PROXIMATE IDENTIFICATION IN VARIETY OF RAMBUTAN SEED AS A BIODIESEL INITIATION

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Abstract
Rambutan is one of the native plants of Indonesia that has good adaptation and abundant fruit production. The use of rambutan so far has only been limited to fruit flesh, while rambutan seeds have only become waste that requires special handling. Rambutan seeds are food waste containing relatively high fat content ranging from 17-39% which can be used as a biodiesel additive. Efforts are being made to be able to take advantage of rambutan seeds, namely by identifying the nutritional content of rambutan seeds. The aims of this study is to identify the nutritional content of rambutan seeds so that they can be used as an information basis for the initiation of biodiesel. The research was conducted in September-Desember 2020 at the Center for Seeds fo Food Crops and Horticulture (B2TPH), Karanganyar regency using a direct survey and descriptive method. Seed proximate analysis was carried out at the Food and Nutrition Laboratory, Faculty of Agriculture, Sebelas Maret University. Determination of water content using the Thermogravimetric method, mineral content using the Dry method, fat content using the Soxhlet method, protein content using the Kjeldahl method, and carbohydrate content using the By different method. The result showed that rambutan seeds contain nutrients such as water, minerals, protein, fat, and carbohydrates. The highest fat content was found in rapiah variety which was 24,15% and the lowest was in lebak bulus variety which only had 18,7% fat content. The fat content is high so that can be used as an environmentally friendly fuel (biodiesel).

Keywords: Proximate, Biodiesel, Fat Content.

1. INTRODUCTION

Rambutan is a plant species native to Indonesia [1], [2]. The adaptation of this plant is very good, and in rambutan season the fruit production is very abundant. So far, rambutan has only been used for the flesh of the fruit, while the seeds for the fruit have not been utilized, even as waste that requires special handling. Rambutan seeds can be used as raw material for biodiesel because they contain several types of fatty acids which are relatively high, ranging from 17-39% [3]–[5]. The fatty acids of rambutan oil can also be used as biodiesel additives [6]. Utilization of food waste can be used as an alternative in the manufacture of vegetable oil.

More and more alternative fuels are being created considering the increasingly limited use of petroleum fuels due to their continuous use due to the growing need for petroleum. Biodiesel is an environmentally friendly alternative fuel made from renewable biological resources such as vegetable oils or animal fats. Vegetable oil has potential as a renewable fuel source, as well as an alternative to petroleum-based fuel (petrodiesel) [7], [8]. Vegetable oil is becoming attractive as a renewable energy source for biodiesel production due to its high availability at low cost [9].

Oil from rambutan seeds can be used as renewable biodiesel because it has properties similar to palm oil [10], [11]. Utilization of waste of rambutan seeds has not been widely carried out due to lack of information about the benefits of its use. One of the efforts that can be done is to identify the nutritional content contained in the seeds by means of proximate analysis of the seeds of several rambutan varieties. Proximate analysis is an analysis that classifies the components contained in a material based on its chemical composition and function [12], [13]. Based on this analysis, it can be seen that the nutritional content contained in rambutan seeds is feasible to be used as a basic ingredient in the manufacture of vegetable oil (biodiesel).

2. MATERIAL AND METHOD

The research was carried out at the Center for Seeds for Food Crops and Horticulture (B2TPH) Karanganyar, to take samples of rambutan seeds on five variety of rambutan from September-December 2020. This research uses a direct survey and descriptive methods. Seed proximate analysis was carried out at the Food and Nutrition Laboratory, Faculty of Agriculture, Sebelas Maret University. Determination of water content using the Thermogravimetric method, mineral content using the Dry method, fat content using the Soxhlet method, protein content using the Kjeldahl method, and carbohydrate content using the by different method. The material used were individuals from 5 varieties consisting of the rapiah, antalagi, binjai, lebak bulus, and sibatuk ganal. Each variety was mashed and weighed as much as 2 grams.

3. RESULT AND DISCUSSION

Based on the results of the research conducted, the result of the proximate analysis of rambutan seeds was obtained as shown in table 1.

Table 1. Result of proximate analysis of rambutan seeds.

Sample Code	Analysis Parameters					
	Water (% wb)	Mineral (% wb)	Ash (% wb)	Fat (% wb)	Protein (% wb)	Carbohydrate (% wb)
Binjai	35,44	1,01	0,99	19,63	1,68	42,24
Siabtuk Ganal	32,68	1,10	1,09	18,89	2,08	45,24
Rapiah	27,18	1,15	1,14	24,15	1,32	46,18
Lebak Bulus	30,60	1,23	1,16	18,70	1,35	48,12
Antalagi	32,14	1,06	1,01	20,88	2,60	43,31

Source: research result

1. Water content

The amount of water content contained in a material expressed in percent (%) based on dry weight is the meaning of water content. Determination of water content of the proximate test on rambutan seeds using the thermogravimetric method. According to [14] the thermogravimetric method uses the principle that the water contened in the material is heated at a temperature of 105 C for a certain time. The result showed that the water content of rambutan seeds ranged from 27,18%-35,44%, this result is almost the same as research conducted by [15] who had research result on the water content of rambutan seeds ranging from 34,2%-34,65.

The result of the average moisture content using the thermogravimteric method showed that the seeds of the binjai variety contained the highest moisture content while the lowest was in the rapiah variety. Binjai has a water content of 35,44%, sibatuk gana has a total water content of 32,68%, antalagi has a total ater content of 32,145, lebak bulus has a water content of 30,60%, and finally the rapiah variety contains the lowest water content as much as 27,18%. According to [16] water content is a very important quality parameter for a product because water content can cause reactions that can reduce the quality of a material. The water content affects the shelf life of the seeds, this is because the amount of free water can be used by microbes for growth. The decrease in water content that occurs in rambutan seeds may occur due to the length of the filtering process so that more water evaporates in the seeds. This is following what was stated by [17], that the longer the filtration time, the less water content will result in the yield will also decrease.

2. Ash Content

Determination of ash content to determine the amount of mineral content contained in rambutan seeds based on dry weight. According to [18], the determination of ash content is related to the mineral content and purity contained in a material. The result showed that the highest ash content of rambutan seeds was found in the lebak bulus at 1,16%, then the rapiah with an ash content of 1,14%, after that sibatuk ganal with an ash content of 1,09%. Varieties with low ash content are found in antalagi with an ash content of 1,01% and binjai with an ash content of 0,99%. According to [19] in his research on oyster mushrooms, the lower the ash content value, the better the quality of the material. By looking at the result of the ash content in rambutan seeds, it can be a benchmark for the mineral content contained in the rambutan seeds. For seeds with high ash content, the mineral content will also be high.

3. Mineral Content

The result showed that the seeds with the highest mineral content were the lebak bulus variety with a mineral content of 1,23%, rapiah with a mineral content of 1,15%, sibatuk ganal with a mineral content of 1,10%, and antalagi with a mineral content of 1,06%. The seeds containing the lowest mineral content were binjai with 1,01% mineral content. The result showed that the ash content was directly proportional to the mineral content the highest ash content value was found in lebak bulus

variety, so that the highest mineral content was also found in lebak bulus. On the other hand, the lowest ash content was found in the binjai variety and the lowest mineral content was also found in the binjai variety. This is in line with the opinion of [20] which states that the value of the ash content contained in the seeds is an illustration of the amount of mineral content contained in rambutan seeds, so it can be said that the seeds that have the highest ash content will be the source of the most minerals.

4. Fat Content

Determination of fat content in the proximate test of rambutan seeds using the soxhlet method. The result showed that the fat content in the five varieties of rambutan seeds (table 1) ranged from 18,70%-24,15%. Other information carried out by [21] in his research, rambutan seeds contain a fairly high-fat content ranging from 37,1%-38,9% and higher fat content compared to mango seed fat content which is only around 6,1%-6,8%. Therefore rambutan seed fat can not only be used to make soap, candles, and fuel but also can be a natural source of edible fat but with proper manufacturing use.

The result also showed that the rapiah variety had the highest fat content, this was presumably because the seeds of the rapiah variety had a light brown color compared to other varieties. This is following [3], [22] in his research which states that generally single light brown rambutan seeds have high levels of fat and oil. And the rapiah has low water content, so the extraction of fat content can run well and produce a high-fat content. If the seeds still contain high water, the solvent will be difficult to enter the tissues/cells and the solvent will become saturated with water so that the fat content extraction process is less efficient [23].

5. Protein Content

The rambutan variety which contains the highest protein content is antalagi as much as 2,6% then sibatuk ganal as much as 2,08%. Binjai variety has a protein content of 1,68% and the last two varieties have a protein content value that is not much different from lebak bulus and rapiah with the total protein content respectively 1,35% and 1,32%. The result showed that the protein content of rambutan seeds ranged from 1,32-2,6%. This is not following [24] who said that rambutan seeds contain protein levels ranging from 7,8%-14,1% based on the dry weight. Table 5 it can be seen that the highest protein content is only 2,6% where the result is very far below the average. This is because the water content in the seeds is very high, causing the protein content in the seeds to decrease.

6. Carbohydrate Content

Based on the result of the study the highest carbohydrate was produced in lebak bulus with 48,12% and the lowest carbohydrate content in binjai with 42,24%. Other varieties such as rapiah have a carbohydrate content of 46,18%, sibatuk ganal with a carbohydrate content of 45,24% and antalagi have a carbohydrate content of 43,31%. Based on the result of the study it was seen that in several analyses, lebak bulus had the highest result in ash content, mineral content, and carbohydrate content. The increase in protein and fat content, as well as ash, was caused proportionally due to the decrease in water[25]. The decrease in water content is caused by the heating process (boiling) which causes the

release of free water from the material. while the highest fat content is in rapiah, because in rapiah the amount of water content is low so that the extraction of fat content can run well and produce high-fat content. If the seeds contain high water, the solvent will be difficult to enter the tissue and the solvent will become saturated with water so that the fat content extraction process is less efficient [26].

4. CONCLUSION

Rambutan seeds contain nutrients such as minerals, protein, fat, and carbohydrates. The highest fat content was found in rapiah variety which was 24,15% and the lowest was in lebak bulus variety which only had 18,7% fat content. the fat content is high so that it can be used as the basic material for biodiesel.

REFERENCES

[1] Mardaleni, H. B. Jumin, A. Yunus, and Nandariyah, "Distribution and mapping pulasan (Nephelium ramboutan-ake Bill. Liinh) in Riau ecosystem zone area," *IOP Conf. Ser. Earth Environ. Sci.*, vol. 905, no. 1, 2021, doi: 10.1088/1755-1315/905/1/012103.

[2] M. S. Ali, H. S. Arifin, and Nurhayati, "Urbanization level and its effect on the structure and function of homegarden (Pekarangan) vegetation in West Java, Indonesia," *Biodiversitas*, vol. 22, no. 1, pp. 173–183, 2021, doi: 10.13057/biodiv/d220123.

[3] U. Issara, W. Zzaman, and T. A. Yang, "Rambutan seed fat as a potential source of cocoa butter substitute in confectionary product," *Int. Food Res. J.*, vol. 21, no. 1, pp. 25–31, 2014.

[4] S. M. Ziaei and K. R. Szulczyk, "Estimating the potential of algal biodiesel to improve the environment and mitigate palm oil mill effluents in Malaysia," *J. Clean. Prod.*, vol. 338, no. January, p. 130583, 2022, doi: 10.1016/j.jclepro.2022.130583.

[5] C. Shao *et al.*, "Rambutan-like hierarchically porous carbon microsphere as electrode material for high-performance supercapacitors," *Carbon Energy*, vol. 3, no. 2, pp. 361–374, 2021, doi: 10.1002/cey2.81.

[6] L. Bai, A. Tajikfar, S. Tamjidi, R. Foroutan, and H. Esmaeili, "Synthesis of MnFe2O4@graphene oxide catalyst for biodiesel production from waste edible oil," *Renew. Energy*, vol. 170, pp. 426–437, 2021, doi: 10.1016/j.renene.2021.01.139.

[7] S. Manikandan, R. Subbaiya, M. Biruntha, R. Y. Krishnan, G. Muthusamy, and N. Karmegam, "Recent development patterns, utilization and prospective of biofuel production: Emerging nanotechnological intervention for environmental sustainability – A review," *Fuel*, no. November, p. 122757, 2021, doi: 10.1016/j.fuel.2021.122757.

[8] S. H. Sedeeq, N. M. T. Al-Layla, and A. B. Fadhil, "Biodiesel production from a non-edible oil, Lipidium sativum L. Seed oil by optimized alcoholysis reaction," *Egypt. J. Chem.*, vol. 64, no. 10, pp. 6075–6087, 2021, doi: 10.21608/ejchem.2021.79680.3915.

[9] M. Abdul Hakim Shaah *et al.*, "A review on non-edible oil as a potential feedstock for biodiesel:

physicochemical properties and production technologies," *RSC Adv.*, vol. 11, no. 40, pp. 25018–25037, 2021, doi: 10.1039/d1ra04311k.

[10] W. Roschat *et al.*, "The synthesis of a high-quality biodiesel product derived from Krabok (Irvingia Malayana) seed oil as a new raw material of Thailand," *Fuel*, vol. 308, no. May 2021, p. 122009, 2022, doi: 10.1016/j.fuel.2021.122009.

[11] W. Wang *et al.*, "Bioenergy development in Thailand based on the potential estimation from crop residues and livestock manures," *Biomass and Bioenergy*, vol. 144, no. May 2020, p. 105914, 2021, doi: 10.1016/j.biombioe.2020.105914.

[12] S. Yousef, J. Eimontas, N. Striūgas, A. Mohamed, and M. A. Abdelnaby, "Morphology, compositions, thermal behavior and kinetics of pyrolysis of lint-microfibers generated from clothes dryer," *J. Anal. Appl. Pyrolysis*, vol. 155, no. January, 2021, doi: 10.1016/j.jaap.2021.105037.

[13] P. Nimmanterdwong, B. Chalermsinsuwan, and P. Piumsomboon, "Prediction of lignocellulosic biomass structural components from ultimate/proximate analysis," *Energy*, vol. 222, p. 119945, 2021, doi: 10.1016/j.energy.2021.119945.

[14] Y. Feng, K. Qiu, Z. Zhang, C. Li, M. M. Rahman, and J. Cai, "Distributed activation energy model for lignocellulosic biomass torrefaction kinetics with combined heating program," *Energy*, vol. 239, p. 122228, 2022, doi: 10.1016/j.energy.2021.122228.

[15] A. Dyjakon, L. Sobol, T. Noszczyk, and J. Mitrega, "The Impact of Torrefaction Temperature on the Physical-Chemical Properties of Residual Exotic Fruit," *energies*, vol. 612, no. 15, 2022.

[16] M. A. Ahmad, M. A. Eusoff, P. O. Oladoye, K. A. Adegoke, and O. S. Bello, "Optimization and batch studies on adsorption of Methylene blue dye using pomegranate fruit peel based adsorbent," *Chem. Data Collect.*, vol. 32, p. 100676, 2021, doi: 10.1016/j.cdc.2021.100676.

[17] N. M. Peixoto Araujo, H. S. Arruda, D. R. P. Marques, W. Q. de Oliveira, G. A. Pereira, and G. M. Pastore, "Functional and nutritional properties of selected Amazon fruits: A review," *Food Res. Int.*, vol. 147, no. May, 2021, doi: 10.1016/j.foodres.2021.110520.

[18] K. Wu, H. Han, C. Rößler, L. Xu, and H. M. Ludwig, "Rice hush ash as supplementary cementitious material for calcium aluminate cement – Effects on strength and hydration," *Constr. Build. Mater.*, vol. 302, no. May, 2021, doi: 10.1016/j.conbuildmat.2021.124198.

[19] S. Marçal *et al.*, "Impact of postharvest preservation methods on nutritional value and bioactive properties of mushrooms," *Trends Food Sci. Technol.*, vol. 110, no. January, pp. 418–431, 2021, doi: 10.1016/j.tifs.2021.02.007.

[20] N. O. Boadi, H. Okyere, M. Badu, J. K. Mensah, and I. Owusu-appiah, "Effect of Mercury on the Proximate Composition of Maize (Zea mays L.)," *J. Agric. Sci. Technol. B*, vol. 3, no. January 2015, pp. 487–492, 2013.

[21] S. S. Kantha and J. W. Erdman, "The winged bean as an oil and protein source: A review," *J. Am. Oil Chem. Soc.*, vol. 61, no. 3, pp. 515–525, 1984, doi: 10.1007/BF02677021.

[22] O. Prakash, M. Karthika Selvi, P. Vijayaraj, and V. B. Kudachikar, “Lipidome, nutraceuticals and nutritional profiling of Pyrus pashia Buch.-ham ex D. Don (Kainth) seeds oil and its antioxidant potential,” *Food Chem.*, vol. 338, no. March 2020, p. 128067, 2021, doi: 10.1016/j.foodchem.2020.128067.

[23] K. Rakariyatham *et al.*, “Synergistic effects of longan (Dimocarpus longan) peel extracts and food additives on oxidative stability of tuna oil,” *Lwt*, vol. 152, no. June, p. 112275, 2021, doi: 10.1016/j.lwt.2021.112275.

[24] M. H. A. Jahurul *et al.*, “Functional and nutritional properties of rambutan (Nephelium lappaceum L.) seed and its industrial application: A review,” *Trends Food Sci. Technol.*, vol. 99, no. March, pp. 367–374, 2020, doi: 10.1016/j.tifs.2020.03.016.

[25] I. Hairunisa *et al.*, “Antioxidant Activities in Different Parts of Pulasan (Nephelium mutabile Blume) from East Borneo,” *IOP Conf. Ser. Earth Environ. Sci.*, vol. 736, no. 1, 2021, doi: 10.1088/1755-1315/736/1/012018.

[26] R. Singh, A. Arora, and V. Singh, “Biodiesel from oil produced in vegetative tissues of biomass – A review,” *Bioresour. Technol.*, vol. 326, no. November 2020, p. 124772, 2021, doi: 10.1016/j.biortech.2021.124772.