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Research Article

Determination of Iron Content, Potassium, Calcium, and Sodium In Chinese Date Fruit (*Ziziphus Jujuba Miller.*) Fresh and Boiled In Atomic Adsorption Spectrophotometry

¹Muhammad Amin Nasution, ²Masfria, ²Effendy De Lux Putra

¹Faculty of Pharmacy Universitas Muslim Nusantara Al-Washliyah, Medan 20147, Indonesia.

²Department of Pharmaceutical Chemistry, Faculty of Pharmacy, Universitas Sumatera Utara, Medan, 20155, Indonesia.

ABSTRACT

Chinese dates fruit are generally used by the people of Indonesia as a fruit that has a fairly good nutritional value, namely every 100 g of Chinese dates fruit contain 79 kcal of energy, 1.2 g protein, 20.23 g carbohydrates, 250 mg potassium, 21 mg calcium, 23 mg. phosphorus, 0.5 mg iron, 3 mg sodium, 10 mg magnesium, 0.1 vitamin B6 and 69 mg vitamin C. Chinese dates fruit are foods that are rich in fiber, so they can lower blood cholesterol and cure chronic constipation. In addition, Chinese dates fruit are foods with good sources of potassium. Adequate potassium intake can lower blood pressure so that it can reduce the risk of cardiovascular disease. High iron content can also prevent anemia. The purpose of this study was to determine the differences in the content of iron, potassium, calcium, and sodium in fresh and boiled Chinese dates fruit, and to determine the percentage decrease in levels after boiling.

The method used in this study included dry digestion, then quantitative analysis of iron, potassium, calcium, and sodium was carried out using the Atomic Absorption Spectrophotometry (AAS) method, namely iron at a wavelength of 248.3 nm, for potassium 766.5 nm, to calcium 422.7 nm, and sodium 589.0 nm.

The results showed that the iron content in fresh Chinese dates fruit was (0.6687 ± 0.0084) mg/100 g and boiled (0.3285 ± 0.0127) mg/100 g. Potassium levels in fresh Chinese dates fruit (657.9024 ± 0.4713) mg/100 g and boiled (158.6504 ± 0.2510) mg/100 g. Calcium levels in fresh Chinese dates fruit were (47.3501 ± 1.1630) mg/100 g and boiled (26.3968 ± 0.5922) mg/100 g, and sodium levels in fresh Chinese dates fruit (16.1272 ± 0.1543) mg/100 g and boiled at (13.4048 ± 0.1973) mg/100 g. The percentage decrease in mineral content in Chinese dates fruit after boiling, for iron was 50.87%, potassium 75.88%, calcium 44.25%; and 16.88% sodium.

Statistically different test of the average mineral levels of iron, potassium, calcium, and sodium using the T distribution, it can be concluded that fresh Chinese dates fruit contain higher levels of iron, potassium, calcium, and sodium minerals than boiled Chinese dates fruit.

Keywords: Fresh Chinese Dates Fruit, Boiled, Chinese Dates Fruit, Iron, Potassium, Calcium, Sodium, Atomic Absorption Spectrophotometry.

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*Address for Correspondence:

Muhammad Amin Nasution, ¹Faculty of Pharmacy Universitas Muslim Nusantara Al-Washliyah, Medan 20147, Indonesia.

INTRODUCTION

Chinese dates fruit (*Ziziphus Jujuba Miller.*) come from Asian countries such as China, Japan, Korea, and India. People of Chinese descent generally know Chinese dates fruit by the name da zao (ang cho). Chinese dates fruit are usually used in traditional medicine.

The fruit is oval or round in shape, about 2 cm long, reddish brown in color, sweet in taste, and the seeds are round^[1]. Chinese medicines are also popular in Indonesia to prevent or treat disease. One of the Chinese medicines used is Chinese dates fruit (*Ziziphus jujuba Miller.*) which are usually served in soup or made into tea. In addition, Chinese dates fruit are used to treat dry skin and itchy skin,

Chinese dates fruit contain protein, sugar, calcium, phosphorus, iron, potassium, sodium, rich in vitamin C and B complex vitamins and other beneficial nutrients. Other content is sterols, coumarins, flavonoids, triterpenes, alkaloids, and glycosides. Dried Chinese dates fruit contain volatile oil which gives the fruit an odor^[1,2].

Minerals are inorganic constituents that are important in the body in the maintenance of cell, tissue, organ and body functions as a whole. In addition, minerals also play a role in various metabolic stages, especially as cofactors in the activity of enzymes^[3]. The balance of mineral ions in body fluids is necessary for the regulation of the work of enzymes, maintenance of acid-base balance, assists in important transfers through cell membranes and maintenance of sensitivity of muscles and nerves to stimuli.^[4]

Minerals are classified into 2 based on their needs, namely macro minerals and micro minerals. Macro minerals that the body needs in amounts of more than 100 mg per day include sodium (Na), chloride (Cl), potassium (K), calcium (Ca), phosphorus (P), magnesium (Mg) and sulfur (S). Meanwhile, the body needs less than 100 mg of micro-minerals a day, which includes micro-minerals such as iron (Fe), zinc (Zn), manganese (Mn) and copper (Cu). Enzyme reactions, components of body fluids (electrolytes), sites for binding oxygen (in transport)^[3,5].

Iron is an important component in red blood cells to facilitate the transfer of oxygen to tissues and vital organs^[10]. The human body contains approximately 3.5 - 4.5 grams of iron, iron deficiency can affect the formation of hemoglobin (Hb). Iron bound to hemoglobin has several essential functions in the body as a means of transporting oxygen from the lungs to body tissues. Iron is also an important part of enzyme reactions in body tissues^[5].

Potassium is a positively charged ion and is present in cells and intracellular fluids. Potassium is needed as a building block for muscle-building activity skeletal and heart, maintain fluid balance in the body and as a carbohydrate and protein metabolism^[16]. An increase in potassium intake in the diet has been associated with a decrease in blood pressure. Potassium promotes natriuresis (loss of sodium through urine), it is thought that increasing potassium intake to offset sodium in the diet is beneficial for cardiovascular health^[6].

Calcium is the most abundant mineral in the body, calcium is found in hard tissues, namely bones and teeth. In the extracellular and intracellular fluids, calcium plays an important role in regulating cell functions, such as for nerve transmission, muscle contraction, blood clotting and maintaining cell membrane permeability. Calcium regulates the action of hormones and growth factors^[5]. The metabolism of calcium (Ca) and phosphorus (P) is closely related. Ca and P bonds in bones and teeth occur as inorganic crystals^[7].

Sodium is one of four electrolytes – the other electrolytes are calcium, magnesium, and potassium that the body needs to function^[8]. Sodium is the main cation in the extracellular fluid, as much as 35 to 40% of sodium is in the skeleton of the human body. Fluids in the digestive tract, as well as bile and pancreatic juices contain a lot of sodium. The main source of sodium is table salt or NaCl^[5].

Mineral sources can come from plants or animals, the mineral needs per day are iron 10 mg/day, potassium 2,500 mg/day, calcium 800 mg/day, and sodium 2,500 mg/day. Fruit is a food that is rich in vitamins, minerals, fat, protein, and fiber. Fruit has its own uniqueness and charm, such as delicious taste, distinctive aroma, and color or shape that contains aesthetic values^[6].

Based on the description above, the authors are interested in examining the content of iron, potassium, calcium, and sodium contained in Chinese dates fruit (*Ziziphus jujuba* Miller.) fresh and boiled. Thus the method chosen for the determination of the levels of iron, potassium, calcium, and sodium is the atomic absorption spectrophotometry method because its implementation is relatively simple, has high sensitivity (detection limit is less than 1 ppm)^[10].

RESEARCH METHODS

Tool

Hitachi Z-2000 Atomic Absorption Spectrophotometer complete with iron, potassium, calcium and sodium cathode lamps, analytical balance (ANDGF-200), hot plate (BOECO Germany), furnace, blender, Whatman No.42 filter paper, porcelain crucible and glassware (Pyrex and Oberoi).

Ingredient

The materials used in this study were fresh and boiled Chinese dates fruit, standard solution of potassium concentration of 1000 g/mL, standard solution of calcium concentration of 1000 g/mL, standard solution of iron concentration of 1000 g/mL, standard solution of sodium concentration of 1000 g/mL, nitric acid 65% w/v and demineralized aqua.

Work Procedures

This research was conducted through several stages of work as follows:

1. Material collection and determination of plants carried out at the Herbarium Medanense, Biology Research Center, University of North Sumatera.
2. Each sample that had been mashed was carefully weighed as much as 25 g, put into a porcelain crucible, heated on a hot plate, then ashed in a kiln with an initial temperature of 100°C and slowly the temperature was raised to a temperature of 500°C with an interval of 25°C every 5 minutes. Ashing is carried out for 24 hours (calculated when the temperature is 500°C, then after the furnace temperature $\pm 27^{\circ}\text{C}$ porcelain crucible removed and allowed cool. The ash was added 5 ml of HNO₃ (1:1), then evaporated on a hot plate (temperature 100 – 120°C) until dry. The porcelain crucible was put back into the kiln with an initial temperature of 100°C and the temperature was slowly increased to 500°C at intervals of 25°C every 5 minutes. The ashing was carried out for 1 hour and allowed to cool in the furnace (furnace temperature $\pm 27^{\circ}\text{C}$)^[11].
3. The digested sample was dissolved in 5 mL of HNO₃ (1:1), then transferred to a 50 mL volumetric flask, rinsed in a porcelain crucible with 10 mL of demineralized water three times and made up with demineralized water to the mark line. Then filtered with

Whatman No. filter paper. 42 where the first 5 mL of the filtrate is discarded to saturate the filter paper then the filtrate is then collected into a bottle [12].

- Quantitative examination is carried out by making calibration curves for potassium, calcium, sodium and iron. For the potassium calibration curve, 10 mL of potassium standard solution (concentration 1000 g/mL) was pipetted, put into a 100 mL volumetric flask and made up to the mark with demineralized water (concentration 100 g/mL). The solution for the potassium calibration curve was prepared by pipetting 0.5 mL; 1 mL, 1.5 mL; 2 mL and 2.5 mL of the standard 100 g/mL solution, respectively, were put into a 25 mL volumetric flask and made up to the mark with demineralized water (this solution contains potassium at a concentration of 2 g/mL, 4 g/mL, 6 g/mL, 8 g/mL and 10 g/mL) and the absorbance was measured at a wavelength of 766.5 nm with an air-acetylene flame.
- Determination of levels is done by pipetting 0.4 mL of the sample solution from the destruction and then put into a 100 mL volumetric flask and filled with demineralized water to the mark line (dilution factor =

100 mL/0.4 mL = 250 times). Then the absorbance was measured at a wavelength of 766.5 nm using an atomic absorption spectrophotometer which had been adjusted to an air-acetylene flame. The absorbance value obtained must be within the range of the calibration curve for the standard potassium solution. The concentration of potassium in the sample is determined based on the equation of the regression line of the calibration curve.

Qualitative Testing, conducting a flame test by cleaning the Ni/Cr wire with concentrated HCl and then ignited it on a Bunsen flame until it did not give a special color to the Bunsen flame. Then dip into the sample and then incandescent on a Bunsen flame, observe the color that occurs in the Bunsen flame. If there is potassium, a reddish-purple color will be formed on the Bunsen flame and Test Potassium Crystals with Picric Acid by dripping 1-2 drops of sample solution on an object glass and then dripping with picric acid, leave for ± 5 minutes and then observed under a microscope. If potassium is present, you will see large needle-shaped crystals.

RESULTS AND DISCUSSION

Qualitative Analysis

Qualitative analysis was carried out as a preliminary analysis to determine the presence or absence of iron, potassium, calcium, and sodium minerals in the sample.

Table 1 Results of Qualitative Analysis of Iron, Potassium, Calcium, and Sodium in Fresh Chinese dates fruit

No	Mineral	Reactor	Reaction Results	Results
1	Iron	Ammonium Thiocyanate 10%	Red	+
2	Potassium	Flame test	Reddish purple color	+
		Picric Acid	Big needle crystal	+
3	Calcium	Flame test	Brick red color	+
		H ₂ SO ₄ 1 N and 96% ethanol	Needle Crystal	+
4	Sodium	Flame test	Golden yellow color	+
		Picric Acid	Small needle crystal	+

Description: (+) contains minerals

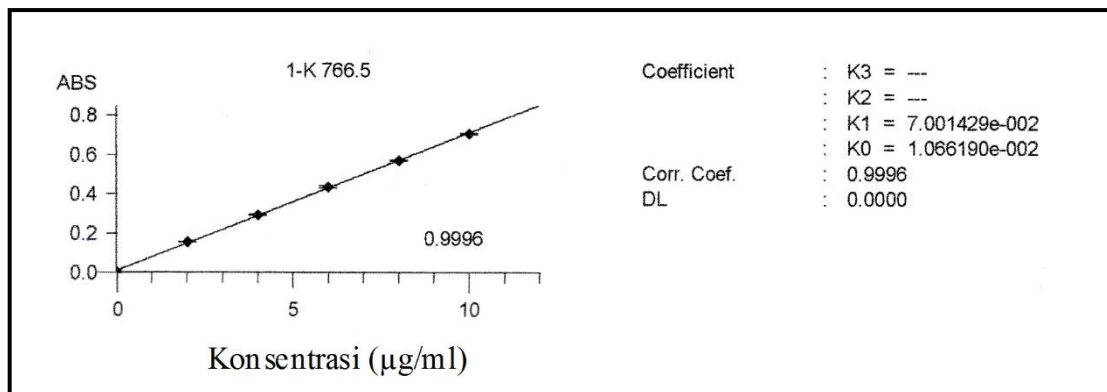
Table 1 shows that samples of fresh Chinese dates fruit contain iron, potassium, calcium, and sodium minerals. The

sample tested positive for containing iron, potassium, calcium, and sodium minerals according to the test contained in table 1.

Analysis with AAS

Absorption results using an atomic absorption spectrophotometer showed an absorbance at a wavelength of potassium 766.5 nm; calcium is 422.7, sodium 589.0 nm and 248.3 nm iron; as stated in the literature

Calibration curves for iron, potassium, calcium, and sodium were obtained by measuring the absorbance of standard solutions of iron, potassium, calcium, and sodium at their respective wavelengths. From the measurement of the calibration curves for the four minerals, the regression line equation is obtained, namely: $Y = 0.03142 X - 0.000734$ for iron, $Y = 0.0701X + 0.0100$ for potassium, $Y = 0.0555X + 0.0029$ for calcium and $Y = 0.0235X + 0.0021$ for sodium.



The results of the analysis of levels of iron, potassium, calcium, and sodium in samples of fresh and boiled Chinese dates fruit can be seen in table 1 below:

Table 2: Results of Analysis of Iron, Potassium, Calcium, and Sodium Contents in Samples

No	Sample	Level (mg/100mg)			
		K	Ca	Na	Fe
1	KCS	657.9024 ± 0.4713	47.3501 ± 1.1630	16.1272 ± 0.1543	0.6687 ± 0.0084
2	KCR	158.6504 ± 0.2514	26.3968 ± 0.5922	13.4048 ± 0.1973	0.3285 ± 0.0127

Description:

KCS: Fresh Chinese dates fruit

KCR: Boiled Chinese dates fruit

Table 3: Results of Reducing Potassium, Calcium and Iron Levels in Fresh Chinese dates fruit and Boiled Chinese dates fruit

Mineral	Sample Rate		Decrease in Level
	KCS	KCR	
K	657.9024	158.6504	75.88
Ca	47.3501	26.3968	44.25

Based on **Table 3**, it can be seen that the potassium content in fresh Chinese dates fruit is much greater than the potassium content in boiled Chinese dates fruit. This is probably because the potassium in Chinese dates fruit boiled a lot of dissolved during the boiling process because most of the potassium in Chinese dates fruit is bound in the form of potassium oxalate which is soluble in water^[13]. So the levels of potassium minerals contained in it are reduced when boiled. Furthermore, the calcium content of fresh Chinese dates fruit was greater than the calcium content of boiled Chinese dates fruit. This is likely due to the boiling process. Calcium levels in fresh Chinese dates fruit have decreased not too much with boiled Chinese dates fruit because of the nature of calcium oxalate which is a form of calcium found in Chinese dates fruit which is difficult to dissolve in water. but the levels are still reduced due to the

release of calcium due to the heating process. Sodium levels in fresh Chinese dates fruit also did not decrease which was not too far from boiled Chinese dates fruit due to heating so that sodium was released. Then, the iron content in fresh Chinese dates fruit is greater than the iron content in boiled Chinese dates fruit. This is probably because the iron salts in Chinese dates fruit are soluble in water, so when boiled, the iron mineral content in them is reduced. The iron content in fresh Chinese dates fruit is greater than the iron content in boiled Chinese dates fruit. This is probably because the iron salts found in Chinese dates fruit are soluble in water, so when boiled, the iron mineral content in them is reduced. The iron content in fresh Chinese dates fruit is greater than the iron content in boiled Chinese dates fruit. This is probably because the iron salts found in Chinese dates fruit are soluble in water, so when boiled, the iron mineral content in them is reduced.

Table 4: Percent Recovery Test for Potassium, Calcium, Sodium Levels and Iron

No.	Analyzed Minerals	Recovery (%)	Requirements Range Percent
1.	Iron (Fe)	101.28	80 – 120
2.	Potassium (K)	99.45	
3.	Calcium (Ca)	97.12	
4.	Sodium (Na)	106.37	

Based on **Table 4** above, it can be seen that the average recovery test results for the iron content of Chinese dates fruit are 101.20%; for the potassium content of Chinese dates fruit is 98.99%; for the calcium content of Chinese dates fruit is 93.63%; and for the sodium content of Chinese dates fruit is 85.39%. The percent recovery shows satisfactory accuracy of work when examining the levels of iron, potassium, calcium, and sodium in the sample. The results of this recovery test meet the specified accuracy requirements, if the average recovery results are in the range of 80% – 120%^[14].

CONCLUSION

The results of the determination of the levels of potassium, calcium, sodium and iron by atomic absorption spectrophotometry showed that there were differences in the levels of the four minerals in fresh Chinese dates fruit

and boiled Chinese dates fruit. The percentage decrease in mineral content of Chinese dates fruit after boiling for potassium was 75.88%; for calcium is 44.25%, sodium 16.88% and for iron is 50.87%.

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