogenin, neotigenin); vitamins A, B₁, C and B₃(3) .

T. foenum-graecum is known to have several pharmacological effects such as hypoglycemia, hypocholesterolemia, antioxidation, laxation, appetite stimulation, antiulcer, and immunomodulatory (4-7).

The seeds of this ancient herb have been used as both a spice and an herbal remedy in the Middle East, India, and Egypt and slightly shorter time in Europe, China and other parts of the world. As a folk medicine fenugreek has been commonly used as a digestive aid and to treat intestinal disorders, diarrhea and other stomach upsets, chronic cough, bronchitis, tuberculosis, fever, sore throat and mouth ulcers, and diabetes. Poultices and other external formulations have been smoothed onto wounds, skin irritations, and areas afflicted by nerve pain (8).

Some companies started to use the seeds or seed extract of *T. foenum-graecum* as a herbal supplement and nutrition in the last few years. In this study, several nutritionally and toxicologically important minerals (Al, Ca, Cd, Co, Cr, Cu, Fe, Mg, Mn, Ni, Pb and Zn) were measured by AAS in the different seeds of *Trigonella foenum-graecum* which are cultivated in different conditions.

EXPERIMENTAL

Material

Domestic samples of *Trigonella foenum-graecum* were collected in 2002 from thirteen different cultivated locations around Konya (Central part of Turkey).

Reagents and Standards

Analytical grade Nitric acid (HNO₃) Merck (K17250843), and hydrogen peroxide (H₂O₂) (K24767600) were used. Standard sample solutions of Al, Ca, Cd, Co, Cr, Cu, Fe, Mg, Mn, Ni, Pb and Zn (1000 mg/ml) were obtained from Merck (Germany).

Mineral Element Analysis

Elemental determinations were performed using a Varian Model AA880 flame atomic absorption spectrometer. The sample (1 g) was weighed analytically and digested in a mixture of HNO₃ (10 ml) and H₂O₂ (2 ml) in microwave digestion unit (Cem MAS 5). The digested samples were diluted to 100 ml in polypropylene volumetric flasks and stored in polyethylene vessels before analysis. All samples were diluted with a 0.1 % HNO₃ solution and analysed three times. Hollow cathode lamps of Al, Ca, Cd, Co, Cr, Cu, Fe, Mg, Mn, Ni, Pb and Zn (Varian) were used. The Al, Cd, Co, Cr, Cu, Mn, Ni, and Pb concentrations in the solution were measured by Graphit Furnace Atomic Absorption Spectrometry (GFAAS). Ca, Fe, Mg and Zn were measured by flame atomic absorption spectrometry (FAAS).

All glassware and other vessels were washed with a detergent, rinsed with reverse osmose water, soaked in 10% nitric acid overnight, rinsed with reverse osmose water and finally rinsed with ultra-pure water. Microwave vessels were rinsed with ultra-pure water, washed with 5 ml 30% HNO₃ in the microwave digestion system using the digestion program and rinsed again with ultra-pure water. Microwave digestion program was performed according to instrument manual.

RESULTS AND DISCUSSION

The most challenging aspect of providing trace elements in plant-based material is to obtain a sufficient concentration for the supplement to be ingested without consuming large quantities of plant tissue. Table 1 shows the mean values of the tested minerals (Al, Ca, Cd, Co, Cr, Cu, Fe, Mg, Mn, Ni, Pb and Zn) in *Trigonella foenum-graecum* samples.

Table 1. Mineral contents of *T. foenum-graecum* seeds from thirteen different cultivated locations (Mean ± SD expressed as µg/g)

Mineral	Mean (n=13) ±SD	Range
Aluminium	24.718 ± 5.853	14.574 – 33.440
Cadmium	0.127±0.068	0.057 – 0.228
Calcium	2341.180±146.325	2030.706 – 2695.596
Chromium	0.641±0.292	0.292 – 1.406
Cobalt	0.413±0.067	0.317 – 0.520
Copper	9.445±1.308	7.572 – 11.570
Iron	62.610±5.437	52.184 – 72.378
Magnesium	1372.731±44.577	1235.323 – 1521.036
Manganese	15.872±1.444	13.171 – 17.575
Nikel	2.085±0.623	1.475 – 3.386
Lead	0.393±0.310	0.010 – 1.078
Zinc	54.612±5.196	43.947 – 70.267

SD: Standard Deviation

According to these results, Ca, Co, Cr, Cu, Fe, Mg, Mn, Ni and Zn contents were found to be low as using mineral supplement. Even many factors affect the elemental contents of plants, for example, variety, state of ripeness, soil type, soil condition, fertilization, irrigation and weather (9). Cu and Mn contents were found in accordance with the results of previous studies on Fenugreek seed. Al, Ca, Co, Cr, Fe, Mg, Ni and Zn contents of Fenugreek seed, determined in this study were low with respect to results of Özcan (10). Lead and cadmium content as toxic metals are in the limit of German Ministry of Health issued draft “Recommendation for Limits of Heavy Metals in Medicinal Products of Plant and Animal Origin” (11).

CONCLUSION

This study shows most comprehensive presentation of mineral composition on thirteen different seed samples of *Trigonella foenum-graceum* which is cultivated in the same geographical region. Mineral composition of our results showed that there were no significant differences observed in the levels of Ca, Fe, Mg, Mn and Zn contents; but significant differences were observed in the levels of Al, Cd, Cr, Co, Cu, Ni and Pb contents in our samples. All mineral contents are found very less compared with recommended daily intake and could not be used as a new source of mineral dietary supplements.

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received: 28.04.2005

accepted: 31.10.2005