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NUTRITIONAL STATUS OF BAROMA RICE IN DIFFERENT COOKING METHODS

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ABSTRACT

Rice is one of the staple foods which is the main source nutrition such as carbohydrates, vitamins, minerals, protein, fat and fiber. The various rice cultivars that have been developed have different nutritional variations so that they provide choices according to the wishes of the community. This study aims to compare the profile of the compound content of Baroma rice in different cooking methods. Baroma rice was chosen in the study because the test for the content of compounds had never been carried out considering that the rice cultivar is a new type. The nutrients such as total protein, total fat, total sugar, starch, and calories were measured in the cooking method using stove and magic com with a completely randomized design and repeated 3 times. The results were analyzed using unpaired t-test analysis for the effect of different cooking methods. The result showed that magic com cooking increases fat and protein content while stove cooking elevates calories, starch, and total sugar.
Keyword : *Baroma variety; cooking method; nutritional status.*

ABSTRAK

Beras merupakan salah satu makanan pokok yang mengandung sumber gizi utama seperti karbohidrat, vitamin, mineral, protein, lemak dan serat. Berbagai kultivar padi yang telah dikembangkan memiliki variasi nutrisi yang berbeda sehingga memberikan pilihan sesuai dengan keinginan masyarakat. Penelitian ini bertujuan untuk membandingkan profil kandungan senyawa beras Baroma pada metode pemasakan yang berbeda. Beras Baroma dipilih dalam penelitian ini karena uji kandungan senyawanya belum pernah dilakukan mengingat kultivar beras tersebut merupakan jenis baru. Kandungan zat gizi seperti protein total, lemak total, gula total, pati, dan kalori diukur pada metode pemasakan menggunakan kompor dan magic com dengan Rancangan Acak Lengkap dan diulang sebanyak 3 kali. Hasilnya dianalisis dengan menggunakan analisis uji-t tidak berpasangan untuk mengetahui pengaruh metode memasak yang berbeda. Hasil penelitian menunjukkan bahwa pemasakan dengan magic com meningkatkan kandungan lemak dan protein, sedangkan pemasakan dengan kompor meningkatkan kandungan kalori, pati, dan gula total.
Kata kunci: metode pemasakan; status nutrisi; varietas Baroma

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INTRODUCTION

Research on the efficacy of a food to meet the nutritional needs of society is increasingly intensive. It is understandable that nutritional intake has a positive effect on health based on (Sepriadi, 2017; Jan et al., 2017). Rice is a staple food that is the main consumption of Asian people, such as in Indonesia (Chun et al., 2015). The need for rice is increasing along with the increase in world population (Kaur et al., 2016), therefore the variety of rice is also becoming more diverse. One cultivar of rice is Baroma, which is a type of Basmati rice grown in Indonesia to provide a wide selection of rice by the Minister of Agriculture of the Republic of Indonesia in 2019. This rice is the result of a cross between a cultivar from Indonesia and a Basmati cultivar from Pakistan using the Pedigree, Bulk and repeated cross selection methods by rice researchers in Indonesia. This cultivar is one of the cultivars that has an aroma and can be used as a substitute for Basmati rice with a pera rice texture (25.55% amylose content) (Sasmita et al., 2019).

Ministry of Agriculture through the Indonesian Rice Research Center (BB Padi) has succeeded in creating the Baroma rice cultivar which can be planted in the lowlands without losing the characteristic size of basmati rice which is longer than rice in general. With the success of growing Baroma rice in Indonesia, it has the advantage of reducing imports, even Baroma rice as a result of breeding from the Ministry of Agriculture has higher productivity than its original cultivar in India. This of course makes Baroma rice have a local taste because it has undergone several generations of breeding so that the cultivar developed by Indonesian scientists has added value. The Indonesian Ministry of Agriculture also stated that the Baroma cultivar has more advantages compared to Basmati from Pakistan, for example it is more pest resistant, has higher productivity, a relatively low glycemic index, and has a distinctive fragrant aroma. Compared to native Basmati from India or Pakistan, Baroma has a higher average yield of 6 t/ha and a potential yield of 9.18 t/ha. Based on this, Baroma Rice could become a new cultivar that has the potential for people to choose for daily consumption because of these advantages.

Many researchers have carried out research related to rice, such as the physiochemical characterization of black rice from West Java by Arifa et al. (2021), public perception of organic rice by Soesilowati et

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al. (2021), and resistant starch in rice by (Ekafitri, 2018). Apart from having a fairly high carbohydrate content, rice contains other nutrients such as vitamins, protein and minerals (Rohman et al., 2014; Chaudhari et al., 2018). Various cultivars of rice are choices according to people's needs, for example pigmented rice which is starting to become popular because it is rich in antioxidants, for example red, brown and black rice. Apart from that, consumption of certain rice varieties and rice cooking methods are often associated with health to avoid diseases such as diabetes mellitus. Research on Basmati rice has also been carried out in several aspects. The flour particles from basmati rice were researched to be finer than the flour particles from non-basmati rice (Jan et al., 2017). Basmati in Somaratne et al. (2017) has 2 variants, namely red pigmented Basmati and white pigmented where the total phenolic acid, total anthocyanin content, and antioxidant activity in red pigmented are higher than white pigmented.

Only a little research has been carried out on Baroma because the cultivar is still new. In Jambi Province, Bobihoe found that Baroma has great potential for planting in irrigated rice fields (Bobihoe et al., 2021). The Baroma variety planted on sub-optimal tidal land in West Kalimantan has a productivity of 3.8 t/ha. The number of grains per panicle and the percentage of grain per panicle of the Baroma variety is significantly greater than the Inpago 9 variety (Subekti et al., 2021). However, in West Nusa Tenggara rice fields, Baroma productivity reached 9.18 T/Ha (Windiyani & Rusdianto, 2020). It can be understood that differences in soil types can affect the production and quality of the rice grains produced. Meanwhile, Arisandi et al. (2020) shows that the viability of Baroma rice seeds is best detected by soaking in 20% bean sprout extract compared to the INPARA 3, Siam Saba and Mutan 14 cultivars. The Baroma cultivar itself is proven to be more resistant to sheath blight than the Inpari 32 cultivar (Milati et al., 2021) so Baroma has the advantage of being a new cultivar introduced to the public. In terms of total phenolic content, Baroma has a content that is no less than the Pamelen, Nutrizinc and Inpari 32 cultivars grown in East Nusa Tenggara (Rahayu et al., 2022). Based on these studies, research regarding the nutritional content of Baroma varieties cooked in different methods has not been documented so far so we investigated Baroma in terms of its nutritional content.

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This study aims to compare the nutritional content of Baroma rice including fat, protein, sugar, starch and calorie content cooked in different cooking methods.

METHOD

The research was conducted at the Biochemistry laboratory at UIN Walisongo Semarang and the Center for Food and Nutrition Studies at Gadjah Mada University. This research uses Baroma rice grown by farmers in the Mijen area, Semarang. A total 200 g of rice was cooked using *liwet* method and another 200 g was cooked using a magic com. Stove cooking takes 30 minutes and cooking using magic com takes 20 minutes until the rice is cooked. The temperature of the rice after cooking is measured using a food thermometer. Rice cooked on the stove has a temperature of 87.8°C and 87.9° C cooked with magic com. After cooking, the rice is tested for total protein, total fat, total sugar, starch and calorie content. Each test was repeated 3 times. The test results for compound content between rice cooked using different methods were analyzed using an independent t-test.

Determination of starch content

Test starch content using the AOAC method (AOAC, 1970). Weigh 1 g of rice in a 250 ml beaker. Add 50 ml of 96% alcohol and stir for 1 hour. Filter the suspension with filter paper and wash with water until the filtrate volume is 250 ml. Quantitatively transfer the residue from the filter paper into an Erlenmeyer by washing with 200 ml of water and adding 20 ml of 25% HCL. Cover with refrigerant and heat over a water bath until boiling for 2.5 hours. Allow to cool and neutralize with 45% NaOH solution and dilute to a volume of 250 ml. Filter the mixture above again on filter paper. Determine the sugar content expressed as glucose from the filtrate obtained. Determination of glucose in the determination of reducing sugar. The weight of glucose multiplied by the conversion factor of 0.9 is the starch content.

Determination of fat content (Soxhlet method)

It is based on Soxhlet method (Hussain, 2023). Samples are hydrolyzed with hydrochloric acid to release bound fats. Then the fat was extracted with dietilether in a Soxhlet extraction apparatus. The diethylether was evaporated and the fat residue in the Soxhlet flask was weighed. Weigh 2-5 g of sample (containing around 200 mg of fat) into a 400 ml beaker. Add 30 ml of 8N hydrochloric acid and 20 ml of distilled water. Boil for 15 minutes (counting

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from the moment it boils). Filter while hot with wet filter paper. Wash the residue with distilled water until it is free from acid (test using litmus paper). Dry the filter paper with the residue in an oven at 100-105ºC. Extract the residue with diethylether (or petroleum ether) using a Soxhlet extraction apparatus, for about 2 hours. Collect the extract in a flask of known empty weight. Evaporate the diethyl ether by reverse cooling distillation. Air the flask containing the fat until it is free of ether. Dry in the oven at 100-105ºC. Cool in a desiccator and weigh. Repeat until a constant weight is produced.

$$fat\ content\ = \frac{C - B}{A}\ x\ 100$$

A: sample weight (g), B: weight of pumpkin fat and fat (g), and C: weight of empty fat flask (g)

Determination of Protein Content (Kjedahl Method)

Principle: The sample is digested with concentrated sulfuric acid using potassium sulfate and mercury oxide as a catalyst (Lim, 1987). The organic nitrogen contained in the sample is converted into ammonium ions, then the ammonium is distilled by adding sodium hydroxide. The nitrogen content in the sample is determined by titration using an acid standard. Weigh approximately 2-5 g (containing approximately 0.04 g N) of sample into a Kjeldahl flask. Add 10 g of anhydrous sulfate, 0.7 g of mercury oxide (or 0.5 g of copper sulfate) and 20 ml of concentrated sulfuric acid. Destroy the sample in an acid chamber over low heat until it no longer smokes. Digestion is continued with higher heat, until the liquid becomes clear Cool. Dissolve the digestion with 50 ml of distilled water and then transfer quantitatively into a distillation apparatus. Connect the distillation apparatus to a 500 ml Erlenmeyer container containing 50 ml of 3% boric acid and a few drops of indicator. Simmer for about 15 minutes. Add excess 60% sodium hydroxide (clear color changes to brown). Distill until the container volume reaches around 200 ml. Titrate the distillation with 0.1N hydrochloric acid. Work on a blank using distilled water instead of sample

Calculation:

$$nitrogen\ content\ = \frac{(V1 - V2)}{B}\ x\ 0{,}0014\ x\ N$$

V1 = the number HCl (ml) used in the sample, V2 = the number of HCl (ml) used in the blank, B = sample weight

Protein content (g/100g) = N x conversion factor

Determination of Total Glucose Content (Nelson-Somogyi Method)

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Determination of Total Sugar Content is based on Nelson-Somogyi method (Bioresource, 2011). It is carried out by preparing 25 ml of sample filtrate and placing it in an Erlenmeyer flask, adding 15 ml of distilled water and 5 ml of HCl. Then heated on a water bath at a temperature of 67-70 °C. Then cool as quickly as possible to a temperature of 20°C. The solution was then neutralized with 45% NaOH and diluted to a volume of 100 ml until the solution contained 2-8 mg/ml reducing sugar. Next, the total amount of sugar is determined based on the OD of the sample solution and the standard curve of the glucose solution.

Determination of Calories Content Calorie Test

The procedure is based on bomb calorimeter (UC Berkeley, 2014). Weigh a 1 g sample into a sample container. Weigh the burning wire and thread. Attach the wire and thread to the bomb calorimeter. Insert 1 ml of distilled water into the calorimeter bomb and sample series as shown in the picture then close the calorimeter tightly. Put oxygen gas into the bomb with a pressure of 20 – 30 bar. The bomb unit was inserted into a chamber filled with 2.1 kg of water. Run the stirrer then observe the thermometer. Once stable, record the temperature shown by the thermometer as the initial temperature. Apply electric current by pressing "Fire" for 5 seconds. Wait until the temperature rises after stabilizing, record it as the final temperature.

(temperature increase = final temperature – initial temperature).

Do the same for standard benzoate acid.

RESULTS AND DISCUSSION

Table 1 shows the result of the tests by independent t-test. The difference of the cooking methods causes a significant result of all test.

Table 1. Content of compound in different cooking method

	Cooking Method	
Test	**"Liwet" method cooking**	**Magic com cooking**
	0,038	0,027
	0,032	0,029
Fat (%)	0,039	0,027
Fat average	**0,0363**	**0,027**
	2,86	2,61
	2,65	2,93
Protein (%)	2,56	3,28

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Test	Cooking Method	
	"Liwet" method cooking	**Magic com cooking**
Protein average	**2,69**	**2,94**
	21,39	19,72
	21,83	20,58
Sugar (%)	21,76	20,42
Sugar average	**21,66**	**20,24**
	4,55	7,23
	4,09	7,73
Starch (%)	4,44	6,43
Starch average	**4,36**	**7,13**
	1093,529	1046,168
	1083,830	1061,358
Calori (Kal/g)	1025,308	1054,949
Calorie average	**1067,567**	**1054,158**

Fat Content

This difference was significant, tested using the t test that the effect of cooking was real. The cooking process greatly influences the nutrients contained in food. Rice resulting from cooking rice on a stove has a greater fat content compared to cooking using magic com. The fat content of rice with stove cooking is 0.0363% while the fat content of rice cooking with magic com is 0.027%. This difference can come from the temperature produced by these two different cooking methods and the different cooking times. Temperature and cooking time can affect the nutritional changes that occur during the process of changing from rice to cooked rice. It is generally known that white rice contains small amounts of fat compared to carbohydrates and protein. However, the cooking process still affects the fat content. The temperature measurement by cooking using a stove was 87.8^{o}C with a duration of 30 minutes. Meanwhile, the temperature measurement using magic com cooking was 87.9^{o}C for 20 minutes. From these results, it can be seen that there is no significant difference in temperature, but in the time required for cooking rice there is a difference in duration. Cooking with a stove takes longer than using magic com. High temperatures cause the decomposition of the fat content. If it was cooked in water, the fat will come out and dissolve with the water. When boiling, fat can be hydrolyzed to produce water-soluble glycerol and fatty acids. Fat hydrolysis is influenced by temperature, water content and high humidity. The fat content in stove cooking is

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higher than the fat content in magic com cooking. This can come from the long cooking time on the stove. The longer cooking time shows that the rice has been exposed to heat longer. The change from rice to rice is greatly influenced by the heating process. When the water used for cooking has boiled, it will enter the rice until the rice becomes rice. During boiling, fat can be hydrolyzed into glycerol and fatty acids. The heating process can reduce the fat content of food by melting the fat, this is caused by the breakdown of fat components into volatile products such as aldehydes, ketones, alcohols, acids and hydrocarbons (Deddy et al., 1992). Klinhom et al. (2016) also stated that high temperatures also cause lipid oxidation thereby reducing the quality of rice in terms of taste, texture, nutrition and appearance (Wang et al., 2023).

Protein Content

Meanwhile, the protein content of different rice processing also causes significant differences. The protein content in stove rice is 2.69% while in magic com rice it is 2.94%. This could be because the cooking process takes longer for stovetop rice, which is around 30 minutes compared to magic com rice which takes around 20 minutes. These results are not in line with research by Hastuti (2019) which shows that differences in cooking methods (steaming, team, pressure cooker and rice cooker) have an effect on water content, ash, carbohydrates, crude fiber, kamba density, water absorption capacity and texture of parboiled instant rice. brown rice but has no effect on the protein, fat, color and aroma of the rice. This can be caused by differences in cooking methods and temperatures used. Vici et al. (2021) shows that protein decreases in Basmati cooked by boiling rather than stewing and microwaving. Rice varieties also determine differences in protein levels. According to Khatoon & Prakash, (2006), the protein content of different rice varieties changes depending on the type of rice and the cooking method used. The protein content of the rice varieties analyzed ranged from 7.5 to 11.6 g/100 g. Cooking resulted in an insignificant difference in the protein content of Gowri sanna and Jeera rice varieties and a significant difference in Bangara Tegalu and Basmati rice. In all four varieties, the protein content of the microwave-cooked samples was lower than the pressure-cooked samples, and the post-test showed that there was a significant difference in the protein content of microwave-cooked Gowri sanna and Basmati. Khatoon & Prakash (2006) also

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stated that the protein content in rice cooked by pressure cooking is greater than in microwave. According to (Sagum & Arcot, 2000), the protein content of Doongara and Inga rice varieties does not show significant changes when cooked, but the Japonica variety shows a significant decrease when boiled and pressure cooked. The value obtained for basmati rice (8.2%) is close to the range of 8.23 to 8.41% reported by Deka et al. (2000) for three Basmati rices. Meanwhile, Indriyani reported that the Ciherang variety had a protein content of 10.73%, higher than the Ciliwung variety at 8.98%.

Total Glucose

According to Waspadji et al. (2003), the higher the temperature and pressure applied to a food ingredient, the easier it is for carbohydrates to be digested. Cooking temperature and cooking time have a significant impact on the physicochemical properties and digestibility of rice starch. Temperature has a more pronounced impact on the rate of change in in vitro digestibility than cooking time (He et al., 2018). The total sugar in stove rice is 21.66, which is greater than magic com rice, namely 20.24. Even though it was measured at relatively the same temperature with a longer cooking time than magic com cooking, apparently the total sugar was still significantly higher in stovetop rice than magic com rice. In the processing process, rice cooked on the stove is cooked by stirring when the cooking process is almost complete. There is a possibility that when we stir it, a lot of the water evaporates compared to cooking magic com where we just wait until it is cooked. This research is in line with (Fadilah, 2018) who stated that prolonged heating treatment will cause the breakdown of starch into simple sugar, namely glucose, so that it can increase the reducing sugar content in brown rice, so this reason is appropriate when associated with our research. The results of research by (Rimbawan & Siagian, 2004) show that prolonged heating can increase the size of starch granules. Where expanding granules increase, free starch molecules are very easily digested. This is because the starch digestive enzymes in the small intestine have a larger surface area to connect with the enzymes, which ultimately causes a rapid increase in blood sugar levels (Sheard et al., 1999). According to Hadwiayh et al. (2018), the effect of heating time in a rice cooker on the reducing sugar content of brown rice shows that the heating time has an effect on the reducing sugar content of brown

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rice. The highest reducing sugar content was obtained in the 16 hours heating treatment, namely 5.01%, while the lowest reducing sugar content was obtained in the 4 hours heating treatment, namely 3.94%. Based on the research results, it shows that the longer the rice cooker is heated, the reducing sugar content in brown rice increases. This is thought to be because the starch content can increase the reducing sugar content. Apart from gelatinization of starch due to heat, a hydrolysis process also occurs where the hydrolysis process breaks down starch molecules into simpler parts such as dextrin, isomaltose, maltose and glucose (Purba. Elida, 2009). Vici et al. (2021) found that total Basmati carbohydrates were smaller in boiling cooking than stewing and microwaving. High temperatures will reduce total carbohydrate sugar as seen in this research. Where closed magic com cooking maintains a stable high temperature so that total sugar is less than stove cooking. However, this research is not in line when compared with research by Juwita et al. (2019) which states that there is no significant difference in total sugar levels in different cooking methods. It could be possible because of the difference in the cultivar used in the research.

Starch Content

The starch in stovetop rice is 4.36 and in magic com rice is 7.13 which indicates greater cooking of magic com. This research is in line with research by Guillén et al. (2018) which also found that Basmati rice cooked using a temperature of 95°C for 100 minutes had less starch content than cooking it at a temperature of 100°C for 8 minutes. However, this research does not have significant figures. The cooking process can reduce the amount of amylose which is part of starch. This is possible due to the dissolution of amylose in water. Sagum & Arcot (2000) studied that the amylose content after boiling decreased, but it was not statistically significant. In this research, it seems that the Aromatic Basmati cultivar that we chose has significant value. Just like protein levels, the cooking process for a longer time can break down the amylose in starch. The heating process at a higher temperature will change the form of gelatinized starch so that more starch granules will be damaged. Not only in the process of cooking rice into rice, Chun et al. (2015) stated that increasing temperature can reduce amylose content and short amylose bonds also increase intermediate amylopectin bonds at increasing grain ripening

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temperatures. This is because GBSSI gene expression decreases so that amylose levels also decrease. Cheng *et al.* (2005) stated that starch content increased in the endosperm of the cultivars Jia 935 and Jia 353. Vici *et al.* (2021) stated, that it was seen that the amylose of Basmati rice also decreased when the rice was cooked at a boiling temperature rather than stewing. Likewise, Adi et al. (2020) showed that the protein in brown rice cooked using the conventional method is significantly higher than in a rice cooker.

Calories Content

Meanwhile, the average value of the calories analyzed for stove-cooked rice was greater than that of magic com cooked rice. This shows that the cooking method apparently influences the calorie content in rice. Like the data in the research, the temperatures for cooking stoves and magic com are not too different. The difference can only be seen in the cooking time, where cooking using a stove takes longer because it has to be stirred to be completely cooked. Calorie restriction can delay aging, reducing the incidence of diseases that accompany aging such as obsession, hypertension and diabetes mellitus. Calorie restriction will reduce IGF-1 and increase corticosteroid levels, thereby reducing the incidence of cancer (Al-Regaiey, 2016). Temperatures higher than 84℃ can reduce the physical quality of amylose and amylopectin (Adi et al., 2020). Seeing the results of this research, it is recommended that cooking using a magic com produces fewer calories than a stove for good body health. Apart from that, this research can be continued with additions to cooked rice, such as adding coconut oil with the hope that the calories produced do not exceed levels that the body can tolerate. However, if the household only has a stove to cook rice, cooked rice can be cooled to reduce calories.

CONCLUSION

The two Baroma rice cooked using the stove and magic com cooking methods affect the content of nutrients significantly. Magic com cooking increases fat and protein content while stove cooking elevates calories, starch, and total sugar. We recommend to do further research by varying another cooking methods to get the best cooking. Besides, we also could test another nutrients in several cooking methods.

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REFERENCES

Adi, A. C., Rifqi, M. A., Adriani, M., Farapti, F., Haryana, N. R., & Astina, J. (2020). Effect of Cooking Methods and Rice Variety on the Sensory Quality and Consumer Acceptance. *Media Gizi Indonesia*, *15*(3), 159. https://doi.org/10.20473/mgi.v15i3.159-166

Al-Regaiey, K. A. (2016). The effects of calorie restriction on aging: a brief review. *European Review for Medical and Pharmacological Sciences*, *20*(11), 2468–2473.

Association of Official Analytical Chemists (AOAC), "Official Methods of Analysis," 10th Edition, Washington D.C., 1970, pp. 154-170.

Arifa, A. H., Syamsir, E., & Budijanto, S. (2021). Karakterisasi Fisikokimia Beras Hitam (Oryza sativa L.) dari Jawa Barat, Indonesia. *AgriTECH*, *41*(1), 15. https://doi.org/10.22146/agritech.53307

Arisandi, N., Wahdah, R., & Rusmayadi, G. (2020). Peningkatan performa viabilitas benih beberapa varietas padi (Oryza sativa L.) dengan organik priming ekstrak tauge. *EnviroScientae*, *16*(2), 309–317. http://www.unpcdc.org/media/15782/sustainable procurement practice.pdf%0Ahttps://europa.eu/capacity4dev/unep/document/briefing-note-sustainable-public-procurement%0Ahttp://www.hpw.qld.gov.au/SiteCollectionDocuments/ProcurementGuideIntegratingSustainabilit

Bobihoe, J., Jumakir, & Endrizal. (2021). Improving rice productivity through the new superior varieties of rice in the irrigation land, Jambi Province. *IOP Conference Series: Earth and Environmental Science*, *807*(4). https://doi.org/10.1088/1755-1315/807/4/042001

Bioresource. 2011. Determination of Reducing Sugars by Nelson-Somogyi Method. https://bioresource.in/2011/04/determination-of-reducing-sugars-by-nelson-somogyi-method/ (Acessed 2 July 2023)

Chaudhari, P. R., Tamrakar, N., Singh, L., Tandon, A., Sharma, D., & Prabha Chaudhari, C. R. (2018). Rice nutritional and medicinal properties: A review article. *Journal of Pharmacognosy and Phytochemistry*, *7*(2), 150–156.

Cheng, F., Zhong, L., Zhao, N., Liu, Y., & Zhang, G. (2005). Temperature induced changes in the starch components and biosynthetic enzymes of two rice varieties. *Plant Growth Regulation*, *46*(1), 87–95. https://doi.org/10.1007/s10725-005-7361-6

Chun, A., Lee, H. J., Hamaker, B. R., & Janaswamy, S. (2015). Effects of ripening temperature on starch structure and gelatinization, pasting, and cooking properties in rice (Oryza sativa). *Journal of Agricultural and Food Chemistry*, *63*(12), 3085–3093. https://doi.org/10.1021/jf504870p

Deddy, N. S. P., Palupi, N. S., & Astawan, M. (1992). Metoda Kimia Biokimia dan Biologi dalam Evaluasi Nilai Gizi Pangan Olahan. In *Departemen Pendidikan dan Kebudayaan Direktorat Jenderal Pendidikan Tinggi Pusat Antar Universitas Pangan dan Gizi Institut Pertanian Bogor*.

DOI 10.20884/1.jgipas.2024.8.2.12808

Deka, S. C., Sood, D. R., & Gupta, K. R. (2000). Nutritional Evaluation of Basmati Rice (Oryza sativa L.) Genotypes. *Journal of Food Science and Technology*, *37*(3), 272–276.

Ekafitri, R. (2018). Pati Resisten pada Beras : Jenis, Metode Peningkatan, Efek untuk Kesehatan, dan Aplikasinya. *Jurnal Pangan*, *26*(3), 55–70.

Fadilah, N. (2018). *Pengaruh penambahan air terhadap kualitas nasi beras merah dengan metode pemasakan menggunakan rice cooker*. Universitas Mataram.

Guillén, S., Oria, R., & Salvador, M. L. (2018). Impact of Cooking Temperature on in Vitro Starch Digestibility of Rice Varieties with Different Amylose Contents. *Polish Journal of Food and Nutrition Sciences*, *68*(4), 319–325. https://doi.org/10.2478/pjfns-2018-0001

Hadwiayh, R., Yasa, W., & Sulastri, Y. (2018). Pengaruh Lama Penghangatan Alat Pemasak Nasi Terhadap Muru Nasi Beras Merah (Oryza Nivara). In *Artikel Ilmiah* (pp. 1–12).

Hastuti, N. H. P. D. (2019). *Karakteristik Fisikokimia dan Sensori Nasi Instan Pratanak Dari Beras Pecah Kulit (Brown Rice) Berdasarkan Variasi Metode Pemasakan*. Universitas Muhammadiyah Semarang.

He, M., Qiu, C., Liao, Z., Sui, Z., & Corke, H. (2018). Impact of cooking conditions on the properties of rice: Combined temperature and cooking time. *International Journal of Biological Macromolecules*, *117*, 87–94. https://doi.org/10.1016/j.ijbiomac.2018.05.139

Hussain, Ghulam. 2023. https://www.researchgate.net/publication/372658021_Soxhlet_Extraction_principal_working_Usage (Acessed 5 July 2023)

Jan, S., Ghoroi, C., & Saxena, D. C. (2017). A comparative study of flow properties of basmati and non-basmati rice flour from two different mills. *Journal of Cereal Science*, *76*, 165–172. https://doi.org/10.1016/j.jcs.2017.05.016

Juwita, L., Keperawatan, F., Katolik, U., & Surabaya, W. M. (2019). The Difference in the Glucose Levels of Rice Cooked with Rice Cooker and Steaming Perbedaan Kadar Glukosa Nasi yang Dimasak dengan Rice Cooker dan Mengukus. In *Jurnal Kesehatan Primer* (Vol. 101, Issue 2, pp. 107–113).

Kaur, B., Ranawana, V., & Henry, J. (2016). The Glycemic Index of Rice and Rice Products: A Review, and Table of GI Values. In *Critical Reviews in Food Science and Nutrition* (Vol. 56, Issue 2, pp. 215–236). https://doi.org/10.1080/10408398.2012.717976

Khatoon, N., & Prakash, J. (2006). Nutritional quality of microwave and pressure cooked rice (Oryza sativa) varieties. *Food Science and Technology International*, *12*(4), 297–305. https://doi.org/10.1177/1082013206068036

Klinhom, P., Klinhom, J., & Methawiwat, S. (2016). Effect of Different Cooking Method on Cooking Loss and Lipid Oxidation in Buffalo Meat. *Applied Mechanics and Materials*, *855*, 70–74. https://doi.org/10.4028/www.scientific.net/amm.855.70

DOI 10.20884/1.jgipas.2024.8.2.12808

Lim, P.Y. 1987. Protein Determination by Kjehdahl Method. https://aquadocs.org/handle/1834/40994 (Accessed 2 July 2023)

Milati, L. N., Nuryanto, B., & Sumarlin, U. (2021). The Relationship between Sheath Blight Disease Incidence, Disease Severity, and Rice Yield. *Jurnal Fitopatologi Indonesia*, *17*(3), 113–120. https://doi.org/10.14692/jfi.17.3.113-120

Purba. Elida. (2009). Hidrolisis Pati Ubi Kayu (Manihot Esculenta) dan Pati Ubi Jalar (Impomonea batatas) menjadi Glukosa secara Cold Process dengan Acid Fungal Amilase dan Glukoamilase. In *Universitas Lampung, Lampung*.

Rahayu, E., Fitrotin, U., Hilmiati, N., Fitrahtunnisa, & Untung, S. (2022). Rice as one of antioxidant source for farming family in COVID-19 pandemic: A case study from West Nusa Tenggara Indonesia. *IOP Conference Series: Earth and Environmental Science*, *1107*(1). https://doi.org/10.1088/1755-1315/1107/1/012120

Rimbawan, & Siagian, A. (2004). *Indeks Glikemik pangan, cara mudah memilih pangan yang menyehatkan*. Penebar Swadaya.

Rohman, A., Helmiyati, S., Hapsari, M., & Setyaningrum, D. L. (2014). Rice in health and nutrition. *International Food Research Journal*, *21*(1), 13–24.

Sagum, R., & Arcot, J. (2000). Effect of domestic processing methods on the starch, non-starch polysaccharides and in vitro starch and protein digestibility of three varieties of rice with varying levels of amylose. *Food Chemistry*, *70*(1), 107–111. https://doi.org/10.1016/S0308-8146(00)00041-8

Sasmita, P., Satoto, Rahmini, Agustiani, N., Handoko, D. D., Suprihanto, Guswara, A., & Suharna. (2019). *Deskripsi Varietas Unggul Baru Padi.*

Sepriadi. (2017). Pengaruh motivasi berolahraga dan status gizi terhadap tingkat kebugaran jasmani. *Jurnal Penjakora*, *4*(1), 77–89.

Sheard, P. R., Nute, G. R., Richardson, R. I., Perry, A., & Taylor, A. A. (1999). Injection of water and polyphosphate into pork to improve juiciness and tenderness after cooking. *Meat Science*, *51*(4), 371–376. https://doi.org/10.1016/S0309-1740(98)00136-3

Soesilowati, E., Kariada, N., & Mutiatari, D. (2021). Consumer's Perception and Opinion Toward Organic Rice Products. *ICE-BEES*, 1–12. https://doi.org/10.4108/eai.27-7-2021.2316928

Somaratne, G. M., Prasantha, B. D. R., Dunuwila, G. R., Chandrasekara, A., Wijesinghe, D. G. N. G., & Gunasekara, D. C. S. (2017). Effect of polishing on glycemic index and antioxidant properties of red and white basmati rice. *Food Chemistry*, *237*, 716–723. https://doi.org/10.1016/j.foodchem.2017.06.002

Subekti, A., Kartinaty, T., & Muflih, M. A. (2021). Keragaan varietas unggul baru padi pada lahan sub optimal pasang surut di Kalimantan Barat. *Jurnal Ilmiah Hijau Cendekia*, *6*(1), 6.

UC Berkeley. 2014. Bomb Calorimetry and Heat of Combustion. https://www.ocf.berkeley.edu/~jmlvll/lab-reports/calorimetry/calorimetry.pdf (Acessed 4 July 2023)

DOI 10.20884/1.jgipas.2024.8.2.12808

Vici, G., Perinelli, D. R., Camilletti, D., Carotenuto, F., Belli, L., & Polzonetti, V. (2021). Nutritional properties of rice varieties commonly consumed in Italy and applicability in Gluten free diet. In *Foods* (Vol. 10, Issue 6). https://doi.org/10.3390/foods10061375

Wang, D., Xiao, H., Lyu, X., Chen, H., & Wei, F. (2023). Lipid oxidation in food science and nutritional health: A comprehensive review. *Oil Crop Science*, *8*(1), 35–44. https://doi.org/10.1016/j.ocsci.2023.02.002

Waspadji, S., Suyono, S., Sukardji, K., & Moenarko, R. (2003). *Indeks Glikemik Berbagai Makanan Indonesia Hasil Penelitian.*

Windiyani, H., & Rusdianto, S. W. (2020). Keragaman Varietas Unggul Baru Padi Fungsional Mendukung Ketahanan Pangan dalam Menghadapi Pandemi COVID-19. *Seminar Nasional Lahan …*, 978–979. http://www.conference.unsri.ac.id/index.php/lahansuboptimal/article/view/1964

DOI 10.20884/1.jgipas.2024.8.2.12808