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# PHYSICOCHEMICAL CHARACTERISTICS OF BLACK RICE BRAN OIL BASED ON STABILIZED OVEN WITH MACERATION EXTRACTION

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**ABSTRACT**

The main problem in the utilization of bran into rice bran oil is that it is easy to rancid because of the high lipase enzyme content. The preheating process on the bran using an oven serves to inactivate the lipase enzyme and increase oil yield. Aim this research is to find out the effect of preheating temperature and preheating time on physical properties (yield, color, and melting point) and chemical properties (free fatty acid, antioxidant activity, phenol levels, and fatty acid profiles) crude black rice bran oil (Oryza sativa L.) cultivar Mutiara. The experimental design used Complete Randomized Design (CRD) with two factors, the temperature and time heating. The research was analyzed using One Way Anova with significance level α = 0,05. The research showed variations in temperature and preheating time had a significant effect on the physical and chemical characteristics of crude black rice bran oil. The preliminary heating treatment at 110°C for 10 minutes is the best treatment. The physical characteristics of yield 9,62%, color is obtained value L* 33,70, a* 2,99, b* 1,08, and whiteness degree 33,62 and melting point 28,50-34,50°C. Chemical characteristics free fatty acid level 18,43%, antioxidant activity 76,69%, and phenol level 0,46%. The fatty acid profiles selected black rice bran oil cultivar Mutiara is myristoleic acid 0,44%, palmitoleic acid 20,04%, elaidic acid 2,01%, linoleic acid 34,91%, linolelaidic acid 0,32%, γ-linolenic acid 38,37%, α-linolenic acid 2,88%, eicosanoic acid 0,65%, and eicosadienoic acid 0,38%. Based on these results, black rice bran oil is suitable for use as cooking oil and oleogel which is applied to fat and oil based spread products.

## 1-Introduction

Based on the Central Statistics Agency (BPS), rice production in 2024 will be around 52.66 million tons of dry milled grain (GKG) with a rice harvest area of 10.05 million hectares. Black rice is rice that has not been milled in large quantities so that the epidermis layer is still intact and has a high fiber content. The difference between black rice and other rice is that it is high in anthocyanins which cause the color to be dark purple or blackish, black rice has a denser and chewier texture with a stronger and more savory taste.

In Indonesia, black rice can be planted in several areas, such as Subang, Indramayu, Sleman, Malang, Purwokerto, and Tana Toraja. Black rice has nutritional content such as minerals, calcium, magnesium, zinc, phosphorus, and vitamins. Black rice also has protein and dietary fiber, which are higher than brown and white rice. In addition, black rice has phytochemical compounds, such as anthocyanins and oryzanol [1]. The black color of the rice is due to the presence of anthocyanin pigments in it which function to prevent DNA damage and degeneration and hardening of the arterial endothelium [2]. Black rice is able to function as antioxidants and prevent diabetes, atherosclerosis, obesity, and cancer [3].

In the process of rice milling, rice bran is about 8–10% of the rice grain and underutilized product [4]. Rice bran has a high protein content (11–15%) and high dietary fiber (7–11%). Furthermore, Rice bran contains approximately 20% lipids [5]. Rice bran oil has attracted attention for its unique nutraceutical properties and fatty acid content. Oleic, linoleic, and palmitic acids were the most common free fatty acids detected in rice bran samples [6].

Rice bran contains 18-22%. RBO contains a range of fatty acids, with 47% monounsaturated, 33% polyunsaturated and 20% saturated. Rice bran oil also has bioactive components such as phenolic compound (oryzanol, ferulic acid) and vitamin E (tocopherol and tocotrienol), that show numerous biological activities by acting as antioxidant, anti-diabetic, anti-carcinogenic, antiatherogenic and antihyperlipidemic agents [7, 8]. Rice bran oil is obtained through an extraction process using solvents, which one of them used maceration. The maceration method is a cold extraction method that does not require heating during the process. By using maceration method, flavonoid and anthocyanin compounds that are heat sensitive will be protected from being damaged or decomposed [9, 10, 11]. Ethanol has also been proposed as an alternative solvent for extraction because it is non-toxic, has good extractability, and prevents partial or total hydrolysis of stronger flavonoid and anthocyanin compounds [11]. This study examines the stabilization of the dry method using an oven followed by maceration extraction with ethanol solvent on the physical properties (yield, color and melting point) and chemical properties (free fatty acids, antioxidant activity, phenol and fatty acid profile). The study of the effect of temperature and initial heating time was also carried out in order to obtain the optimal yield of rice bran oil and obtain functional compounds.

## 2-MATERIALS AND METHODS

Materials

The main material used in this study was black rice bran of the Mutiara cultivar obtained from Mojogedang, Karanganyar Regency. The main chemical used for the study were Folin ciocalteau, distilled water, methanol, sodium carbonate or Na2CO3, pure phenol, 96% ethanol solvent, DPPH and methanol solutions, Whatman filter paper,
0.05 N NaOH, phenolthalein indicator (PP), distilled water, alcohol (Merck). The tools used were a 60-mesh sieve, oven (Memmert), evaporator flask (Schott Duran), magnetic stirrer, thermometer, condenser (Iwaki-Pyrex) and hot plate (Heidolph MR 3001 K) and rotary evaporator (Buchi R-215) equipped with a V-700 vacuum pump.

Procedures

The main stage performed is milling. Black rice bran is still very rough and clumpy. Therefore, it is necessary to carry out a sieving process using a 60 mesh size
[12] to obtain black rice bran with a soft and smooth texture. The next stage is stabilization of black rice bran. The sifted bran is put into the oven and heated using treatment temperatures in 50°C, 80°C and 110°C for time treatment 10, 20 and 30 minutes. Stabilization with preliminary heating aims to inactivate lipase and lipoxygenase activity because rice bran contains enzymes that are still active, increase the efficiency of oil extraction, and sterilize the rice bran [13]. . The selection of variations in temperature treatment and initial heating time took into account Hadipernata (2007) who stated that in rice bran, a temperature of 100-120ºC is required to deactivate lipase. Stabilization using an oven can increase the shelf life of bran and can prevent damage caused by oxidative stress [14].

The final stage is carried out by extraction with a maceration method. The stabilized black rice bran is then extracted using maceration methods with 96% ethanol solvent with a ratio of material:solvent of 1:3 (250 gram rice bran : 750 gram solvent). Furthermore, the black rice bran that has been added with 96% ethanol is left to stand/macerate for 24 hours. The filtration process is carried out using a vacuum pump coated with filter paper, the filtration results are collected in an Erlenmeyer flask. The filtrate is evaporated to separate the black rice bran oil and the solvent. The evaporation process uses a Rotary Evaporator Vacuum at a temperature of 50˚C with a pressure of ±500-700 mmHg to produce crude black rice bran oil. In this research, physical and chemical testing was carried out as followed:

Physical characteristic of black rice bran oil

Black rice bran oil was subjected to physical analysis consisting of color analysis with L*, a*, b* method using Chromameter Konica Minolta CR-400 [15]. This method involves measuring L* (lightness), a* (redness/ greenness), and b* (yellowness/ blueness) values to quantify color properties. L* represents the lightness of a color, ranging from 0 (black) to 100 (white). a* indicates the degree of redness (+ values) or greenness (- values), while b* indicates the degree of yellowness (+ values) or blueness (- values).

Yield analysis of rice bran oil is calculated based on the comparison of the weight of the oil produced with the initial weight of the material (rice bran) multiplied by 100%. The higher the yield value produced indicates the value of the rice bran oil produced is greater. [19]. Melting point analysis using Slip Melting Point [20]. The sample is heated in a capillary tube at a controlled rate. The temperature at which the fat column in the capillary tube begins to rise is recorded as the slip melting point.

Chemical characteristic of black rice bran oil

Chemical analysis consisted of free fatty acid analysis using alkalimetric titration method [21]. In this experiment, we measured the free fatty acid (FFA) levels of the ethanol layer obtained from the extraction process using the acid-base titration method. Mutista 2024 research says, the FFA concentration is calculated by titrating with a standard sodium hydroxide (NaOH) solution, which neutralizes the FFA present in the oil.

Antioxidant content analysis using DPPH method [4,34]. DPPH solution is made by dissolving DPPH crystals in methanol p solvent. a. at a concentration of 1 mM. The process of making a 1 mM DPPH solution is carried out at a low temperature and kept away from sunlight. Next, 4.50 ml of the extract solution and BHT antioxidant solution were taken each, then mixed with 500 µl of 1 mM DPPH solution in a separate test tube. The reaction took place at a temperature of 37°C for 30 minutes, after which the absorbance was measured using a UV-VIS spectrophotometer at a wavelength of 517 nm.

Phenol content analysis using folin ciocalteu method [22]. The phenol sample of black rice bran oil was reacted with Folin-Ciocalteu reagent. The hydroxyl group of phenol will react with the reagent, forming a blue complex. The total phenol content was calculated based on the absorbance obtained and the gallic acid calibration curve.

Determination of the best treatment

Determination of the best treatment was carried out using an effectiveness index test or weighting test. The principle of the test carried out is to provide a weight value (score) according to the contribution of a characteristic to the stabilization treatment used. Determination of the weighting test or effectiveness index has a procedure, namely sorting variables based on priority and contribution to the results. Giving a weight value to each variable (VW) according to its contribution with a relative number of 0-1. This weight differs depending on the importance of each variable whose results are obtained as a result of the treatment. Normal weight (NW) is determined from each variable by dividing the variable weight (VW) by the total variable weight.

$$Effectiveness\ value\ (EV) = \frac{Treatment\ value - Lowest\ value}{Highest\ value - Lowest\ values}$$

$$Result\ value\ (RV) = \text{EV x NW}$$

The Best of Rice Bran Oil Fatty Acid Profile Fatty acid profile analysis using Gas Chromatography in best treatment [4, 35]. Fatty acid profile testing also compared the best treated black rice bran oil with commercial rice bran oil "Oryza Grace".

## 3-RESULTS AND DISCUSSION

Physical Characteristics of Black Rice Bran Oil

Analysis of physical properties of black rice bran oil aims to determine the physical characteristics of black rice bran oil that has been stabilized using an oven. In addition, testing the physical properties of oil also serves to determine the level of damage to the oil it self.

Table 1. Physical Characteristics of Black Rice Bran Oil

| Treatment | Yield (%) | Color | | | | Melting Point Degree(°C) |
|---|---|---|---|---|---|---|
| | | Brightness (L*) | Redness (a*) | Yellowish (b*) | White (h0) | |
| H1 | 5,23±0,09a | 35,07±0,39f | 3,25±0,09e | 2,02±0,06g | 34,95±0,39f | 25,75-30,25 |
| H2 | 5,99±0,24b | 34,67±0,24ef | 3,16±0,08de | 1,95±0,06g | 34,56±0,24ef | 26,50-30,50 |
| H3 | 6,44±0,07c | 34,38±0,29de | 3,14±0,08cde | 1,69±0,05f | 34,28±0,28de | 26,75-30,75 |
| H4 | 6,82±0,06d | 34,10±0,19cd | 3,10±0,05bcd | 1,55±0,09e | 34,01±0,20cd | 27,25-31,25 |
| H5 | 7,70±0,08e | 34,05±0,28cd | 3,06±0,09bcd | 1,34±0,07d | 33,96±0,28cd | 28,00-32,75 |
| H6 | 8,40±0,12f | 34,02±0,31cd | 3,01±0,07abc | 1,18±0,05c | 33,94±0,31cd | 28,25-34,00 |
| H7 | 9,62±0,19i | 33,70±0,22bc | 2,99±0,13ab | 1,08±0,05b | 33,62±0,21bc | 28,50-34,50 |
| H8 | 9,19±0,12h | 33,30±0,19b | 2,92±0,04b | 0,97±0,05ab | 33,22±0,19b | 29,25-34,75 |
| H9 | 8,77±0,02g | 32,57±0,27a | 2,90±0,07a | 0,95±0,09a | 32,50±0,27a | 29,75-35,25 |

Notes:
Values followed by different letters in the same column indicate a significant difference at a significance level of 0.05.

H1: 50°C for 10 minutes H6: 80°C for 30 minutes
H2: 50°C for 20 minutes H7: 110°C for 10 minutes
H3: 50°C for 30 minutes H8: 110°C for 20 minutes
H4: 80°C for 10 minutes H9: 110°C for 30 minutes H5: 80°C for 20 minutes

In Table 1, the results of the yield analysis obtained showed that the crude black rice bran oil had an oil yield value ranging from 5.23-9.62%. Sample H1 had the lowest oil yield value of 5.23%, while the highest oil yield value was found in sample H7, which was 9.62%. Based on the results obtained, it showed that variations in temperature and preheating time on black rice bran produced significantly different crude black rice bran oil yield values in each treatment. The stabilization treatment carried out on rice bran can increase the yield value of the rice bran oil produced [16]. Treatment at a temperature of 50°C for 10 minutes obtained the lowest yield value compared to all treatments, while treatment at a temperature of 110°C for 10 minutes obtained the highest yield value. However, in samples H8 and H9, the yield value decreased. This shows that heating at high temperatures and long times exceeding the optimal limit will decrease the yield value. Adding heating time at the optimal temperature and time will reduce the rice bran oil yield value [8].

Based on the L* value, a* value, b* value and whiteness value obtained (Table 1.), it shows that the crude black rice bran oil has a yellowish-brown color that tends to be dark. This is same with Islamic research [17], that the extraction of white rice bran oil using ethanol solvent produces yellowish-brown oil. The crude black rice bran oil resulting from extraction with variations in temperature and preliminary heating time can be seen in Fig.2.

At a temperature of 50°C for 10 minutes (H1), the highest whiteness value was obtained compared to other samples. Preheating rice bran oil at a low temperature and a short time will prevent a decrease in color in rice bran oil due to the low maillard reaction due to low temperatures in a short time. At a temperature of 110°C for 30 minutes (H9), the whiteness value was the lowest compared to other heating treatments. The maillard reaction will cause the color of rice bran oil to become darker than rice bran heated at low temperatures. In rice bran oil, the main color pigments are β-carotene and chlorophyll. The pigment content in rice bran oil varies depending on the type of rice bran. Maillard reaction can occur with increasing heating temperature of rice bran. Maillard reaction in rice bran will cause the color of the oil to become darker

and give a brownish color. This happens because the extraction process that lasts too long can cause excessive heating of the oil, so that the extracted oil can be damaged. According to Jambe et al (2019), the decrease in yield value was caused by the loss of compounds that were not resistant to heat due to oxidation.

Fig 2. Color of Black Rice Bran Oil Samples with Variation of Heating Temperature and Time Introduction

The lowest melting point value was obtained in sample H1 (temperature 50°C for 10 minutes) which is in the range of 25.75-30.25°C. The highest melting point value was obtained in sample H9 (temperature 110°C for 30 minutes) which is in the range of 29.75-35.25°C. These results indicate that the higher the temperature and the longer the preheating time will increase the melting point value of black rice bran oil of Mutiara cultivar. The high melting point of oil is due to the longer carbon chain in fatty acids, increasing saturation of fatty acids and having straighter (trans) bonds. The melting point increases with the increasing length of the carbon chain so that the bonds between molecules become strong and not easily broken. The shorter the carbon chain and has a double bond causes the bond to be less strong and easily broken so that the lower the melting point value of the oil.

Chemical Characteristics of Black Rice Bran Oil

Analysis of chemical properties of black rice bran oil aims to determine the nutritional content of black rice bran oil and stabilize the lipase content in bran that has been stabilized using a heating method using an oven. This chemical property analysis includes free fatty acid levels, antioxidant levels and phenol levels.

Table 2. Chemical Characteristics Analysis of Black Rice Bran Oil

| Treatment | Free Fatty Acid (%) | Antioxidant (%) | Fenol (%) |
|---|---|---|---|
| H1 | 25,65±0,29i | 72,27±0,45a | 0,21±0,010a |
| H2 | 24,98±0,27h | 72,63±0,62ab | 0,23±0,003b |
| H3 | 23,71±0,23g | 73,70±0,98bc | 0,28±0,012c |
| H4 | 22,90±0,20f | 74,64±0,94cd | 0,31±0,012d |
| H5 | 21,98±0,27e | 75,45±0,95de | 0,35±0,015e |
| H6 | 20,63±0,15d | 75,90±0,50e | 0,40±0,007f |
| H7 | 18,43±0,11c | 76,69±0,84e | 0,46±0,003h |
| H8 | 17,49±0,17b | 76,28±0,86e | 0,44±0,010g |
| H9 | 16,48±0,09a | 75,40±0,94e | 0,41±0,009f |

Notes:
Values followed by different letters in the same column indicate a significant difference at a significance level of 0.05.
H1: 50°C for 10 minutes
H2: 50°C for 20 minutes
H3: 50°C for 30 minutes
H6: 80°C for 30 minutes
H7: 110°C for 10 minutes
H8: 110°C for 20 minutes

H4: 80°C for 10 minutes H9: 110°C for 30 minutes H5: 80°C for 20 minutes

Based on these data, the results of the H9 sample analysis have the lowest free fatty acid value of 16.48%, while the highest free fatty acid value is found in sample H1, which is 25.65%. In the findings obtained by Dunford [30] rice bran oil has a free fatty acid content of 33.3% to 40%. The results of the study showed that the higher the temperature and heating time, the lower the free fatty acid value of rice bran oil. The same results were also stated by Hashem et al. [18], the higher the temperature and the longer the stabilization time of rice bran, the lower the free fatty acid value of rice bran oil. This shows that heat stabilization treatment of black rice bran is effective in inactivating the lipase enzyme so that the free fatty acid content of black rice bran oil becomes low.

Antioxidants are one of the flavonoid compound groups. The flavonoid compound group includes anthocyanins which are glycone forms of anthocyanidins. Anthocyanins found in plants act as antioxidants. Black rice bran contains tocols (tocopherols and tocotrienols). The results of the analysis showed that sample H7 had the highest antioxidant activity value of 77.72%, while the lowest antioxidant activity value was found in sample H1 at 72.27%. The higher the temperature and the preheating time will increase the antioxidant content of black rice bran oil, however, at the maximum heating temperature, increasing the preheating time will result in a decrease in the antioxidant content of rice bran oil. The same results were also stated by Demak et al. [23], the higher the oven temperature, the higher the antioxidant levels. This is due to the formation of new antioxidants during the oven process, namely melanoidin from the Maillard reaction. However, antioxidants decrease when they exceed the optimum temperature and time. This is due to the degradation of antioxidant compounds which are easily damaged by their nature.

The results of the phenol content analysis showed that the phenol content of crude black rice bran oil ranged from 0.21% -0.46%. In general, Hartati (2023) says the effectiveness of phenolic compounds as antioxidants is influenced by several factors. These include the bonding of the hydroxyl group on the aromatic ring, the position of this bond, and the alternating positions of the hydroxyl group on the aromatic ring. Apart from that, the ability of this compound to donate hydrogen or electrons also plays an important role, as does its ability to overcome free radicals. The results of the H7 sample analysis had the highest phenol content of 0.46%, while the lowest phenol content was found in sample H1, which was 0.21%. The results of the study obtained the phenol content of black rice bran oil has a positive correlation with the level of antioxidant activity where the higher the phenol content, the higher the antioxidant activity level. These results are similar to the findings of Wani et al. [24], phenol content can increase during the oven process, allegedly due to the effect of heat induction on the extracted phenolic compounds and ovens caused by the Maillard reaction with the production of many compounds that have shown antioxidant activity can react with the Folin-Ciocalteu reagent.

Determining the Best Treatment

Determination of the highest and lowest values for each parameter is based on the desired quality of rice bran oil. In physical parameters, the desired yield of black rice bran oil is a high yield value. In other physical parameters, namely color, black rice bran oil has a bright color because it is expected that the heating treatment will not cause a color change. In the desired melting point parameter, a low melting point is desired. The desired chemical parameters in black rice bran oil are to have high antioxidant and phenol content. Meanwhile, the free fatty acid content in black rice bran oil is desired to have a low value. This is because the black rice bran that will be stabilized has a high nutritional content and functional compounds so that it can be used as a raw material for functional food in the form of black rice bran oil.

Table 3. Effectiveness Value of Preliminary Heating Treatment on Black Rice Crude Rice Bran Oil

| Characteristic | Variable Weight (VW) | Normal Weight (BN) | H1 | | H2 | | H3 | | H4 | | H5 | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | EV | RV | EV | RV | EV | RV | EV | RV | EV | RV |
| Physics | | | | | | | | | | | | |

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Yield | 1 | 0,17 | 0,00 | 0,00 | 0,17 | 0,03 | 0,28 | 0,05 | 0,36 | 0,06 | 0,56 | 0,09 |
| Color | 1 | 0,17 | 1,00 | 0,17 | 0,84 | 0,14 | 0,73 | 0,12 | 0,62 | 0,10 | 0,60 | 0,10 |
| Melting Point | 1 | 0,17 | 1,00 | 0,17 | 0,89 | 0,15 | 0,84 | 0,14 | 0,72 | 0,12 | 0,47 | 0,08 |
| Chemical | | | | | | | | | | | | |
| Antioxidant | 1 | 0,17 | 0,00 | 0,00 | 0,08 | 0,01 | 0,32 | 0,05 | 0,54 | 0,09 | 0,72 | 0,12 |
| Fenol | 1 | 0,17 | 0,00 | 0,00 | 0,08 | 0,01 | 0,28 | 0,05 | 0,40 | 0,07 | 0,56 | 0,09 |
| Free Fatty Acid | 1 | 0,17 | 0,00 | 0,00 | 0,07 | 0,01 | 0,21 | 0,04 | 0,30 | 0,05 | 0,40 | 0,07 |
| Total | 6 | 1,00 | | 0,333 | | 0,356 | | 0,442 | | 0,490 | | 0,552 |

| Characteristic | Variable Weight (VW) | Normal Weight (BN) | H6 | | H7 | | H8 | | H9 | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | EV | RV | EV | RV | EV | RV | EV | RV |
| Physics | | | | | | | | | | |
| Yield | 1 | 0,17 | 0,72 | 0,12 | 1,00 | 0,17 | 0,90 | 0,15 | 0,81 | 0,13 |
| Color | 1 | 0,17 | 0,59 | 0,10 | 0,46 | 0,08 | 0,29 | 0,05 | 0,00 | 0,00 |
| Melting Point | 1 | 0,17 | 0,31 | 0,05 | 0,22 | 0,04 | 0,11 | 0,02 | 0,00 | 0,00 |
| Chemical | | | | | | | | | | |
| Antioxidant | 1 | 0,17 | 0,82 | 0,14 | 1,00 | 0,17 | 0,91 | 0,15 | 0,71 | 0,12 |
| Fenol | 1 | 0,17 | 0,76 | 0,13 | 1,00 | 0,17 | 0,92 | 0,15 | 0,80 | 0,13 |
| Free Fatty Acid | 1 | 0,17 | 0,55 | 0,09 | 0,79 | 0,13 | 0,89 | 0,15 | 1,00 | 0,17 |
| Total | 6 | 1,00 | | 0,624 | | 0,745 | | 0,671 | | 0,552 |

The weighting value (Table 3) shows that each parameter has the same weight in contributing to determining the best treatment at the preheating temperature and preheating time of black rice bran cultivar Mutiara. The principle of testing carried out is to provide a weight value (score) according to the contribution of a characteristic to the stabilization treatment used. Determining the weighting test or effectiveness index has a procedure, namely sorting variables based on priority and their contribution to the desired results.

Based on the sample H1, the result value (RH) of effectiveness is 0.333, H2 with a result value (RH) of 0.356, H3 obtained a result value (RH) of 0.442, H4 has a result value (RH) of 0.490, H5 obtained an effectiveness result value (RH) of 0.552 and in sample H6, the result value effectiveness index (RH) of 0.624 was obtained. In sample H7, the result value (RH) of 0.745 was obtained, sample H8 obtained a result value (RH) of 0.671 and in the last sample H9, the result value (RH) of effectiveness was obtained of 0.552.

Based on the calculation of the weighting test or effectiveness index, the highest number of results (RH) was found in treatment H7, namely oven stabilization of black rice bran at a temperature of 110°C for 10 minutes with a value of 0.745. Based on the effectiveness index test, it can be concluded that the best treatment regarding the effect of preheating temperature and preheating time on the physical and chemical characteristics of black rice bran oil cultivar Mutiara is the treatment at a temperature of 110°C for 10 minutes.

The Best of Rice Bran Oil Fatty Acid Profile

Table 4. Fatty Acid Profile of The Best Black Rice Bran Oil and Commercial Rice Bran Oil “Oryza Grace”

| No | Fatty Acid | Relative Component (%) | |
|---|---|---|---|
| | | Black Rice Bran Oil Kultivar Mutiara | Commercial Rice Bran Oil "Oryza Grace" |
| 1 | Myristoleic Acid | 0,44 | 0,40 |
| 2 | Palmitoleic Acid | 20,04 | 18,19 |
| 3 | Elaidic Acid | 2,01 | 2,28 |
| 4 | Linoleic Acid | 34,91 | 42,92 |
| 5 | Linolelaidic Acid | 0,32 | ND |
| 6 | γ-Linolenic Acid | 38,37 | 33,25 |
| 7 | α-Linolenic Acid | 2,88 | 1,23 |
| 8 | cis-11-Eicosanoic Acid | 0,65 | 0,97 |
| 9 | cis-11,14-Eicosadienoic Acid | 0,38 | 0,76 |

Note:
*ND = Not Detected

The unsaturated fatty acid components found in black rice bran oil of the Mutiara cultivar are myristoleic acid (0.44%), palmitoleic acid (20.04%), elaidic acid (2.01%), linoleic acid (34.91%), linolelaidic acid (0.32%), γ-linolenic acid (38.37%), and α-linolenic acid (2.88%), eicosanoic acid (0.65%) and eicosadienoic acid (0.38%). In rice bran oil "Oryza grace" fatty acid profile consists of myristoleic acid (0.40%), palmitoleic acid (18.19%), elaidic acid (2.28%), linoleic acid (42.92%), γ-linolenic acid (33.25%), α-linolenic acid (1.23%), eicosanoic acid (0.97%) and eicosadienoic acid (0.76%). Overall, black rice bran oil of Mutiara cultivar contains 97.67% unsaturated fatty acids and commercial rice bran oil "Oryza grace" is 97.72%.

The results of the study were higher than Xu et al. [4] by 75.24% and Mingnyai et al. [25] by 73.67. The difference in fatty acid composition in rice bran oil is caused by agronomic factors of rice including the rice varieties used and different extraction methods. Orsavova et al. [26] stated that the fatty acid composition in rice bran oil varies depending on the oil source from the technological process used (type of extraction) and the plant variety. These results are in accordance with the opinion of Liu et al. [27] differences in fatty acid levels can be due to planting area, environmental/climate conditions, post-treatment processes and cultivars.

The results of the fatty acid composition of the selected "Mutiara" black rice bran oil and "Oryza grace" rice bran oil, no oleic acid content was found. Similar things were also found in Masud et al. [28] where rice bran oil only contains 0.08% oleic acid. While research by Gumilar et al. [29] the results of the composition of fatty acids in rice bran oil obtained were not identified as linoleic acid with oleic acid only 0.42%. This is due to the increasing temperature of the preliminary heating of rice bran oil. In addition, unsaturated fatty acids (oleic and linoleic) have double bonds between the carbon atoms that make them up. The presence of double bonds in unsaturated fatty acids causes them to react easily with oxygen (easily oxidized). Heating temperature can cause fatty acids to be reactive to oxygen and catalyze coenzymes by increasing the number of double bonds in the molecular chain. The decrease and loss of certain fatty acid compositions occurs due to the change in some of the fatty acids in rice bran oil into compounds with lower molecular weights, such as the formation of aldehyde compounds or trans fatty acids due to the heating process.

## 4-CONCLUSION

The treatment of temperature and preheating time affects the physical properties (yield, color, and melting point) and chemical properties (free fatty acids, antioxidant content, and phenol content) of black rice bran oil of the Mutiara cultivar. In terms of color and melting point, the use of low temperature and short time can provide a good appearance in black rice bran oil. In terms of free fatty acid parameters, the use of high temperature for a long time can reduce the levels of free fatty acids in rice bran oil. In terms of bioactive content (antioxidants and phenols) and oil quantity (yield), the use of high temperature for a short time can produce a high yield and maintain the antioxidant and phenol content in black rice bran oil. The best black rice bran oil has a high content

of unsaturated fatty acids of 97.67%.

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