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Determination of Iron (Fe), Zinc (Zn) Levels and Organoleptic Tests in Coconut Pulp Flour

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Abstract

Coconut pulp is a by-product of coconut milk which contains high protein and good nutrition. This study aimed to determine the iron (Fe) and zinc (Zn) levels in coconut pulp flour using atomic absorption spectrophotometry and determine the characteristics of coconut pulp flour using organoleptic tests. The results showed that iron (Fe) level was 44.075 mg/Kg and zinc (Zn) was 24.2 mg /kg. The organoleptic characteristics of the pulp were white and brownish for the dry powder, coconut-scented, a powder-shaped texture, and normal taste. The highest percentage level of hedonic scale for each criterion was 64% preferred for color, 52% preferred for aroma, 48% preferred for texture, and 52% preferred for taste. Based on these results, coconut pulp can be an alternative local food to meet iron and zinc needs for humans. The processing of coconut pulp as food can be used as a substitute flour in making bread, cakes, cookies, and other food preparations.

Keywords: Coconut pulp, flour, atomic absorption spectrophotometry (AAS), iron, zinc, organoleptic test

Introduction

Coconut (Cocos nucifera L) is a commodity plant that grows and develops well in Indonesia. In particular, this plant grows along sandy beaches and can grow in highland areas. This plant is a multi-functional plant because almost all plant parts can be used properly to meet the community's food needs. Some processed products produced from coconut plants are coconut milk, sugar, and coconut water (Saepulah et al., 2017).

Coconut plants have many uses due to the presence of nutrients such as sugar, protein, vitamins, and phytochemical compounds and organic compounds in them (Ouma et al., 2019). Coconut plants with various uses have many processed products for food needs, especially the part of the coconut flesh, the most widely used. Coconut flesh has several nutritional contents such as water, protein, fat, carbohydrates, fiber, sugar, iron, magnesium, phosphorus, potassium, sodium, zinc, copper, etc. Coconut flesh as a food product is mainly used for coconut milk. Coconut milk is a natural oil-water emulsion that is sweet and milky in color. Coconut milk is traditionally processed in Southeast Asia, including Indonesia (Victor & Elijah, 2016). Processing of coconut flesh into coconut milk has a by-product or waste that is rarely used, namely coconut pulp. The coconut dregs produced from processing coconut milk are thrown away. Even though coconut pulp is a by-product, it still has a relatively high protein content (Silvia & Widodo, 2018).

Coconut dregs, a by-product of the processing coconut fruit, still have advantages as a supporter of sustainable food security; this is supported by high production potential. The process and equipment used in its production are inexpensive and straightforward. They can be processed into higher quality products and added to bakery products, food recipes, and other food products. (Angelia, 2016).

The by-product or waste from coconut fruit processing currently has not been used optimally by the community and is only considered as waste even though the diversification results of coconut fruit waste processing have economic added value and have a high selling value. (Lestari et al., 2019).

Several studies have been conducted to reduce coconut pulp waste. One of the results of food products intended to develop processed coconut waste products is to become coconut pulp flour (Silvia & Widodo, 2018). However, coconut pulp flour as a local food ingredient is still not widely used by the community. In some processed food products, flour is still dominated by wheat flour (Hasan, 2018).

Flour consumed as a food ingredient has been regulated by the National Standardization Agency (BSN), wheat flour. The flour must meet the test of appropriateness standards intended to protect

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consumers' health. In general, the flour used as food ingredients has been regulated by BSN, which includes the physical properties of flour such as color, texture, aroma, and taste. Likewise, some are iron (Fe) and zinc (Zinc) with metal ions in flour. The quality requirements for iron ion (Fe) content are a minimum of 50 mg/kg and a minimum of 30 mg/kg for zinc (Zn).

Iron and zinc are essential metals needed by humans in small amounts <100 mg/day (Mulyaningsih, 2013). As important metals required by the body, these two substances have several functions. One of them, iron, functions as a red blood cell-forming agent and an activator of several enzymes and antibody-forming enzymes (Hamzah & Yusuf, 2019). Just as iron has an essential function for the body, zinc also functions for cell regeneration, helps prevent cell oxidation, and helps children's growth and development process. (Riskiyah, 2017).

Coconut dregs flour, which is diversified as a local food ingredient, requires a preliminary test using several panelists to test the organoleptic properties of flour. In the future, it is hoped that it can be used as a food product with high acceptability and can be one of the food choices in its development (Putri et al., 2018).

This study aims to utilize coconut dregs processed into coconut dregs flour based on the description above. As flour is used as a food ingredient, further knowledge is needed about the mineral content of coconut dregs flour, especially iron and zinc minerals, and additional knowledge about the organoleptic properties of coconut dregs flour. Therefore, this study was conducted to determine the levels of iron (Fe), zinc (Zn), and organoleptic tests on coconut pulp flour. It is hoped that this research will be an effort to reduce environmental pollution from coconut dregs. The results of processing coconut dregs, namely coconut dregs flour, can be utilized optimally.

Methods

This research is experimental research conducted in the laboratory Chemistry Education Tadulako University and the Health laboratory of Palu City, Central Sulawesi Province.

Tools and materials

The tools used are a baking sheet, blender, oven, 70 mesh sieve, dropper, 100 mL volumetric flask, 50 mL beaker, stir bar, electric bath, digital balance, funnel, spatula, SSA tools, watch glass, and spatula. The materials used were coconut pulp, aquades, nitric acid (HNO$_3$) 65%, standard solution of iron (Fe), and zinc (Zn).

Making coconut dregs flour

The coconut pulp sampling process was carried out at the Inpres market in Palu City. Then the coconut pulp is put into a container and washed to separate the coconut pulp from the husk. The cleaned coconut dregs were then dried using an oven at 70 ℃ for 6 hours. After drying, the coconut pulp is mashed using a blender. Blended coconut dregs, then sieved using a 70 mesh sieve.

Preparation of sample

Two grams of coconut pulp flour are put into a 50 mL beaker, dissolved with 10 mL of concentrated HNO$_3$ then added with 20 mL of distilled water. After that, it is heated using an electric bath and stirred using a stirring rod until all the samples in the beaker are completely dissolved and not again visible yellowish gas vapor. After all the samples were completely dissolved, the sample solution was filtered using filter paper into a 100 mL volumetric flask until the filtrate and residue separated. The filtered filtrate obtained was diluted using distilled water gradually as much as 10 mL for each addition; the addition of 10 mL of distilled water was repeated until the 100 mL volumetric flask was marked.

Preparation of standard solutions of Fe and Zn 100 ppm

Standard solutions of 100 ppm Fe and Zn were obtained from 1000 ppm mother liquor; each 10 mL of the mother liquor was pipetted into different 100 mL volumetric flasks. Then diluted using distilled water whose volume is set to the limit mark.

Calibration curve creation

From a standard solution of 100 ppm Fe, a standard series was made as follows; 0.05 ppm; 0.1 ppm; 0.5 ppm; 1.0 ppm; and 1.5 ppm. Likewise, with the standard solution of 100 ppm Fe. Then, the absorbance was measured using AAS in the standard series of the two solutions. The absorption data of the two solutions, a calibration curve were made using Microsoft excel.

Content of iron (Fe) and zinc (Zn)

Fe and Zn levels were determined by measuring the absorption using an AAS device at a wavelength of 248.30 nm for Fe and Zn, and the absorption was measured at a wavelength of 213.90 nm. Measurement of sample uptake was repeated twice.

The data obtained from the absorption of the sample solution were then analyzed to obtain the concentrations of Fe and Zn in the sample using the standard solution calibration curve regression equation (Alizah et al., 2019):

$$Y = a + b . X$$

where Y is the value of Absorbance (A); a is a constant (a constant); b is the slope of the line, and X is the sample concentration (mg/L). Determination of the levels of Fe and Zn in the sample used the following equation:

$$Y = \frac{q.N}{p}$$

where M is the content of Fe and Zn (mg/kg); q is the sample determination volume (L); N is the

concentration of the sample solution (mg/L), and P is the dry weight of the sample.

Organoleptic test

Organoleptic tests were carried out by taking into account the characteristics of the test samples, which included indicators of color, aroma, texture, and taste. Then a hedonic test was carried out to assess the level of preference of the authors for coconut dregs flour. There were 25 researchers in this test, and the test was carried out by presenting coconut dregs flour using a watch glass to each panelist. Then the panelists were given a questionnaire to fill in according to their respective opinions regarding their level of preference.

The hedonic test data obtained from the researchers were collected and processed manually and then analyzed using descriptive percentage analysis. The score to get the percentage of the panelist's preference level is formulated as follows:

$$Percentage\ (\%) = \frac{n}{N} x\ 100$$

where % is the percentage score; n is the number of scores obtained; N is the ideal score (highest score x number of panelists). The score obtained can be known by the preference level based on the percentage interval and the test preference criteria. Existing criteria are very like, like, somewhat like, dislike and dislike very much. The percentage interval and preference criteria can be seen in **Table 1**.

Table 1. Percentage interval and preference criteria

Percentage (%)	Favorite criteria
84-100	Really like
68-83.99	Likes
52-67.99	Somewhat like
36-51.99	Dislikes
20-35.99	Dislike very much

Results and Discussion

The results of the research regarding the determination of the levels of iron (Fe), zinc (Zn), and organoleptic tests on coconut pulp flour obtained data regarding the concentrations of Fe and Zn in the sample solution of coconut pulp flour (mg/L) and the levels of Fe and Zn in the sample flour (mg/kg) and flour organoleptic test results coconut pulp.

Determination of the concentration of Fe and Zn was carried out using the results of the absorption of standard solutions of Fe and Zn. The results of the absorption, obtained Fe and Zn calibration curves which can be seen in **Figures 1** and **2**.
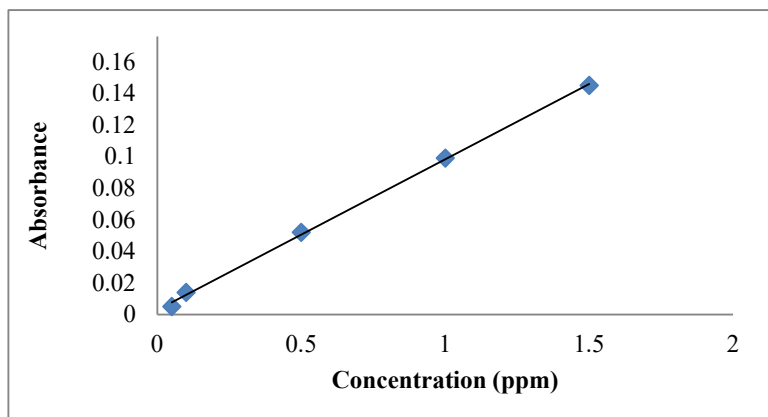
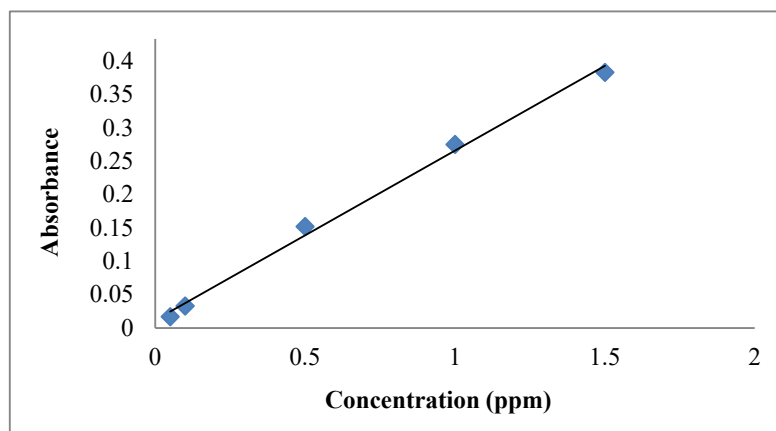**Figure 1.** Solution calibration curve Fe standard

Figure 2. Solution calibration curve Zn standard

Based on the calibration curve data obtained, the regression equation line for Fe is y = 0.0954 x + 0.0029 and 0.2538 x + 0.383 for Zn. The regression equation line is used to analyze the concentration of Fe and Zn in the sample solution. Then the results of the concentration analysis in the sample solution were used to calculate the levels of Fe and Zn in coconut pulp flour using the equation.

$$Y = \frac{q \cdot N}{p}$$

Based on the calculation results, data on Fe and Zn levels in coconut dregs flour can be seen in **Tables 2** and **3**.

Table 2. Concentration of iron (Fe) content
in coconut dregs flour

No	Repetition	Absorbance	Concentration (mg/L	Level ((mg/Kg)
1	1	0.086	0.871	43.55
2	2	0.088	0.892	44.60
	Avarage	0.087	0.881	44.075

Table 3. Concentration of zinc (Zn) levels
in coconut dregs flour

No	Repetition	Absorbance	Concentration (mg/L	Level ((mg/Kg)
1	1	0.135	0.484	24.2
2	2	0.135	0.484	24.2
	Avarage	0.135	0.484	24.2

The characteristics of the coconut dregs flour produced are white, brown pollen, a characteristic coconut aroma, the texture of the powder is ordinary. Coconut dregs flour can be seen in **Figure 3**.

Figure 3. Coconut dregs flour

The percentage level of an enormous hedonic scale of coconut pulp flour for each criterion can be seen in **Table 4**.

Table 4. The percentage level of the most significant hedonic scale of coconut dregs flour

Indicator	Percentage (%)	Favorite criteria
Color	64	Likes
Aroma	52	Likes
Texture	48	Kinde like
Flavor	52	Kinde like

Content of iron (Fe) and zinc (Zn)

After being analyzed and calculated, the average levels of Fe and Zn in coconut dregs flour were 44.075 mg/kg for Fe and Zn, namely 24.2 mg/kg. The results obtained can be seen in Figure 3.

Iron and zinc are minerals contained in the flesh of coconut (Coconut Nucifera L). Iron is an essential mineral because the body needs it to form blood. Also, iron has a vital role in distributing oxygen in human blood, which maintains immunity. One of the effects of a lack of iron intake can cause anemia and lower immunity (Kurniawati & Sugiarso, 2016).

Zinc (Zn) is a macromineral found in all body cells of living things, including humans. As a mineral needed by the body, it is necessary to pay attention to the nutritional intake of zinc minerals because a lack of zinc intake can cause disturbances in the digestive system (Handayani et al., 2016).
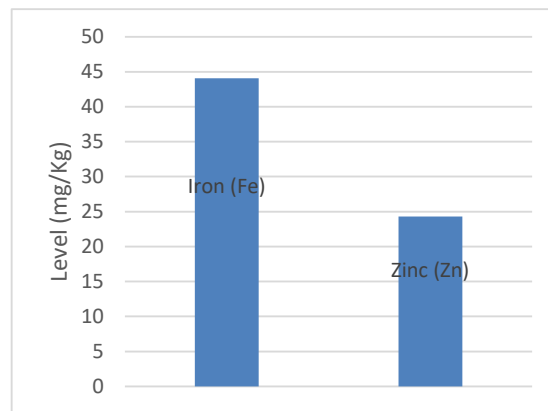

Figure 4. The average levels of Fe and Zn in coconut dregs flour.

The mineral content of wheat flour, which is used as a food ingredient, has been regulated according to the quality requirements of the national standardization body, which was made to protect consumers' health. For quality requirements, the iron content in wheat flour is at least 50 mg/kg and zinc at least 30 mg/kg.

This research was conducted to determine the levels of iron and zinc in dregs flour. Then the results obtained were compared to the data with iron and zinc levels in wheat flour because we

wanted to see how the mineral content of the two differs and the potential for developing coconut dregs flour.

Compared with the research results conducted by Rahmawati et al. (2015), which used white sweet potato flour and purple sweet potato flour as ingredients for making bread. The iron content of coconut pulp flour (44.075 mg/kg) was higher than the iron content of white sweet potato flour (42.679 mg/kg), and the zinc content of coconut pulp flour was also higher (24.2 mg/kg) than the zinc content of sweet potato flour white sweet potato (2.7017 mg/kg). Compared with the results studied, the iron content of purple sweet potato flour was higher (51.531 mg/kg). And then, the zinc content of purple sweet potato flour (7.846 mg/kg) was lower than coconut pulp flour.

The mineral content in coconut dregs flour shows that coconut dregs flour is a source of food containing iron and zinc minerals. The results of this study are in line with the results of research conducted by Widiastuti et al. (2015). This study found that market coconut pulp flour has an iron mineral content of 31.97 mg/L and coconut pulp flour virgin coconut oil (VCO). has an iron mineral content of 75.1 mg/L. Based on the description of the research results obtained above, these results indicate that coconut pulp flour can be a source of food ingredients that can meet the body's nutritional needs, especially the intake of iron and zinc minerals. The body requires iron and zinc intake in <100 mg/day (Mulyaningsih, 2013). Therefore, flour from coconut pulp can be used as an alternative to local food ingredients to meet iron and zinc needs in the body.

Organoleptic test

There were 25 authors in this study. The panelists conducted an organoleptic test or hedonic test to give their opinion about their level of preference for coconut dregs flour. Test the level of preference using six scales consisting of; like very much (5), like (4), like somewhat (3), dislike (2), and strongly dislike (1). The results of the hedonic test are described as follows:

1. Color criteria

Color is an essential component for the acceptance criteria of a food ingredient. A food ingredient with an unattractive color or a color that deviates from that which should not be consumed. So that the acceptance of the quality of food generally depends on the color that is seen first (Herlambang et al., 2019).

In the resulting coconut pulp flour, the flour is white. Based on the percentage of the level of preference testing, the highest level of preference was obtained, namely 64% or the like category. Then 28% of the panelists chose the type rather like it; this was because there was still a brownish color of the powder in the flour caused by grating the coconut pulp, the epidermis of the coconut meat was carried away. The level of preference for coconut dregs flour, which reached 64% in the liking category, was influenced by the temperature and duration of the heating process. Drying for 6 hours at 70 °C is the best heating process to get coconut pulp flour with the highest degree of whiteness (Azis & Akolo, 2018).

2. Aroma criteria

Aroma is a criterion for organoleptic testing using the sense of smell. Based on the percentage of testing the level of liking for the aroma category, the highest level of preference was found, namely 52% or the like type. Then 28% love the fragrance of coconut dregs flour.

The coconut dregs flour produced has a distinctive aroma, namely the aroma of coconut. The process of making coconut dregs flour affects the smell produced. Coconut dregs flour has a reasonably distinctive aroma, namely the distinctive aroma of coconut (Putri, 2014).

3. Texture criteria

The texture or shape of flour is one of the criteria for testing, which is done by touching the test sample. Based on the percentage level of preference for the texture of coconut pulp, the highest level of preference was found, namely 48% who stated that they liked it somewhat and 44% said they wanted it.

The texture of a food ingredient such as flour is influenced by several factors: water content. High water activity in the material will affect the acceptance of the texture of a product (Aminah et al., 2018). Coconut dregs flour produced by its fineness level is still below that of wheat flour; this is because wheat flour in the manufacturing process uses a 100 mesh sieve to make the resulting texture smoother (Putri, 2014).

4. Taste criteria

Taste is an evaluation criterion that uses the sense of the tongue. Based on the percentage level of preference results, the taste of coconut dregs flour was found to be 52%, stating that they liked it somewhat and 32% said they didn't like it.

Taste is an essential parameter to determine the acceptance of a food ingredient. Each flour has a distinctive and different taste; the taste is judged based on a person's response after receiving a stimulus on the tongue. When tested to panelists for coconut dregs flour, the existing panelists are unfamiliar with the resulting taste and will judge it as normal. Therefore, to receive better taste parameters from coconut pulp flour, further treatment is needed to be tested in making brownies. Making brownies mixed with coconut dregs flour will give a distinctive and more dominant coconut taste so that the level of taste acceptance in coconut dregs flour will be better (Hasan, 2018). Coconut dregs flour can be used as a food ingredient by paying attention to processed.

Processing coconut dregs flour as an ingredient for the manufacture of several processed foods can

be used as the main ingredient or as a substitute for several types of flour. Research conducted by (Herni et al., 2018) utilizes coconut pulp flour in the manufacture of high-fiber biscuits. Likewise, with research conducted by (Mulyati et al., 2019), coconut dregs flour in making brownies combined with durian seed flour in this study. The resulting brownies have increased in quality, especially with the content of carbohydrates, fats, and proteins in these products.

Therefore, processing coconut dregs flour as a food ingredient can be done by substituting it with wheat flour in bread, cakes, cookies, and several other food preparations. The use of coconut dregs flour can reduce or reduce the use of coconut dregs to save wheat flour.

Conclusions

The levels of iron (Fe) and zinc (Zn) in coconut pulp flour were 44,075 mg/kg for iron (Fe) and 24.2 mg/kg for zinc (Zn). For color criteria, the organoleptic characteristics of dregs flour are white and contain brown pollen. Standards for aroma, distinctively coconut scent. Texture criteria, in powder form. Taste criteria, normal. The highest percentage level of the hedonic scale for each standard was: 64% liked the color, 52% liked the aroma, 48% liked the texture somewhat, and 52% liked the taste. Based on these results, coconut pulp flour can be used as an alternative local food ingredient to meet iron and zinc needs in the body. Processing of coconut pulp flour as food can be used as a substitute or substitute for wheat flour in the manufacture of bread, cakes, cookies, and several other food preparations.

Acknowledgment

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