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The use of durian seeds (*Durio zibethinus Murr*) as flour products from Tolitoli and Donggala Regencies

Ningsih Purnama, Said Irwan, Mulyani Sri, Rahmawati Sitti, Dandi

Chemistry Study Program, Mathematics and Sciences Division, Faculty of Teacher Training and Education, Tadulako University, Palu, Mantikulore, 94148, Indonesia

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Corresponding Author:
Purnama Ningsih
Chemistry Study Program, Mathematics and Sciences Division, Faculty of Teacher Training and Education, Tadulako University;
Tel. +6281357938655
Email: purnama_ningsih@untad.ac.id

Abstract*. Durian seeds (*Durio zibethinus *murr) have gotten less attention in the past. Therefore, it is necessary to treat them as culinary items like flour. The durian used in flour production was a local durian from Tolitoli and Donggala Regencies. This research method consisted of sample preparation, preparation of standard solutions, analysis of carbohydrates, fats, and proteins, and determination of the levels of Mn and Zn in durian seed flour. The results showed that the composition of durian seeds flour from the Tolitoli regency obtained was 59,2% for carbohydrates, 3,24% for lipids, 8,75% for proteins, 10,1 mg/kg for Mn, and 6,30 mg/kg of Zn. While durian seed flour from Donggala Regency obtained 41,76% of carbohydrates, 3,24% of lipids, 10,93% of protein, 7,1 mg/kg of Mn, and 1,22 mg/kg of Zn. According to these results and the National Standardization Agency of Indonesia, durian seed flour can be used as an alternative local food ingredient to fulfill the body's demands for carbohydrates, lipids, proteins, manganese, and zinc. Furthermore, durian seed flour, when processed as a food ingredient, can be used as a replacement for wheat flour.*

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INTRODUCTION

The durian (*Durio zibethinus murr*) is one of Indonesia's most popular fruits, particularly in the Tolitoli and Donggala Regencies. This king of fruits is a fruit that belongs to the Bombacaceae family and is extensively found in the tropics area (Djaeni and Aji 2010). According to data from the Statistic Central Bureau of Central Sulawesi (BPS), durian output in Central Sulawesi in 2020 would be 25.288 tons, with a percentage increase of roughly 81,35%. So far, the part of the durian fruit that is more commonly consumed is the fruit or flesh coating. The percentage of the weight of this part is low at only 20–35%. This means that the skin (60–75%) and seeds (5–15%) have not been utilized optimally (Djaeni and Aji 2010). A large number of durians can surely benefit society, but they can also generate challenges, such as the problem of durian seed waste.

Durian seeds are a food waste still routinely dumped by the community despite their poor usage (Amid and Mirhosseini 2012; Purnomo *et al.* 2016). Durian seeds are a component of the durian fruit that cannot be consumed directly due to harmful cyclopropane fatty acids (Djaeni and Prasetyaningrum 2010). Durian seeds are usually only consumed after being processed, cooked, steamed, or burned or as animal feed ingredients (Srianta *et al.* 2012). The local community's lack of knowledge and abilities in utilizing the by-products of

durian seed waste results in waste accumulation that can pollute the environment. In fact, durian seed waste can be converted into culinary raw ingredients (Cornelia *et al.* 2015; Seer *et al.* 2017; Zebua *et al.* 2018) and commercially valuable materials (Ismail *et al.* 2010).

Based on the foregoing, a study was carried out on the macronutrient levels of carbohydrates, lipids, and proteins as well as the micronutrients of manganese and zinc in durian seed products from Tolitoli and Donggala regencies. The utilization of durian seed waste (*Durio zibethinus murr*) can be optimized once the macro and micro levels of durian seed flour are known.

METHOD

The tools used in this research were analytical balance, digital balance, beaker glasses, measuring cup, magnetic stirrer, stirring rod, spatula, funnel, measuring flasks, Soxhlet extraction, desiccator, cotton, filter paper, knife, oven, condenser, Kjehdal flask, Erlenmeyer, Atomic Adsorption Spectrophotometer (AAS). The following materials used were Aluminium, Luff Schoorl, NaOH 40%, HCl 3%, H_2SO_4 25%, KI 15%, $Na_2S_2O_3$, $K_2SO_4.5H_2O$, 0,1 N HCl, Bromocresol indicator, Concentrated HNO_3, Mn and Zn standard solutions, and cathode lamp.

Preparation of the Sample

Durian seed samples were first properly cleaned to remove dirt and impurities. The durian seeds were then blanched for 5 minutes at 800°C, then steeped for 1 hour in lime water with a 10% concentration. After soaking the seeds of durian, then were washed again, then sliced thinly, and dried in the sun for 2 days, then dried again in the oven at a temperature of 100°C for 2 hours. To make fine durian seed flour, the dried durian seeds were mashed through an 80 mesh.

Analysis of Carbohydrate

The sample was weighed up to 3 grams, then placed in an Erlenmeyer with 120 mL of HCl and refluxed for 150 minutes. The sample solution obtained was then chilled and neutralized with 40% NaOH to make it pH 7, before being diluted in a 1.000 mL volumetric flask. Then 25 mL of the diluted sample solution was removed and placed in an Erlenmeyer with luff school, which was heated for 10 minutes, cooled, and then 25 mL of 25% H_2SO_4 and 15 mL of 15% KI were added. Next, it was titrated with 0,1 N $Na_2S_2O_3$ solution until the orange hue fades, then 2 mL of 1% starch indicator was added, and the titration was gently continued until the blue-black solution turned milky white. The amount of 0,1 N $Na_2S_2O_3$ that was used was measured (repetition was done).

Analysis of Lipids

The lipids content was evaluated using the Soxhlet extraction method, according to Ramluckan *et al.* (2014). To begin, dry the flask in an oven large enough to accommodate the size of the Soxhlet extraction device. Then it was weighed after cooling in a desiccator. After that, weigh 2 grams of the sample, wrapped it in cotton and filter paper, and placed it in the Soxhlet extraction apparatus, placed the condenser on top of it, and the flask under the Soxhlet apparatus, then filled the flask with enough petroleum ether solvent, and carried out the reflux process until the solvent was dissolved. Returning to the flask, the result was a clear color. In addition, the flask was heated until the solvent boils and evaporates up to the filter paper-wrapped sample, then down to the flask, and so forth. Then the solvent containing the lipids extract in the flask was distilled, the solvent was accommodated, and the flask containing the extracted lipids were heated in the oven at 105^{o}C, then cooled in a desiccator, and then weighed till the weight remained. Then use the following calculation to get the lipids content (Ramluckan *et al.* 2014).

$$Lipid\ content\ (\%) = \frac{final\ flask\ weight - \ initial\ flask\ weight}{dry\ sample\ weight}\ x\ 100\%$$

Analysis of Protein

The micro-Kjehdal technique was used to determine the protein content (Chromý *et al.* 2015). The balance of chemical processes was used to calculate protein content. There are three stages in protein analysis, namely destruction, distillation, and titration. The working process was to weigh a 2 gram sample before placing it in the Kjehdal flask. The catalyst (a mixture of K_2SO_4 and $CuSO_4$) was then added, followed by 10 mL of concentrated sulfuric acid and 5 grams of catalyst (a mixture of K_2SO_4 and $CuSO_4$), which were destroyed in a fume hood until the liquid was a clear green. In a volumetric flask, the solution was diluted with distilled water to a concentration of up to 100 mL after cooling. The solution was pipetted 10 mL and put into the Kjehdal distillation apparatus, and then added 10 mL of 30% NaOH, which had been standardized by oxalic acid. The distillation was carried out for around 20 minutes in an Erlenmeyer containing 25 mL of 0,1 N HCl solution that had been normalized with borax (the end of the condenser had to be dipped in HCl). After that, 0,1 N NaOH solution was used to titrate the excess HCl solution. After that, 0,1 N NaOH solution was used to titrate the excess HCl solution. Calculating the volume of titrant used (Va) was using a bromocresol green and methyl red mixed indicator, then repeating the operation for the blank (Vb) using the formula below (Chromý *et al.* 2015).

$$Protein\ content\ (\%) = \frac{0{,}007\ x\ (Vb - Va) x\ 6{,}25\ x\ 20}{A}\ x\ 100\%$$

Analysis of Mn and Zn Levels

Atomic absorption spectrophotometer was used to determine the amounts of Mn and Zn (AAS) (Jacob *et al.* 2015; Nascentes *et al.* 2005). The working technique begins with preparing the sample by pouring a 1.000 ppm Mn and Zn standard solution into a 100 mL volumetric flask as much as 10 mL, then diluting with distilled water to the limit. The next stage is to create a set of calibration curves for standard Mn and Zn solutions, with concentrations of 0,05 ppm, 0,1 ppm, 0,5 ppm, 1,0 ppm, 1,5 ppm, and 2,0 ppm, respectively.

To begin the sample analysis, weighed 2 grams of durian seed flour and placed it in a beaker. The material was then dissolved in 10 mL of 65 percent concentrated HNO_3 before being added to distilled water. Furthermore, the sample solution was heated in an electric bath while stirring with a stirring rod until it became dry, at which point distilled water was added and the heating procedure repeated until all organic compounds had evaporated, resulting in a clear sample solution. The sample solution is then filtered using filter paper into a 100 mL volumetric flask, and the filtrate is gradually diluted with distilled water to the tera limit, before measuring the absorbance of manganese at 279,5 nm and zinc at 213,90 nm. Finally, the content of Mn and Zn in durian seed flour was determined by evaluating the absorption data.

RESULT AND DISCUSSION

As previously stated, this study examined the macronutrient amounts of carbohydrates, lipids, proteins, and micronutrient levels of manganese and zinc in a sample of durian fruit (*Durio zibethinus* murr*)* collected from Tolitoli and Donggala Regencies. The focus of the study is durian seed flesh, which will be processed into flour-based goods. Sample preparation, destruction, and titration are the three phases of determining the total carbohydrate content in durian seed flour. Cleaning and blanching begin the sample preparation process, which improves the quality of the samples acquired by inactivating enzymes that cause color degradation, removing latex, and softening the texture.

Because durian seed flour contains a lot of sap, $CaCO_3$ is added when soaking the durian seeds to maximize the absorption of the existing sap, until a fairly clean sample is produced, and then flour is obtained

using a blender and an 80 mesh screen according to standard. The following stage is destruction, which breaks the complex down into its constituent elements so that it may be studied. At this point, the sample is treated with HCl to hydrolyse starch into monosaccharides and neutralize the pH. The pH must be conditioned in this Luff Schoorl carbohydrate test (Fitra *et al.* 2020; Kurnia *et al.* 2021) because if the pH is too low (too acidic), the results will be higher than they are, and if the pH is too high (too alkaline), the solution used to neutralize HCl will be NaOH, and vice versa. After destroying the samples, a solution of Luff schoorl and H_2SO_4 is added to bind copper ions formed from the reduction of monosaccharides, forming $CuSO_4$, and then KI indicator is added to test the sensitivity to iodine from the dark blue dye created by starch indicator. The following are the reactions that occur.

$$\text{R-COH} + CU_2O \rightarrow \text{R-COOH}$$
$$H_2SO_4 + Cu_2O \rightarrow CuSO_4 + H_2O$$
$$CuSO_4 + 2KI \rightarrow CuI_2 + I_2$$
$$2CuI_2 \rightarrow CuI_2 + I_2$$

The last stage is titration, which is used to determine how much iodine reacts with sodium thiosulfate. The titration is completed when the color of the solution changes from blue to milky white. The following are the reactions that occur in this stage.

$$I_2 + Na_2S_2O_3 \rightarrow Na_2S_4O_6 + NaI$$
$$I_2 + \text{amylum} \rightarrow \text{blue}$$

The lipid content of durian seed flour was determined using the soxhletation extraction method, which involves extracting the lipid from durian seed flour using a fat solvent. The sample is neatly wrapped in filter paper and given a boiling stone on the Soxhlet apparatus to avoid an explosion when the solution is heated and to heat it more uniformly in this soxhletation process (Ramluckan *et al.* 2014). Because durian seed flour is included in the dry sample, the lipid solvent chosen is hexane, which dissolves fat easily and has a lower boiling point than water, requiring less energy in the extraction process. As a result, the sample must be entirely dry at the time of weighing because when the sample (lipid extract) is baked, the hexane evaporates, but the water remains, adding to the weight of the lipid. As a result, the water must be removed first before weighing it with a desiccator.

The digestion process, distillation process, and titration process are the three processes of the Kjehdal method for determining protein content. During the destruction stage, concentrated sulfuric acid, a strong oxidizing agent, decomposes the sample into its constituent constituents, namely H, O, N, and C. Carbon and hydrogen will be oxidized to CO_2, CO, and H_2O, while nitrogen will be converted to $(NH_4)_2SO_4$, where ammonia gas cannot be released in an acidic solution because it is bonded with sulfate ions (SO_4^{2-}). The inclusion of a catalyst aids the destruction process by speeding up the increase in sulfuric acid temperature, which varies from 370^{o}C to 410^{o}C, allowing for faster destruction. The catalyst used is a mixture of solids K_2SO_4 and $CuSO_4$, where 1 g of K_2SO_4 can raise the boiling point 3^{o}C. This process is stopped when the sample solution becomes clear. The reaction that occurs during the digestion process is as follows.

$$CuSO_4 + 2H_2SO_4 \rightarrow 2CuSO_4 + 2H_2O + SO_2$$
$$\text{Protein/(CHON)} + O_n + H_2SO_4 \rightarrow CO_2 + H_2O + (NH_4)_2SO_4$$

By adding NaOH to ammonium sulfate $(NH_4)_2SO_4$, the distillation process tries to remove the target ingredient, which is ammonia (NH_3). Because the reaction cannot take place in an acidic environment, NaOH is added to create an alkaline environment. The addition of NaOH causes the produced ammonium sulfate to

break into ammonium and release one hydrogen atom. Because ammonium is a volatile gas, it must be trapped in an acidic solution, such as hydrochloric acid coupled with bromine cresol green and methyl red indicators, to produce a clear colored solution. The reactions that take place throughout the process of destruction.

$$(NH4)_2SO_4 + H_2O \rightarrow Na_2SO_4 + 2\ NH_4OH$$
$$2\ NH_4OH \rightarrow 2NH_3 + 2H_2O$$
$$4\ NH_3 + 2\ HCl \rightarrow 2(NH_4)_2Cl$$

Titration is the final step in determining how much hydrochloric acid reacts with ammonia. The results of the distillation are titrated with NaOH. The NaOH solution will titrate the ammonium chloride to ammonium hydroxide, resulting in excess of NaOH at the end of the titration. The shift in color of the solution from yellowish green to pink indicates the end of the titration. The reaction that takes place.

$$4\ NH_3 + 2\ HCl \rightarrow 2(NH_4)_2Cl$$
$$2(NH_4)_2Cl\ + 2\ NaOH \rightarrow 2\ NH_4OH + Na_2Cl_2$$

Tables 1 and 2 show the macro content (carbohydrates, lipids, and proteins) as well as the micro-content (manganese and zinc) of durian seed flour. The average carbohydrate content of Tolitoli durian seed flour was 41,76%, while the average carbohydrate content of Donggala durian seed flour was 56,16%, according to Table 1. Tolitoli durian seed flour has a higher carbohydrate content than Donggala durian seed flour. This is due to the higher sodium thiosulfate reacting with iodide in Tolitoli durian seed flour compare to durian seed flour from Donggala. By determining the titration using sodium thiosulfate, the cupric oxide is calculated in solution before being reacted with reducing sugar (blank titration) and after being reacted with a reducing sugar sample (sample titration) in the Luff Schrool technique.

Table 1 % Carbohydrates, lipids, and proteins in durian seed flour

Sample	% Carbohydrates	% Lipids	% Proteins
Tolitoli	41,76 ± 2,04	3,24 ± 0,16	10,93 ± 3,09
Donggala	56,16 ± 2,04	3,25 ± 0,01	8,75 ± 0

Tolitoli and Donggala durian seed flour had 3,24% and 3,25% lipids content, respectively. Both durian seed flours have the same lipids content. This is because the levels are measured at the same time, and because temperature impacts lipids content, the longer the Soxhlet time, the lower the lipids content. This is due to the formation of volatile degradation products that cause a decrease in the amount of lipid extracted (Ramluckan *et al.* 2014). The average protein content of Tolitoli and Donggala durian seed flours was 10,93% and 8,75%, respectively. Tolitoli durian seed flour has a higher protein content than Donggala durian seed flour. The difference in levels obtained is due to the fact that each region has a different level of soil fertility, which means that the mineral content of each fruit will vary.

One of the minerals found in durian seeds is manganese and zinc (*Durio zibethinus mur*). Manganese is an essential mineral for the body since it aids in the formation of bone structure, bone metabolism, and enzyme production (Yang *et al.* 2000; Horning *et al.* 2015). Manganese is corrosive; thus, it must be consumed in the proper amount. If there is an excess of manganese, the body will become sick. Zinc (Zn) is a tiny mineral that may be found in all living creatures' cells, including humans. Zinc deficiency can create problems with the digestive, respiratory, and immune systems, so it's important to keep track of your intake as one of the body's essentials (Hambidge 2000; Das and Green 2013). The mineral content of minerals in wheat flour, which is used as a food ingredient, is created in compliance with the National Standardization Agency of Indonesia (BSN) quality regulations with the goal of preserving customers' health. The manganese content in wheat flour

meets BSN quality requirements of 10 mg/kg, while the Zinc level meets BSN quality criteria of at least 30 mg/kg.

Table 2 Levels of Mn and Zn in durian seed flour

Sample	Mn (mg/kg)	Zn (mg/kg)
Tolitoli	10,1 ± 0,3	6,3 ± 0,1
Donggala	7,1 ± 0,1	1,2 ± 0

According to Table 2, in Tolitoli and Donggala regencies, average manganese levels were 10,1 mg/kg and 7,1 mg/kg, while zinc levels were 6,3 mg/kg and 1,2 mg/kg, respectively. The mineral content of durian seed flour suggests that the flour is a source of manganese and a zinc-rich diet. As a result, durian seed flour can be used as a local dietary item to fulfill manganese and zinc requirements in the body.

CONCLUSION

Durian seeds from Donggala and Toli-toli regencies can be used as flour-processed products and can be used as a substitute for wheat flour because they meet the standards of BSN (the National Standardization Agency of Indonesia).

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