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Determination of Magnesium and Iron in Goat's Milk Powder by Flame Atomic Absorption Spectrophotometry

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ABSTRACT

This research aims to determine the levels of magnesium and iron in goat milk powder. The method of this research was atomic absorption spectrophotometry. The research subject was goat milk powder. Moreover, the research object was the amount of magnesium and iron in goat's milk powder. Before analyzing, the first step was removing organic substances in the sample that could interfere the analysis by dissolved it in concentrated nitric acid and heated. Based on the measurement using flame atomic absorption spectrophotometry method, absorbance and concentration of magnesium and iron in the sample were obtained. The analysis showed that the levels of magnesium and iron in the sample were 0.0032 mg/g and 0.0218 mg/g.

Keywords: *goat's milk, flame aas, magnesium, iron*

1. INTRODUCTION

People understood about the content of milk that has many benefits for human body. Milk contains the substance that needed in growth and optimize the health. Milk can be used as source of nutrition because it has various active components played an important role in maintaining the healthy. Even though goat's milk is not as popular as cow milk, but goat milk also has own fans. Goat's milk has characteristic on taste and a little bit different from cow's milk. People believe that goat's milk can cure diseases if continuously consumed. Currently, goat's milk is in demand because it has a specific composition that can be used as raw material for baby food and diet for old.

Besides in liquid form, goat's milk can also be processed into powder. Powder form makes milk more durable and easy to distribute. Goat's milk in powder form is also as a solution of many market demand of milk in various times because goat's milk production is not as much as cow's milk. Luckily, goat's milk powder did not change or even eliminate the nutrients and mineral contents.

Consuming goat's milk can be useful for health because it has antimicrobial properties and immunological properties. Goat milk's can also treatment of cardiovascular diseases, gastrointestinal diseases, cancer, allergy, and others (Zenebe et al, 2014). Goat's milk also can be consumed by people that has cow's milk allergy. That is because goat's milk has the lower levels of αs1-casein than cow's milk (Ulusoy, 2015). Those can be the market potential of goat's milk.

The benefits of goat's milk are based on its nutrient. The main contains of goat's milk and cow's milk are the same. Both have protein, lipid, carbohydrate, vitamin and minerals. However, goat's milk generally has a total of proteins, lipid, and vitamins higher than cow's milk. Goat's milk is also reported to have higher content of potassium, magnesium, calcium, phosphorus,

selenium, iron, zinc, manganese, iodine, chloride, and copper than cow's milk (Zenebe et al., 2014, Ulusoy, 2015, Turkmen, 2017). The other minerals such as sodium and sulfur also exist in goat's milk even though not as much as in cow's milk. Those mineral has many benefits for human body.

Magnesium in goat's milk is an essential electrolyte for human. A magnesium deficiency is associated with a variety of diseases such as cardiovascular diseases, arteriosclerosis, diabetes mellitus, metabolic syndrome, and neurological symptoms (Gröber, Schmidt, & Kisters, 2015). Iron is an essential element for human as it participates in metabolic processes, including oxygen transport, DNA synthesis, and electron transport. Iron deficiency can cause anemia. Iron deficiency during pregnancy is associated with a variety of adverse outcomes for both mother and infant (Abbaspour, Hurrell, & Kelishadi, 2014).

One of the goat's milk brands in the market of Yogyakarta is goat milk with Zuzuka Full Nutrition brand. Unfortunately, the packaging only lists some of the benefits of goat's milk without including a list of existing nutrients in the milk. It makes consumers can not know whether milk is sufficient or how much milk they need to consume in order to meet their nutritional needs. So, the objective of this research is to analyze the magnesium, iron, and manganese metal content in etawa goat milk powder.

2. RESEARCH METHOD

This research use the atomic absorption spectrophotometry method. The first step is prepare the sample. 1.5 grams of goat milk powder Zuzuka Full Nutrition brand weighed and then put it into a Kjeldahl flask. Then, into the flask is added 30 ml of nitric acid solution and let it for 1 night. After one night, into the flask is inserted 3-4 grains of boiling stone and then the flask is placed on a heating mantle in low temperatures. After the solution in Kjeldahl flask start boiling, the lid of flask is opened. Heating is continued until the orange-red gas is gone. If the sample become charcoals, add 1ml of nitric acid solution and heat it using a heating mantle again. Heating that makes the sample dry out has been avoided, because it will make a blast. After the gas disappears, the flask is cooled with a wet napkin. Then, the sample in the Kjeldahl flask is placed into a 100 ml measuring flask and add it with distilled water until the marking limit.

The second step is prepare a standard solution of iron, magnesium, and manganese metals. Each number of 10 ml of Fe and Mg metal solutions are inserted into a 100 ml measuring flask and added it with aquades until the marking limit, so it result in 100 mμ/ mL main solution of Fe and Mg, metals. The standard solutions of Fe and Mg metals is made by diluting the main solution of each metals so will obtain solutions with concentration 0 μg / mL; 0.05 μg / mL; 0.1 μg / mL; 0.2 μg / mL; 0.4 μg / mL; 0.8 μg / mL, 1.6 μg / mL, and 3.2 μg / mL.

The final step is measure the absorbance of each standard solutions. The measurement is done at the wavelength 317.9 nm. And then make the calibration curve to obtain the equation of the regression line. Then also measure the absorbance of test samples that have been prepared. So we will know the concentration of Fe and Mg metals in samples.

3. RESULTS AND ANALYSIS

The aim of this research is to know the metal content of Iron (Fe) and Magnesium (Mg) in dairy goat etawa milk powder form of Zuzuka Milk Full Nutrition brand using Atomic Absorption Spectrophotometry (AAS) method. This method is chosen because this method is very appropriate for determining small amounts of dissolved metals. AAS has a high speed of analysis and accuracy. In addition, the analysis is very sensitive, meticulous and relatively simple.

Before analysis, the sample must first be in destruction. The function of this step is to remove organic substances that can interfere with the calculation of metal content with AAS. The destruction process is carried out with the addition of concentrated nitric acid and left for one night

and then heated to a low temperature using a heating mantle. The orange-red gas will form when the sample is dissolved with HNO_3 and left one night.

From the results of quantitative analysis known that the sample of milk powder Zuzuka Milk Full Nutrition powder contains Fe and Mg. This is evidenced by data obtained from atomic absorption spectrophotometer analysis, as follows

Table 1. Result of analysis of iron and magnesium content with AAS in dairy goat etawa milk powder form of Zuzuka Milk Full Nutrition brand.

Metal	Absorbance	Concentration (ppm)
Fe	0.0389	0.3265
Mg	1.1566	0,0476

The results of analysis of Fe and Mg metals concentrations showed the presence of the metal in a sample of dairy goat etawa milk powder form of Zuzuka Milk Full Nutrition brand. The concentration of samples obtained from the result of AAS analysis with unit ppm then converted to milligram / gram (mg / g) unit, the result is as follows,

Table 2. The concentration of Fe and Mg metal in sample dairy goat etawa milk powder form of Zuzuka Milk Full Nutrition brand

Metal	The metal concentration of AAS results (ppm) (mg / L)	The metal concentration in 100 mL (1.5 gram) sample (mg)	The metal concentration in 1 gram of sample (mg/g)	The metal concentration in 250 gram of sample (1 pack) (mg/250gram)
Fe	0.3265	0.0326	0.0218	5.4400
Mg	0.0476	0.0048	0.0032	0.7925

The metal element being analyzed is a mineral that the body needs in small amounts as micronutrients. In the human body iron is one of the micro elements termed as minerals remaining permanently in the biological system. Iron is required by the body in the formation of red blood cells and enzymatic processes of the body. Iron (Fe) also plays an important role in the immune system. A person with low Fe content will have a low immune system against infection. Iron deficiency will also lead to a decrease in blood hemoglobin or iron nutritional anemia. The body's need for iron elements averages 12-18 mg per day. Therefore, goat's milk can be one of alterrnatif in sufficient iron needs in the body. But also need to be balanced with other foods containing iron to meet the needs of iron in the body.

According to Regulation of the Minister of Health of the Republic of Indonesia Number 75 Year 2013, Adult Nutrition Numbers of Magnesium per day is 350 mg for men and 320 for women. So with a concentration of 0.00317 mg / g is not possible magnesium nutritional needs sufficient if only consume this milk powder goat. Therefore, consumers should consume other nutrients to meet their nutritional needs. Foods that contain lots of Magnesium are chocolate, avocado, beans, fish, bananas, and green vegetables.

By consuming foods and drinks that contain magnesium can provide various benefits in the body because physiologically, magnesium (Mg) has an important role in the structure and function of the human body (Lukaski, 2000). In normal body conditions the concentration of magnesium will always remain constant in the blood circulation. Homeostasis relies on a balance between absorption in the intestine and excretion in the kidney where the renal tubules play a major role in the magnesium setting. Magnesium also plays a role in DNA synthesis. Magnesium deficiency causes an increase in intracellular sodium and a lot of potassium out and into extracellular. This results in the cell having hypokalaemia which can only be treated by

administration of magnesium. Some magnesium compounds are beneficial to maintain a healthy body. $Mg(OH)_2$ is used as magnesium milk (milk of magnesia), chloride salt and citrate is used as a health supplement.

In this study, it is possible that an error occurs when standard solutions are used poorly, thereby affecting the results of metal analysis. In addition to errors due to research, it is possible to use atomic absorption spectrophotometers to occur disorders that cause the absorption of the analyzed elements to be inaccurate. Disturbances that can occur in an atomic absorption spectrophotometer that can be physical disturbances, spectral disorders and chemical disorders (Hina, Rizwani, & Naseem, 2011).

The first is physical disorders. This disturbance is derived from the sample matrix, so it can affect the number of samples that reach the flame. The properties of the matrix include viscosity, surface tension, density, and vapor pressure. Another matrix disturbance is the deposition of the analyzed element, so that the number of atoms reaching the flame becomes less than the concentration that should be contained in the sample. The second one is spectral disorder. This disturbance occurs when the interfering material has the same or very close absorption to the spectra of the analyzed material that can not be separated by the monochromator. Other spectral disorders are caused by combustion products that have wide absorption spectra or because of particles of combustion products that cause fluorescent radiation. And the third is chemical disturbance. Chemical disturbances may include: The process of formation of compounds having low volatile properties.This process occurs from the anions that form the compounds with the elements analyzed. The result of this reaction is of low altitude thereby decreasing the atomization velocity, and the results obtained are lower than the real ones. Other chemical disturbance is dissociation. In heat and in flame-forming gases, dissociation and association reactions cause the metal compound to be converted into its element. Some of these reactions may be reversible. The dissociation reaction of metal oxidation and metal hydroxide greatly influences the absorption spectra. And the other is ionization in flame. Ionization of atoms and molecules in flame that use air as oxidants is small enough, whereas when oxidation is used the nitrogen oxide temperature of the flame is higher and ionization occurs.

4. CONCLUSION

In Etawa goat milk powder sample, the content of magnesium and iron can be detected by instrument, those are 0.0032 mg/g for Mg and 0,0218 mg/g for Fe. If the amount daily adequacy rate of magnesium is 350 mg and iron is 12–18 mg/day, this milk is not sufficient the daily nutrient needs. Goat milk can be one of the alternative source of nutrient but consumers have to consume other food to sufficient their body needs.

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