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Research article

EVALUATION AND DETERMINATION OF MINERALS CONTENT IN FRUITS

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ABSTRACT: Minerals are important in human nutrition, some play essential role in bone making others are important in body maintenance or metabolic; some of minerals are part of enzyme molecules. To determine mineral content of donat peach, apple, pear, plum and nectarine 10 g of each weighted then burned in 550 ˚C. Obtained ash was used to measure different types of minerals which have important functions in the body they are calcium, phosphorus, iron, potassium and sodium. Dry matter content of samples was determined according to AOAC method. Results showed that among analyzed fruits nectarine has highest ash content as % 0.54 on the other hand the lowest ash content belongs to pear (%0.34) other fruits has similar ash content. Analysis indicated that calcium content of peach is the lowest (600 mg/100g) but peach has the highest content of potassium (0.273 mg/100g) and iron (228.4mg/100g). The highest phosphorus content measured in apple (33 mg/100g) although apple had lowest sodium content (134.9 mg/100g). Highest ash content of nectarine may be due to high calcium content of this fruit (1240 mg/100g) but nectarine had lowest potassium content (115.2 mg/100g). Consumption one serve of nectarine or two serves of peach a day can provide human body need to calcium. Consumption of two serves of pear during day can provide half of body need to sodium. Examined fruits cannot provide the daily body need to phosphorus, potassium and iron.
Keywords: Fruit, dry matter, mineral, health

INTRODUCTION

Daily diet has an important role on our health. Healthy diet means getting enough of the essential ingredients the body needs during the day, including mineral substances needed by the body. Minerals are needed to improved body functions. Minerals are inorganic substances and are found in the soil or in the water which is absorbed by plants or is consumed by animals [1]. Potassium, iron, calcium and magnesium are examples of minerals. Body should receive a large amount of minerals daily to ensure proper functioning of the body organs, bones, tissue and the immune system. Providing the body with mineral resources such as food and supplements is vital during aging. Minerals can be divided into two categories depending on the body needs. Some are needed in higher quantity and some are needed in low levels. In case of mineral riched diets there is no necessity to consumption of supplements [2]. Minerals are elements that originate in the soil and cannot be created by living things, such as plants and animals. Yet plants, animals and humans need minerals in order to be healthy. Plants absorb minerals from the soil, and animals get their minerals from the plants or other animals they eat. Most of the minerals in the human diet come directly from plants, such as fruits and vegetables, or indirectly from animal sources. Minerals may also be present in drinking water, but this depends on where someone lives, and what kind of water drinks (bottled, tap). Minerals from plant sources may also vary from place to place, because the mineral content of the soil varies according to the location in which the plant was grown. Potassium is a very important mineral for the proper function of all cells, tissues, and organs in the human body. It is also an electrolyte, a substance that conducts electricity in the body, along with sodium, chloride, calcium, and magnesium [3]. Potassium is crucial to heart function and plays a key role in skeletal and smooth muscle contraction, making it important for normal digestive and muscular function. Potassium has various roles in metabolism and body functions and is essential for the proper function of all cells, tissues, and organs:

- It assists in the regulation of the acid-base balance.
- It assists in protein synthesis from amino acids and in carbohydrate metabolism.
- It is necessary for the building of muscle and for normal body growth.
- It is essential for the normal electrical activity of the heart.

Phosphorus is a mineral that makes up 1% of a person's total body weight. It is present in every cell of the body, but most of the phosphorus in the body is found in the bones and teeth. The main function of phosphorus is in the formation of bones and teeth. It plays an important role in the body's utilization of carbohydrates and fats and in the synthesis of protein for the growth, maintenance, and repair of cells and tissues. It is also crucial for the production of ATP, a molecule the body uses to store energy. Phosphorus works with the B vitamins. It also assists in the contraction of muscles, in the functioning of kidneys, in maintaining the regularity of the heartbeat, and in nerve conduction. Phosphorus can be found in the environment most commonly as phosphates. Calcium, the most abundant mineral in the body, is found in some foods, added to others and available as a dietary supplement. Calcium is required for vascular contraction and vasodilatation, muscle function, nerve transmission, intracellular signaling and hormonal secretion, though less than 1% of total body calcium is needed to support these critical metabolic functions. The remaining 99% of the body's calcium supply is stored in the bones and teeth where it supports their structure and function [4]. The two main forms of calcium in supplements are carbonate and citrate. Calcium carbonate is more commonly available and is both inexpensive and convenient. Due to its dependence on stomach acid for absorption, calcium carbonate is absorbed most efficiently when taken with food, whereas calcium citrate is absorbed equally well when taken with or without food [5]. Calcium citrate is also useful for people with achlorhydria, inflammatory bowel disease, or absorption disorders. Iron is an integral part of many proteins and enzymes that maintain good health. In humans, iron is an essential component of proteins involved in oxygen transport [6]. A deficiency of iron limits oxygen delivery to cells, resulting in fatigue, poor work performance, and decreased immunity [7, 8]. Almost two-thirds of iron in the body is found in hemoglobin, the protein in red blood cells that carries oxygen to tissues. Smaller amounts of iron are found in myoglobin, a protein that helps supply oxygen to muscle, and in enzymes that assist biochemical reactions. Iron is also found in proteins that store iron for future needs and that transport iron in blood. Iron stores are regulated by intestinal iron absorption [9]. The current study was took place to evaluate the mineral content of some conventional fruits which are consumed during summer by different age groups. If the mineral content of fruits be in the recommended range by the official organizations then the analyzed fruits can be regarded as a valuable source for minerals.

MATERIALS AND METHODS

Moisture content of fruit samples were determined by AOAC method [10]. In this method samples were weighed and placed in the oven at 100˚c until weight remained constant, at the end of the experiment moisture content and dry matter content were calculated according to below equation:

$$MC_{wb} = \frac{m_1 - m_2}{m_1} \times 100$$

$$\text{Dry matter} = 100 - MC_{wb}$$

m_1: initial weight of sample

m_2: final weight of sample after drying in oven

MC_{wb}: moisture content of sample

Ash solution was needed to measure the calcium and phosphorus content of samples. For this purpose, 10 g of sample was burned in a furnace at 550°C. Ash weight and we 5 ml of concentrated nitric acid was added to the obtained ash and the mixture was boiled for 5 min on a hot plate. Nitric acid was added to maintain the volume in initial amount. Solution was transferred into a container and 40 ml distilled water was added then boiled for 10 min. After cooling 100 ml of ash solution was prepared in a flask. The resulting solution following the procedure used to measure calcium and phosphorus [10]. Spectrophotometric method was used to measure phosphorus. For this purpose, 5 ml of ash solution was transferred to a 100 ml volumetric flask then 25 ml of vanadate - molybdate reagent was added and solution was made up to 100 ml. After 10 minutes relaxation, absorbance of the solution determined at the 420 nm wavelength against blank sample. To prepare vanadate – molybdate solution, 20 g of ammonium molybdate was solved in 400 ml water at 50 ° c and cooled. 1 g ammonium vanadt was solved in 300 ml boiling distilled water and cooled then 140 ml of concentrated nitric acid was added gradually while stirring. Finally, the molybdate solution gradually was added in the acid solution while stirring and solution was made up to 1 l by distilled water.

Titration by potassium permanganate method was applied to determine the amount of calcium in samples. To this 20 ml of ash solution was transferred to a container and approximately 100 ml of distilled water and some of methyl red indicator were added. Ammonium hydroxide solution (1 +1) was applied to adjust pH of the solution to about 6.5- 7; in this step the color of solution was yellow, then by hydrochloric acid (3 +1) pH decreased to about 2.5- 3 and color of solution changed to pink. Volume of the solution was made up to about 150 ml by adding distilled water and 10 ml of hot saturated ammonium oxalate was slowly added to boiling solution. The solution was kept for 6-20 h in a dark place. After this period precipitation was collected by ash less filter paper and washed by ammonium hydroxide solution (1+50) several times, and then 125 ml of solution transferred to a container, to dissolve the precipitation 5 ml of concentrated sulfuric acid was added slowly. The solution was heated until temperature was reached to 70- 80 °c. The solution was titrated by 0.1 n solution of potassium permanganate until pink color. To measuring iron 10 ml of ash solution was transferred to 50 ml volumetric flask and diluted 2 times. Then 5 ml hydroxyl ammonium chloride and 2 ml 1, 10 - phenanthroline were added and made up to 50 ml then the absorbance was measured using atomic absorption. Flame photometric method was utilized for determination of potassium and sodium content of samples.

RESULTS AND DISCUSSION

Figures 1 and 2 show values of dry matter as well as ash respectively for analyzed fruits. Pear has the highest level of dry matter content among the analyzed samples on the other hand plum has the lowest amount of dry matter content. Dry matter content of apple and donat peach are same relatively but less than nectarine. The highest and lowest ash content belongs to nectarines and pears respectively, regarding to ash content other analyzed fruits have almost close to each other amounts of ash (figure 2).

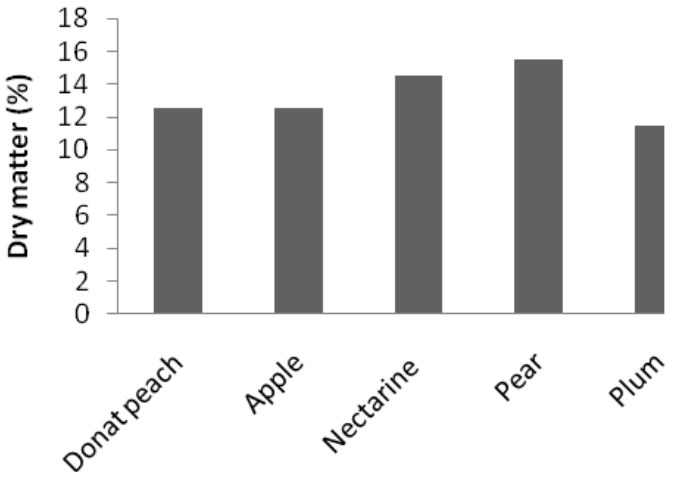

Figure 1. Dry matter content of analyzed fruits.

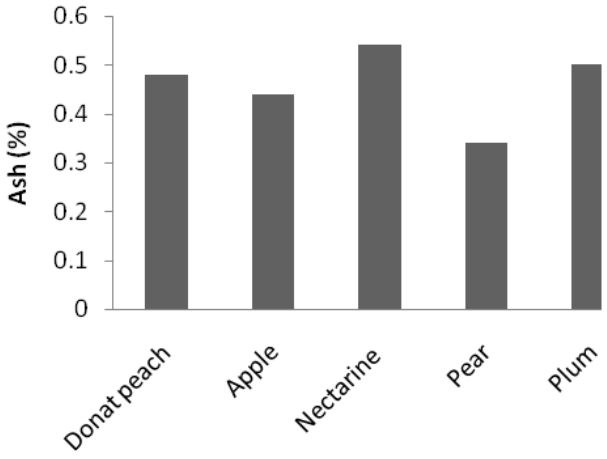

Figure 2. Ash content of analyzed fruits.

Dry matter content of the donat peach is almost like the other of the examined fruits. Figure 3 shows the values obtained for minerals (calcium, phosphorus, iron, potassium and sodium) in the donat peach; calcium content of donat peach is the lowest measured amount among the others (600 mg/100 g) but donat peach is the richest fruit regarding of iron and potassium content in compare with other fruits, 0.273 mg/100g and 228.4 mg/100g for iron and potassium respectively. Iron content of donat peach makes it recommendable for iron deficiency anemia patients. The World Health Organization considers iron deficiency the number one nutritional disorder in the world [11]. As many as 80% of the world's population may be iron deficient, while 30% may have iron deficiency anemia [12]. Iron deficiency anemia can be associated with low dietary intake of iron, inadequate absorption of iron, or excessive blood loss [13, 14]. Women of childbearing age, pregnant women, preterm and low birth weight infants, older infants and toddlers, and teenage girls are at greatest risk of developing iron deficiency anemia because they have the greatest need for iron [11]. Women with heavy menstrual losses can lose a significant amount of iron and are at considerable risk for iron deficiency [15]. Adult men and post-menopausal women lose very little iron, and have a low risk of iron deficiency.

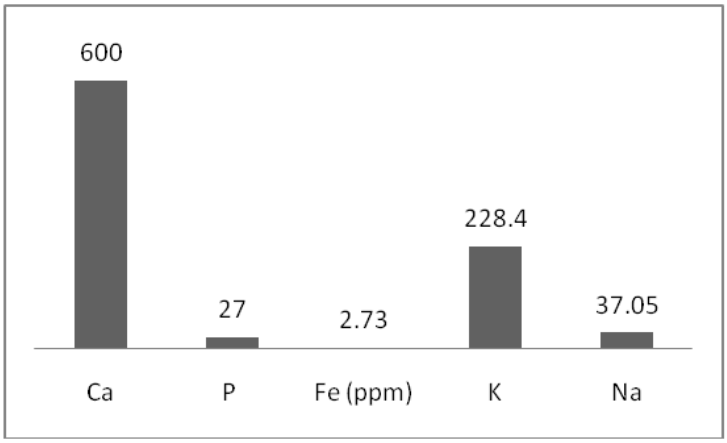

Figure 3. Measured mineral content of donat peach (mg/100 g)

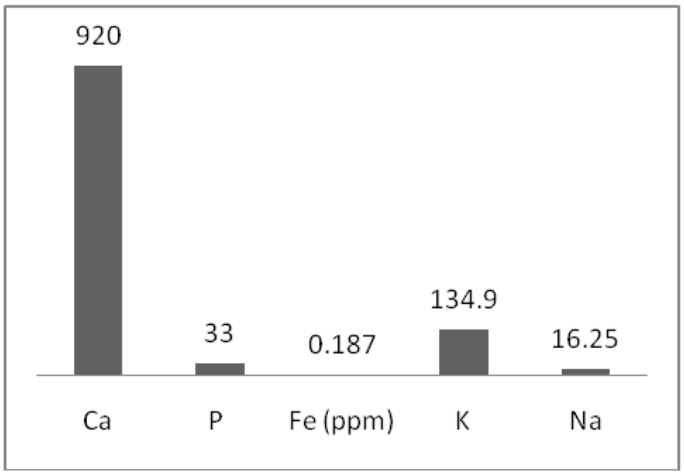

Figure 4. Measured mineral content of apple (mg/100g)

Data obtained for mineral composition of apple is shown in figure 4. Dry matter content of apple is like donat peach. Apple contains the highest amount of the phosphorus (33 mg/100 g) on the other hand it contains the lowest amount of sodium (134.9 mg/100 g) among the analyzed fruits. Phosphates are important substances in the human body, because they are a part of DNA materials and they take part in energy distribution. Phosphates can also be found commonly in plants. Humans have changed the natural phosphate supply radically by addition of phosphate-rich manures to the soil and by the use of phosphate-containing detergents. Phosphates were also added to a number of foodstuffs, such as cheese, sausages and hams [16].

Figure 5 contain data obtained for analyzing of nectarine; nectarine has the highest ash content (%0.54) among the examined fruits, the high amount of ash in nectarine can be related to high amount of calcium content (1240 mg/100 g) in this fruit, since nectarine has the highest measured calcium content among the analyzed fruits although potassium content of nectarine fruit is low compared to the other fruits. Inadequate intakes of dietary calcium from food and supplements produce no obvious symptoms in the short term. Hypocalcaemia results primarily from medical problems or treatments; Symptoms of hypocalcaemia include numbness and tingling in the fingers, muscle cramps, convulsions, lethargy, poor appetite, and abnormal heart rhythms [17]. Data obtained of analyzing took place on pear is shown in figure 6. It contains the lowest ash amount (%0.34). Iron content of the pear was non detectable by utilized technique but pear is very rich in sodium than other fruits (114.75 mg/100 g). Sodium is an element that the body needs to function properly. Sodium is necessary for humans to maintain the balance of the physical fluids system. The body uses sodium to regulate blood pressure and blood volume. Sodium is also required for nerve and muscle functioning. Too much sodium can damage kidneys and increases the chances of high blood pressure. Sodium is an essential nutrient but, while the body needs some sodium to function, too much may lead to high blood pressure, a major risk factor for stroke, heart disease and kidney disease [18].

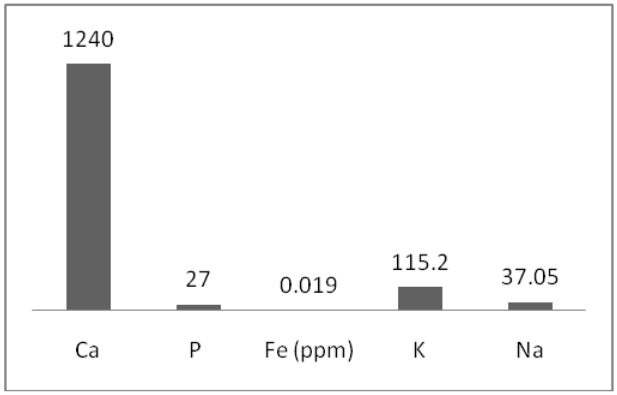

Figure 5. Measured mineral content of nectarine (mg/100 g)

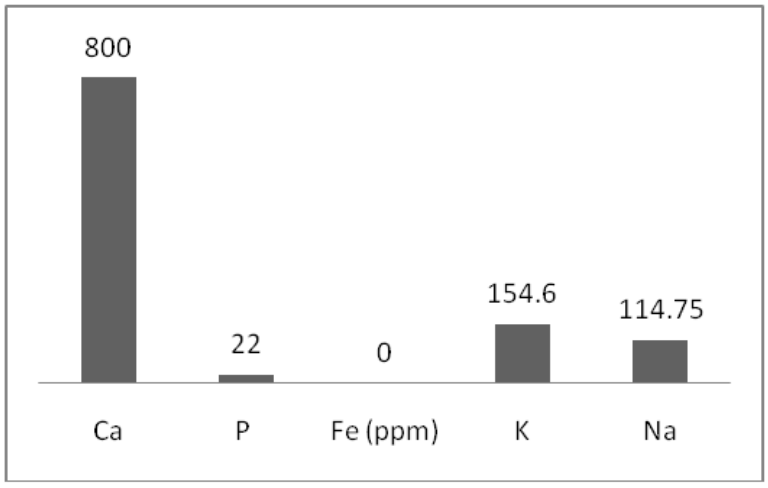

Figure 6. Measured mineral content of pear (mg/100 g)

Figure 7 show the values of plum analyzing. The dry matter of fruit is low in comparison to other analyzed fruits. Plum has average amount of ash content regarding other fruits, the amount of each measured mineral content of plum is also in average quantity. Only the phosphorus content of the fruit is the lowest one (11 mg/100 g). Most people get all of the potassium they need from a healthy diet rich in vegetables and fruits. Studies show a positive link between a diet rich in potassium and bone health, particularly among elderly women, suggesting that increasing consumption of foods rich in potassium may play a role in osteoporosis prevention. More research is needed to determine whether a diet high in potassium can reduce bone turnover in people.

The values obtained of the minerals determination in the fruits are shown in figures 3-7. The highest amount of calcium was found in the nectarine while donat peach had the lowest amount of calcium; the calcium content of the donat peach is about half of the calcium amount in nectarine. The highest phosphorus content was measured in apple and the plum phosphorus content is the one-third of apple phosphorus content. The highest iron content was measured in donat peach and pear had the lowest iron content. Donat peach is also rich sources of potassium among the analyzed fruits while nectarine contains half amount of donat peach`s potassium content which is the lowest among the samples. Sodium content in pear is the highest among the samples on the other hand the lowest level of this mineral was measured in apple.

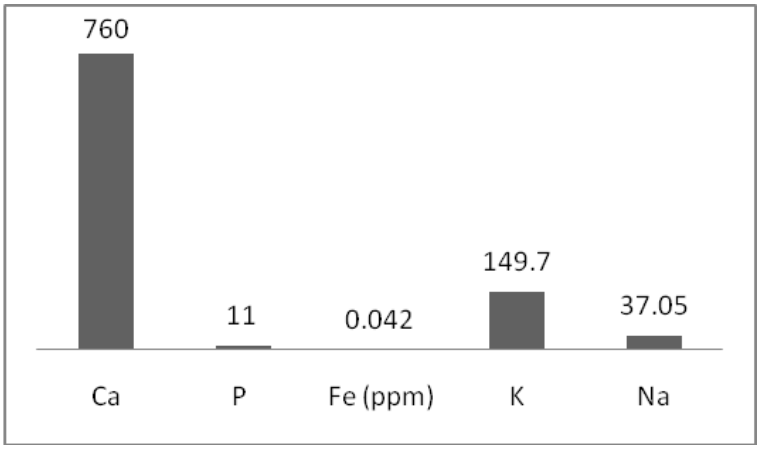

Figure 7. Measured mineral content of plum (mg/100 g)

CONCLUSION

According to results of analysis and measurements taken place to determine minerals content of fruits and comparing these results with recommended daily intake of minerals by authorized organizations, it seems that consumption of 100 g of nectarines can provide the total calcium need in the human body of men and women. The daily requirement of calcium in the human body, according to the Food and Agriculture Organization for mature women is 1300 mg/day and for adult men 1000 mg/day [19]. Although the lowest amount of calcium among the analyzed fruits belongs to donat peach, consumption of 200 g of it will provide total calcium need of body. Due to the high body`s need for phosphorus and iron on the other hand the low content of these minerals in analyzed fruits, body need for mentioned minerals cannot be provided by consumption of analyzed fruits. Then these fruits should not be considered as sources of phosphorus and iron. Recommended dose of phosphorus to the human body for men is 800 mg/day and for women is 1200 mg/day [20] some of the references have been recommended 700 mg/day phosphorus for adult and 500- 1250 mg/day for children [21]. The body's need for iron for men is 10 mg/day and for women 15 mg/day. Donat peach contains significant amounts of potassium but it cannot provide body need for potassium and just can be considered as a supplier. Consumption of 200 g of pear during the day will supply half amount of body need for the sodium then fruits can be a safe replacement for salt as an important sodium provider for human body. Adult body needs 15 mg potassium and 2000 mg sodium per day [21].

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