Nutrient Comparation between Date Fruit (*Phoenix dactylifera L.*) and Lemon Fruit (*Citrus lemon L.*) Infused Water

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Abstract. Infused water is commonly consumed as rehydration beverage. It is also assumed contains nutrious components that can help fulfill nutrients in the body. There was limited data to prove date fruit-based infused water, have higher nutrient properties the usual lemon infused water. This study aimed to compare nutrient properties between date fruit and lemon infused water. We used pre-experimental designs with one-shot case study approach. The study determined fat, protein, carbohydrates, iron and potassium composition respectively by the soxhlet method, micro-Kjeldahl method, by different, Uv-Vis spectrophotometry method, and AAS method. The result showed that date fruit has significantly ($p<0.05$) higher value than the lemon infused water in protein (0.185% vs 0.067%), carbohydrate (5.719% vs 4.936%), Iron (0.00343% vs 0.00295%), potassium (0.01523% vs 0.00778%) composition, except fat (0% vs 0%). It can be concluded that mostly macronutrient and some micronutrient content of date fruit infused water are higher than the lemon one.

Keywords: date fruit, infused water, lemon, nutrient content.

1. Introduction

Researches proved that there is correlation fluid intake with physical morbidities and neural performance (Goodman, Moreland, & Marino, 2019; Popkin, D'Anci, & Rosenberg, 2011). the meta-analysis and review of 26 studies showed that high fluid intake in the Asia population has protective effect against bladder cancer (Liu et al., 2017). Good Hydration also gives a beneficial effect on exercise performance and routine activities (Ali et al., 2018; Ilyas et al., 2018). However, people in Spain, France, Turkey, Iran, Indonesia, and China intake water in range 0.76 to 1.78 L/day, lower than the recommendation (Guelinckx et al., 2015). Particularly, the Indonesian Regional Hydration Study (THIRST) research showed that 46.1% of the Indonesian population had mild dehydration (Hardinsyah et al., 2010).

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Since of this issue, it is suggested to expend infused water so that hydration can be expanded. Basically infused water is single aqueous extract of fruit and herbs (Soraya, 2014). in addition to hydration purposes, infused water also was assumed contains nutrients that can help fulfill nutrients in the body. The nutritional content of fruits that are soaked in water will be released. Commonly used infusion water is infused lemon water.

Lemon and date fruits are Asia's typical fruits that have distinct characteristics for each other. Lemon fruit infused water was commonly consumed as a beverage. The nutrient composition and its bioactive compound are known as a natural remedy for many physical morbidities. Nevertheless, date fruit-based water infusion was unfamiliar to be drunk. Whereas, date fruit infused water is part of *Tibb an-Nabawi*, which has been able to rise globally in terms of research and practice, but there is little or no emphasis on the basic principles underlying this medical system. Several studies proved the clinical effect of the date fruit and it's aqueous extract (Akunna et al., 2012; Al-Alawi, et al., 2017; Al-Farsi & Lee, 2008; Ali et al., 2014; Ali, et al., 2016; Gautam, 2016; Marzieh et al., 2008). There were also utilization of date fruit to some food product (Ismail, Darni, & Setyorini, 2018; Purwanto, Nurohmi, Rahadiyanti, & Naufalina, 2018). On the other hand, there was limited data to show the chemical composition of the infused water from date fruit. Therefore, we aim to analyze nutritional value of date fruit based infused water compared with lemon infused water.

2. Methods

2.1 Preparation of Lemon and Date Fruit Infused Water

Khalas date fruit in *tamr* stage and lemon sample were procured from local store in Yogyakarta and Sragen, Indonesia in a row. The fruits were sorted carefully , and weighted exactly 100 g each of them. Date fruit was chopped and lemon was sliced. Two bottles were prepared for adding water with a ratio of 10: 1 fruit (Naheeda, 2013) then put the fruits in to the water and let them immersed for 12 hours (Harifah, Mustofa, & Suhartatik, 2015) in refrigerator temperature (8-15^{o}C) according to Handini (2018). After 12 hours, infused water were analyze for nutrient contents.

2.2 Analysis of Nutrient Content

The analysis was conducted in Chemix Pratama Laboratory for nutrition and other proximate compotition. The aim of anlyzing selected minerals (iron and potassium) was the biggest proportion in date fruits. While potassium was chosen because date fruit contain high potassium among other fruits. Therefore, this study wants to prove whether in the form of infusion water, the levels of these nutrients are also higher in infusion water date fruit than in lemon infused water.

Protein was determined by Micro-Kjeldahl method (Yenrina, 2015). Weigh the sample which has been pureed as much as 0.2 ml into the kjeldhal flask. Add 0.7 grams of N catalyst (250 grams of Na2SO4 + 5 Gram of CuSO4 + 0.7 grams of Selenium / TiO2), then add 4 ml of concentrated H2SO4. Destruction in acid cupboards until the color turns clear green, after the color becomes clear green then cool then add 10 ml of distilled water. Then distilled by adding 20 ml of NaOH - Tio (NaOH 40% + Na2S2O3 5%) and distillate is accommodated using 4% H3BO3 which has been given the Mr-BCG indicator. Run distillation until the distillate

volume reaches 60 ml (The color changes from red to blue). After the volume reaches 60 ml, stop distillation then the distillate is titrated using the standard 0.02 N HCl solution to the end point of the titration (the color changes from blue to pink). Note the volume of titration obtained then calculate the protein content using the formula.

% Protein = % N x conversion factor

NB:

% N = Nitrogen

Conversion factor = 6,25

Fat was analyzed by soxhlet method. We prepared 5 ml sample then put the sample into filter paper casings and tie with yarn. Dry it in an oven at 80oC for 15 minutes. Cool and put into soxhlet. Pour into enough petroleum ether. Heat with an 8-scale electric heater for 3 hours. Cool with the desiccator and weigh the fat (Maligan, 2014).

Carbohydrate was essstimated by difference of mean values. This method requires data on fat and protein composition, as well as moisture and ash composition test results. Moisture composition was determined by Association of Analytical Communities ,1970. Calculated based on = 100% - (moisture content + ash content + fat content + protein content) (Nielsen, 2010; Yenrina, 2015).

Iron was determined by UV-Vis spectrophotometry with wavelength of 510 nm (Yenrina, 2015). Weigh sample as much as 5 ml. Put in a muffle furnace until it is formed into ash. Dissolve the ash using 50 ml HNO3 1: 3 while grinding in a porcelain mortar. Filter using filter paper tamping filtrate into the 100 ml Erlenmeyer. Take 1 ml of clear filtrate, add 2 ml of Amonium Tiosianat 1.5 M, if the sample contains iron (Fe), the color of the solution will turn red. Add Aquadest to a volume of 10 ml then read the absorptions using a spectrophotometer with a wavelength of 510 nm. Record the data obtained then calculated using the standard Iron curve.

Potassium content was analyzed by Atomic Absorption Spechtrophotometry (AAS) in wavelength of 766,5 nm. The sample is weighed as much 5 ml. Put in a muffle furnace until it is formed into ash. Dissolve the ash into 25 ml of HNO3 (1: 3). Read the absorptions using a AAS with a wavelength of 766.5 nm (Nielsen, 2010).

2.3 Data Analysis

All data obtained through tests of normality and homogeneity to determine the method. Analysis was carried out using independent samples t-test in one direction for normally distributed data, and used the Mann Whitney test for abnormally distributed data. The significant difference in independent samples t-test or man whittney test was indicated by the p-value <0.05.

3. Result

The difference in the use of fruit types affects the macro nutrient content in infused water. Based on Table 1, the date fruit infused water has a higher protein content (0.19 g / 100 g) than lemon infused water. Statistical test results using independent samples T-test showed that there were significant differences in the protein content between infused water with different types of fruit, such as dates and lemons (p-value = 0.027). The results showed that fat contents in date fruit and lemon infused water have zero content of fat. Similarly protein, date fruit infused water higher carbohydrate content (5.72 g / 100 g) than lemon infused water . Statistical test results using independent samples T-test showed a significant difference in carbohydrate content between the two types of infusion water (p-value = 0.021), so it can be seen that there was effect of type fruit on carbohydrate content infused water.

Table 1: Comparation of Nutrient contents of lemon and Date fruit infused water

Nutrient	Date fruit infused water	Lemon infused water	p- value
Protein (g)	0.19	0.07	0.027*
Fat (g)	0	0	-
Carbohydrate (g)	5.72	4.94	0.021*
Iron (mg)	3.43	2.95	0.020*
Potassium (mg)	15.23	7.78	0.000*

Differences in the use of fruit also affect in the micro nutrient content of infused water. Based on Table 1, the date fruit infused water has a higher iron content (3.43 g / 100 g) than lemon infused water. The statistical test results using Mann Whitney test, there are significant differences in the iron content between infused water with different types of fruit such as dates and lemons (p-value = 0.020). Date infused water has a higher potassium content of (15.23 g / 100 g) than lemon infused water. Statistical test results using independent samples T-test showed that there were significant differences in the potassium content between two types of infused water (p-value = 0.000), so that it can be seen that there was effect of type fruit on potassium content.infused water.

4. Discussion

4.1 Protein

Date fruit have the highest protein content (2.3-5.6%) of other fruits such as apples (0.3%), oranges (0.7%), bananas (1.0%), and grapes (1,0 %). There are twenty-three different amino acids contained in protein date fruit (Al-Shabib & Marshall, 2003). for example alanine, arginine, aspartic acid, cystine, glutamic acid, glycine, histidine, iso-leucine, leucine, lysine, methionine, phenylalanine, proline, serine, threonine, tyrosine, valine, and tryptophan (Al-Barnawi, 2018; Assirey, 2015; Birlangi, 2016). Amino acid content increases in dry varieties mainly due to water reduction (Al-Farsi & Lee, 2008).

The protein content in lemon is only about 0.9% (Indonesia Ministry of Health, 2018) and is not significantly diffirent with other citrus family (Sayd, 2014; Paul & Shaha, 2004). But the investigation (Sayd, 2014) show numerous kind of free amino acid content in lemon juice that distinctive to date fruit's. They are α-amino-butiric acid, glutamine, and asparagine.

Although they have a plenty of amino acids, we can say fruit is not a source of protein (Dwiyani, 2014). Dissolved proteins in date fruit and lemons into the water because hydrogen bonds not only form intermolecular water but also with molecules that have polar groups. Protein has an amine group which is a polar group so that the protein in date fruit and lemons can be dissolved in water (Kusnandar, 2010).

4.2 Fat

Date fruit and lemons Infused water do not contain fat. The explaination is that fat is a non-polar ester compound that is not soluble in water (Kusnandar, 2010). Since the mechanism of infused water involve diffusion process, that explained as the process of mass transfer of the soluble molecule (the nutrient) from the high concentration (date fruit and lemon) into the low concentration (water), so anything that is not soluble in water may not experience the diffusion (Demirel, 2014).

4.3 Carbohydrate

Table 1. showed a significant difference between the carbohydrate content of date fruit infused water and lemon (p=0.021). The carbohydrate content of date fruit infused water was higher than lemon infused water, that was as much 5,719g/100g while the carbohydrate content of lemon infused water was 4,9362g/100g. The analysis of total carbohydrate content of three dried date varieties date fruit (*Khasab, Khalas, and Fardh*) ranges between 68.53 to 75.37 g / 100 g of date flesh. The highest value of 75.37 g / 100 g was observed in the *Khalas* variety. Types of carbohydrates in date fruit are glucose, fructose, sucrose, mannose, maltose, small amounts of cellulose and starch. Total simple carbohydrate increases with the level of fruit maturity (Al-Farsi & Lee, 2008).

Date fruit is clasified into 5 categories step of maturity and there are 3 edible stages of *khalal*, *rutab* and *tamr* (Ghnimi et al., 2016). Glucose and fructose are the dominant component of date fruits in tamr stage. These reducing sugars was produced by hydrolysis of sucrose from previous level of rippening. They engander the sweetness and softness of the moisture. They also contribute to fruit colouring through maillard and caramelization reactions. Consequently, the date fruit infused water looks more brown than the lemon infused water (Ghnimi et al., 2018).

Date fruit khalas variety have 52.10-78% components are carbohydrates in certain sugars (Ali, Al-kindi, & Al-said, 2009; Ghnimi et al., 2018; Habib & Ibrahim, 2011). High carbohydrate content in date fruit can make date fruit as an energy source. Lemon has carbohydrate content yet, although it not as much in date fruit. It is around 6.2% (Indonesia Ministry of Health, 2018). Carbohydrates in ripped lemons consist of fructose, glucose, and sucrose. Especially in tropic regions, the hot climate plays major role in citrus family development and maturation. The fruit potentially can reduce the time to reach mature stage fo 50% (Sadka et al., 2019). But that condition can not make lemon exceed date fruit in sugar content.

Dissolved carbohydrates in date fruit and lemons into the water because hydrogen bonds not only form intermolecular water but also with molecules that have polar groups. Carbohydrates have hydroxyl groups which are polar groups so that carbohydrates in date fruit and lemons can be dissolved in water (Kusnandar, 2010).

4.4 Iron

Dates and lemons are included in the category of iron Fe^{2+} type. According to Habib and Ibrahim (2011) who conducted research on nutrient content in 18 different date varieties, the micromineral levels studied were iron (Fe), zinc (Zn), copper (Cu), manganese (Mn), cobalt (Co), molybdenum (Mo) and selenium (Se) and it was found that the highest micromineral content that was combined in date fruit was iron. The results showed that iron levels ranged from 0.67 mg / 100 g to 1.75 mg / 100 g, and the khalas variety had the highest iron content. Date fruit can be used as a source of iron for people with anemia, because the iron content in date fruit can increases blood haemoglobin levels. This has been proven in Pravitasari's (2014) study that giving date fruit for 60 days can increase blood hemoglobin levels in vitro in male white mice.

Date fruit provide benefits in maintaining health during pregnancy. Based on a study (Widowati, Kundaryanti and Lestari, 2019) giving date fruit-based beverage to pregnant women has an effect in increasing hemoglobin levels compared to before intervention. Date fruit is able to support erythropoietin synthesis increasing by the liver in order to stimulate the spinal cord to produce more red blood cells or hemotopoiesis mechanism (Onuh et al., 2012).

Balanced amount of iron fulfillment is preeminent for the body . Iron deficiency can cause anemia. as well as bad affect for the immune system. (Anani et al., 2017) explained that children who symptomatic and asymptomatic lack iron substances may change CD4+ and CD8+ cells ratios. Increase the amount of substances that can affect the role of IFN-signaling receptors and then influence MHC class I molecules that lead to NK cell activation (Sottile et al., 2019).

4.5 Pottassium

Date fruit are the fruits that contain the highest potassium among fruits. The content of potassium date fruit ranges from 100-800mg/100g dry weight but, depends on the type of variety and the origin of the fruit. While the potassium content in lemons is only 120-145mg/100g. Potassium is an important mineral that the body needs for muscle contraction, maintaining a healthy nervous system and helping the body's metabolism (Rostita, 2009). High potassium levels in date fruit are proven to reduce blood pressure by playing a role in maintaining the arterial wall to remain elastic and optimize its function so that it is not easily damaged by high blood pressure (Satuhu, 2010). Althought potassium in fruit has beneficial health effect in the body metabolism. its not considered necessary to establish a health- based guideline value for potassium in drinking water (infused water). Potassium intake from dringking water is well below the daily requirement (World Health Organization, 2009).

According to (Ningtyas, 2017) The presence of glucose and potassium content in date fruit water can replace sport drink as a rehydration drink because it can regulate fluid balance in the body.

5. Conclusion

There was a significant differences in carbohydrate contents, protein, iron and potassium between date fruit and lemon infused water, except in fat content. We recommend for future research to consider mineral content in water used for infused water production.

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