

## Determination of Iranian Walnut and Pistachio Mineral Contents

Zeynab Siahnouri, Masoomeh Sadeghian, Mohammad Hossein Salehisormghi,  
Mahnaz Qomi

Islamic Azad University of Pharmaceutical Science, Tehran, Iran

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### ABSTRACT

Iran is the first largest producer of Pistachios and the third producer of walnuts in the world. This study was conducted to evaluate of mineral concentration of Iranian Walnut (*Juglans regia* L) and pistachio (*Pistacia Vera*). Pistachio of Damghan region and walnut of Hamedan city was used in this study. Dried digestion was used for Determination of Na, K, Ca, Mn, Cr and wet digestion method was applied for Fe and Zn. Finally Levels of Na, K, Ca, Mn, Cr, Zn, and Fe in the cultivars, and their regional water and soil were analyzed by Atomic absorption spectroscopy. The mineral contents of Walnut and pistachiocultivars were K (166.5, 91.3), Ca (268.8, 151.5), Fe (355.3, 372.1), Zn (56.8, 44.5), Na (166.5, 91.3), Mn (12.5, 6.2), Cr (2.7, 6.2) mg/100g respectively. Differences in the levels of mineral contents in the cultivars might have been related to different fertilizers, cultivation methods, soil constitution and geographical conditions. There are high amounts of Fe, Ca, K, Zn, and Na in Iranian Walnut and pistachio so that these cultivars have high nutritional value and daily consumption of these nuts can supply some of the needed dietary mineral intake. Iranian Pistachio is rich source of iron which its iron level is 10 times that of the U.S. type. Also among the five nuts (walnuts, pistachios, hazelnuts, almonds, and peanuts) it accounted for the greatest amount of potassium. Sodium, magnesium and calcium in the walnut among the 5 above nuts have the highest rates.

**KEYWORDS:** Walnut, Pistachio, Iranian, Mineral Content, Atomic absorption.

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### 1. INTRODUCTION

Nuts are nutrient dense foods rich in unsaturated fatty acids and other nutritional compounds such as protein, carbohydrate, fiber and minerals. Nuts are highly beneficial to human health because of their unique composition [1-3]. Pistachios and walnut have been shown to reduce LDL (bad cholesterol) and increase the HDL (good cholesterol). Pistachios are an incredibly rich source of vitamin B6, an essential factor to make hemoglobin and wide-ranging effects on the nervous system. lutein and zeaxanthin are two important carotenoids found in pistachio have protective antioxidants to defend tissues from damage from free radicals. walnuts have highest levels of polyphenolic antioxidants than any other common edible nuts. The nuts are rich source of energy and contain health benefiting nutrients, minerals, antioxidants and vitamins that are essential for optimum health. [4-6].

Optimum geographical conditions in Iran have led to the growth of about 8000 herbal species in the country. Different kinds and varieties of nuts are grown in different areas of Iran since the arrival of the early settlers. Walnut (*Juglans regia*) and pistachio (*Pistacia Vera*) are the two successful kinds of nuts that can be grown in Iran well. In addition Iran is the first largest producer of Pistachios and the third producer of walnuts in the world. Iran has about 450000 hectares of land under pistachio cultivation and 250000 hectares under walnut. Kerman, Yazd, Khorasan, Fars, Semnan, Markazi, Isfahan, Qom are important rejoin for pistachio cultivation. Walnut is cultivated in some regions such as Kerman, Hamedan, Qazvin, East-Azarbaijan, Kermanshah, Khorasan and Fars.[7]. Iran is the greatest producer of pistachio in the world. Iran's pistachio production in 2010 was over 446647 tons which is roughly half of the world production. USA, as the second country, produced 236775 tons and Turkey is third biggest country in pistachio production by 128000 tons at 2010. After china and USA, Iran is third biggest producer of walnut in the world and just in 2010; Iran produced 270300 tons of walnut with shell.

Analysis of micronutrients in foods, a prominent area in food chemistry, is of great interest not only regarding nutrition but also regarding the commercial aspects. On the other hand water and soil of the cultivation regions have an important role on quality and quantity of micronutrient compounds (such as minerals, vitamins, fatty acids and amino acids) in pistachio and walnut. There have been numerous studies on the analysis of micronutrient levels of nuts in some countries such as USA, Spain, China, and Turkey, but Iranian studies have been limited to evaluation of Fe, fatty acids and protein contents [8-14].

Considering the lack of data related to the levels of mineral contents in Iranian pistachio and walnut, the current study was conducted to measure amounts of Na, K, Ca, Mn, Cr, Zn and Fe in the cultivars and their regional water and soil.

## MATERIAL AND METHODS

Pistachio samples were taken from Damghan, Semnan and walnut samples from Hamedan. Water and soil samples of these lands were also used for detailed analysis. The nut, water, and soil samples were packed in polyethylene bags and care was taken to avoid any contamination. Walnut and pistachio samples were washed thoroughly with tap water and then with deionized water to remove dust and pollutions. Dry digestion method was used to determine Na, K, Ca, Mn, Cr and wet digestion was used to analyze Zn and Fe. All analyses were conducted in duplicate.

### Dry digestion

The pistachio seed was ground to a fine powder with mortar and pestle and then 2 gm of the sample was placed into a high form porcelain crucible. The furnace temperature was slowly increased from room temperature to 700°C in 1 hr. The sample was ashed for about 4 hr until a white ash residue was obtained. The residue was dissolved in 50 ml of distilled water and then was centrifuged for 15 minutes at 10000 RPM (centurine-k241). Supernatant concentration was read by spectrophotometer (Atomic absorption spectrometer Shimadzu, AA-680). The process was performed for walnut too.

### Wet digestion

The fruit was ground to a fine powder with mortar and pestle and then 2gm of the sample was dissolved in 5 ml distilled water and boiled for ten minutes. Wet digestion of samples was performed by an acid mixture of HNO<sub>3</sub>/HCl (1/1) (10 ml of each sample) in a 100ml beaker inside a hood. This mixture was brought to a volume of 25 ml with distilled water and was centrifuged for 15 minutes at 10000 RPM. Supernatant concentration was read by spectrophotometer. The process was performed for each fruit.

### Determination of soil samples

Soil samples were determined by an acid mixture of HClO<sub>4</sub>/H<sub>2</sub>SO<sub>4</sub>/HNO<sub>3</sub> (1/1/3) in a 100-mL beaker inside a hood. The mixtures were brought to a volume of 100 ml each, with distilled water and centrifuged for 15 minutes at 10000 RPM. Supernatant concentration was read by spectrophotometer.

### Determination of Water samples

Water samples were determined by an acid mixture of HCl/HNO<sub>3</sub> (1/1) (0.25ml/0.25ml) in a 25mL beaker inside a hood. The mixtures were brought to a volume of 20 ml each, with distilled water. The concentrations were read by spectrophotometer.

## RESULTS AND DISCUSSION

Nuts are known to be concentrated foods for human diet because of their major and mineral contents, they are of the best sources of essential elements, amino acids, vitamin B [14] and supplies of natural antioxidants [15,16]. Minerals have pivotal roles in human health. They provide structure in forming bones and teeth, helping to maintain normal heart rhythm, muscle contractility, neural conductivity, and acid-base balance. They regulate cellular metabolism by becoming part of enzymes and hormones that modulate cellular activity [14]. Fe is an important element in hemoglobin, myoglobin, and a large number of enzymes; therefore it is an essential mineral in daily diet [17]. About 30% of iron in human body is as the storage form or ferreting and just a small level is associated with blood transport protein transfer. Zn as an essential element is a constituent of metabolic enzymes [18] and there is high amount of Zn in bones and muscles. Manganese, another essential element, plays an important role in structure and function of some enzymes [19]. Chromium, an essential cofactor in insulin, has an important role in Glucose metabolism. Na as an important electrolyte and essential ion in the extra cellular fluid (ECF) plays a key role in enzyme functions and muscle contraction. In addition, it is important for osmosis regulation and fluid maintenance of the human body. Other roles of sodium include heart performance, nervous system and glucose absorption. K is the third most abundant mineral in human body which is acting as an electrolyte. This mineral is needed for keeping heart, brain, kidney, muscle tissues and other important organs of human body in good state. Potassium chloride is the principal variety of K amongst others. It works in association with sodium to perform a number of critical body

tasks. About 2% of total body weight of human body is consisted of Calcium. Ca is found in the bones and teeth in large volumes and its Traces are present in the circulatory system, which prevents life threatening hemorrhages [20, 21].

In the current study the mineral contents of Iranian pistachio and walnut were analyzed by using atomic absorption technique. The results of mineral contents of the cultivars analysis are listed in table 1 and 2. The sequence of mineral contents in the two cultivars was  $K^+ > Fe^{+2} > Ca^{+2} > Na^+ > Zn^{+2} > Mn^{+2} > Cr^{+3}$ . Mineral contents of nuts depend on their soil, water and geographical conditions.

The results obtained about the pistachio and walnut showed that the fruit of these plants is a rich source of potassium and iron. Calcium, sodium and zinc also exist modestly. They also contain small amounts of manganese and chromium as well.

Due to the amount determined, the soil of planting areas is rich in calcium and iron which this high level of iron in the soil of area, has a great impact on the highness of iron in the fruits. This demonstrated an inalienable role of geographic conditions on the amount and quality of nutrients to the plants. Values obtained from the water by which the plants would be irrigated indicate which it is rich in sodium and calcium.

According to the researches done in this field, after Iran, the United States of America has devoted the highest level of pistachio production to itself. The comparison between the product of Iran and U.S.A shows that: Iranian pistachio's iron is roughly 10 times more than the amount of iron that the American type has. Also the level of zinc in the Iranian product is 2 times more than the American product. Instead, the level of calcium in American pistachio is 7 times more than the Iranian product and also the amount of potassium in the American product is 4 times more than the Iranian product [14, 15].

Also, according to a study that was conducted on pistachio and the recommended daily amounts of these elements, it was determined by taking 34 grams of pistachios a day, the daily need for iron to be supplied. Consumption of 10 grams of pistachios a day provides the daily requirement of chromium. The minerals in pistachio and walnut are very useful for human health. Using these nuts in diet prevents mineral deficiencies complications. According to the present study results, the minerals can supply some of the dietary intake.

Contributorship: all authors made substantial contributions to conception and design of the study, data analysis and interpretation and writing manuscript.

Competing interests: we declare that we have no significant competing financial, professional or personal interests that might have influenced the performance of the study described in this manuscript.

Table 1. Mineral contents of Pistachio (Damghan, Semnan)

Elements	Almond(mg/100g)	soil(mg/100g)	water(mg/100g)
Na	91.3	1186.6	477.9
K	2904	459.2	2.51
Fe	372.1	3475.3	0.35
Zn	44.5	24.9	0.14
Cr	3.8	4.9	0.09
Mn	6.2	307.1	0.02
Ca	151.5	4637.4	305.03

Table 2. Mineral contents of Hamedan walnut

Elements	Almond(mg/100g)	soil(mg/100g)	water(mg/100g)
Na	166.5	21.8	2.17
K	1328.5	257.3	1.36
Fe	355.3	7259.3	0.56
Zn	56.8	29.2	0.23
Cr	2.7	6.39	0.16
Mn	12.5	345.1	0.02
Ca	268.8	17024	3.6

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