

SENSORY AND CHEMICAL CHARACTERIZATION OF COOKIES SUBSTITUTED WITH BLACK GLUTINOUS RICE FLOUR

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Abstract

Cookies are a popular type of dry cake in Indonesia and are liked by various groups. Generally, cookies are made using wheat flour as the main ingredient, but black glutinous rice flour, which is rich in fibre and has health benefits, is chosen as an alternative substitute for wheat flour. This study aims to explore the effect of substituting black glutinous rice flour in cookies on organoleptic acceptance and nutritional content of the product. Objective: This study aims to identify the effect of substituting black glutinous rice flour on the organoleptic acceptance of cookies and to identify the effect of substituting black glutinous rice flour on the nutritional content of cookies. Method: This study uses an experimental method with a Completely Randomised Design (CRD). Organoleptic tests were conducted to assess parameters of colour, aroma, taste, crunchiness, and texture by using the Kruskal-Wallis test. Analysis of nutritional content using the anova test was carried out to measure the levels of water, ash, fat, protein, and carbohydrates in cookie products that use black glutinous rice flour as a substitute. Results: The results showed that there was a significant effect of adding black glutinous rice flour on the parameters of colour, aroma, taste, and crunchiness ($P < 0.05$). However, there was no significant effect on the texture parameter ($P > 0.05$). The nutritional content analysis showed that the water content of cookies varied, with the lowest value in P2 (4.98%), which almost reached the SNI standard limit (maximum 5%). Ash content increased with the increase in substitution of black glutinous rice flour, reaching the highest value in P4 (2.36%), which exceeded the SNI standard limit (maximum 1.8%). Fat content also increased, although it remained within the limits allowed by SNI (maximum 35%). Protein content slightly decreased in P2 (8.09%) compared to P1 (8.18%), showing no significant increase. Meanwhile, carbohydrate content decreased with the increase in substitution of black glutinous rice flour, with a significant difference between P1 (60.66%) and P2 (59.63%). Conclusion: Substitution of black glutinous rice flour in cookie production can improve organoleptic acceptance and nutritional content of the product, especially in terms of colour, taste, aroma, and crunchiness. The addition of black glutinous rice flour also affects the levels of water, ash, fat, protein, and carbohydrates, with the potential to increase the nutritional value and health benefits of the product.

Keywords: *Characterization, Cookies, Black glutinous rice, Substitution*

INTRODUCTION

Cookies are dry cakes that are made from soft dough, having a texture that is quite crunchy when broken, and the cut has a texture that is not too dense (BSN, 2022). Cookies are very popular in Indonesia and are enjoyed by people of all ages, from children to adults. Cookies are typically made using wheat flour as the primary binding ingredient, along with sugar and fat that contribute to their aroma and crunchiness (Syifahaque et al., 2023). According to SNI 01-2973-2011, cookies are classified as biscuits made from soft dough with a high fat content and a crunchy texture when broken. Making cookies requires an individual to go through several steps, such as mixing, icing, shaping, and baking. Cookies that contain flour different from wheat flour are usually referred to as shortbread cookies. In making cookies, safety procedures must be adhered to. In cookies, the safety procedures are the quality standards established by the Indonesian National Standard (SNI 01-2975-2011). Cookies can be produced using various types of flour, including gluten-free flour, because the manufacturing process does not require dough development (Indah Raya et al., 2023). According to data from BPS (2018), cookie consumption in Indonesia increased annually between 2014 and 2018, with an average annual growth rate of 33.31%. In 2020, cookie consumption increased by 4.25% compared to the previous year (BPS, 2020).

Black glutinous rice flour is among the primary ingredients utilised for the preparation of classic Indonesian cakes and is used the same way as rice flour (Williana Ariani, 2024). The preparation of glutinous rice flour is relatively simple and can be performed on both household and industrial scales. Black glutinous rice flour, which comes from black glutinous rice, has excellent potential as a local alternative to reduce dependence on wheat flour. This flour contains high fibre because it does not undergo a polishing process, which provides health benefits and helps with weight management (Williana Ariani, 2024). Generally, cookies contain low fibre that only comes from wheat flour. Therefore, the researcher chose black glutinous rice flour as a research material in making cookies due to its various advantages in creating healthy and innovative food products. The addition of black glutinous rice flour not only increases nutritional value but also provides antioxidant benefits for health, including anthocyanin, and contains minerals such as calcium, iron, and potassium.

Several previous studies have examined the use of flours other than wheat flour in cookie production, such as the study by Syifahaque *et al.* (2023) which used sorghum and avocado flour as fat substitutes to produce cookies with good chemical, physical, and organoleptic characteristics, and the study by Indah Raya *et al.* (2023) which used mocaf flour (modified cassava flour) as a substitute for wheat flour in cookie production. However, these studies have not specifically utilised black glutinous rice flour as the main ingredient in cookie production to increase fibre and antioxidant content. Therefore, this study differs from previous studies because it uses black glutinous rice flour to produce healthier cookies, high in fibre, and with antioxidant activity that is beneficial for health.

LITERATUR REVIEW

One type of food that should be utilized more widely is black glutinous rice. Black glutinous rice is one variety of pigmented rice that Indonesian people have consumed for a long time as a food ingredient (Adam *et al.*, 2022; Ayyumi *et al.*, 2021). It is due to the potential of black glutinous rice as a source of carbohydrates, bioactive compounds, antioxidants, and high fibre that are beneficial for health (Rahayu *et al.*, 2021). The image of black glutinous rice is presented in Figure 2. In Indonesia, black glutinous rice is available in significant quantities, with an annual production of approximately 42,000 tons (Muchlisyyah *et al.*, 2016). Data from the Central Statistics Agency (BPS) shows that between 2014 and 2018, the average growth in consumption of glutinous rice reached 19.10%. In 2019, the average per capita consumption of glutinous rice was estimated to reach around 1.504 kg per week (Central Statistics Agency, 2019). Black glutinous rice has a purple-black colour and contains better nutrition compared to other types of rice (Hairiyah & Nuryati, 2020; Asfar *et al.*, 2021). In addition, black glutinous rice also contains secondary metabolite compounds such as alkaloids, flavonoids, tannins, and steroids. Proximate analysis is a method of chemical analysis used to identify the nutritional composition of feed or food ingredients (Andyarini & Hidayati, 2017). The term "proximate" refers to an analysis that yields results that are not exact, but rather approximate values. It is due to the presence of other components in the sample being analysed, which, although present in small amounts, should not be included in the intended fraction (Mikdarullah *et al.*, 2020).

Proximate analysis has the advantage of being a commonly used method to obtain information about the chemical composition of a food ingredient without requiring advanced testing technology. This method provides a general overview of the material's composition, allows for the calculation of total digestible nutrient (TDN) values, and offers an overall assessment of the food ingredient's usefulness. However, proximate analysis also has weaknesses, namely that it cannot provide accurate results regarding the content of chemical components with certainty (W. Purwasih, 2017). Proximate analysis is a commonly used method to measure the content of carbohydrates, fats, proteins, moisture, and ash in food ingredients. Despite this, the analysis has several weaknesses, one of which is in the measurement of protein. The method used to calculate the amount of nitrogen, such as alkaloids and nucleic acids, can be detected as protein (Andi Saputri Sarika Daeng *et al.*, 2024). Proximate analysis is a method used to identify the nutritional content of feed or food ingredients. In this analysis, feed components are grouped based on their chemical content and function. Several methods used in proximate analysis include the Kjeldahl method for protein analysis, the Soxhlet method for fat analysis, the oven method for moisture analysis, and the dry ashing method for ash analysis. One of the advantages of proximate analysis is that the technology used is relatively accessible and affordable, allowing for the calculation of the total nutritional content of feed or food in percentage units. However, proximate analysis also has limitations, one of which is its inability to explain the digestibility or texture of feed or food (Miftahul Janna *et al.*, 2022).

METHOD

Research on cookie products with black glutinous rice flour substitution was conducted through an experimental method using a Completely Randomized Design (CRD), which included 4 experimental units as follows:

P1 = 100% wheat flour : 0% black glutinous rice flour

P2 = 50% wheat flour : 50% black glutinous rice flour

P3 = 25% wheat flour : 75% black glutinous rice flour

P4 = 0% wheat flour : 100% black glutinous rice flour

The subjects in this study were students of Teuku Umar University who were willing to participate as panellists. To measure the level of consumer preference for cookie products, an organoleptic test was conducted involving 70 respondents who served as panellists.

The variables observed in this study included organoleptic parameters, namely colour, taste, aroma, texture, and nutritional content analysis of black glutinous rice cookie products. In this study, there were dependent and independent variables, as follows:

1. Independent variable (free variable) includes the concentration of black glutinous rice flour (P1, P2, P3, P4)
2. Dependent variable includes sensory testing and nutritional content analysis (moisture content, ash content, protein content, fat content, and carbohydrate content).

The formulation of cookies was made using black glutinous rice flour with concentration treatments of 0%, 50%, 75%, and 100%. The additional ingredients used include wheat flour (Segitiga Biru), eggs, milk powder (Dancow), powdered sugar, vanilla, salt, margarine (Palmia), and oil (Sunco).

RESULTS AND DISCUSSION

This study thoroughly answers the hypotheses and achieves the predetermined objectives, involving all relevant variables. The study focuses on organoleptic analysis to assess sensory responses to the product, including colour, taste, texture, aroma, and crunchiness, which provides an overview of quality from the panellist's perspective. Additionally, this study involves the analysis of nutritional content, also known as proximate analysis, which evaluates the nutritional composition of the product, including protein, fat, carbohydrates, ash, and moisture content. Below is the product of cookies made from black glutinous rice flour presented in Figure 1.

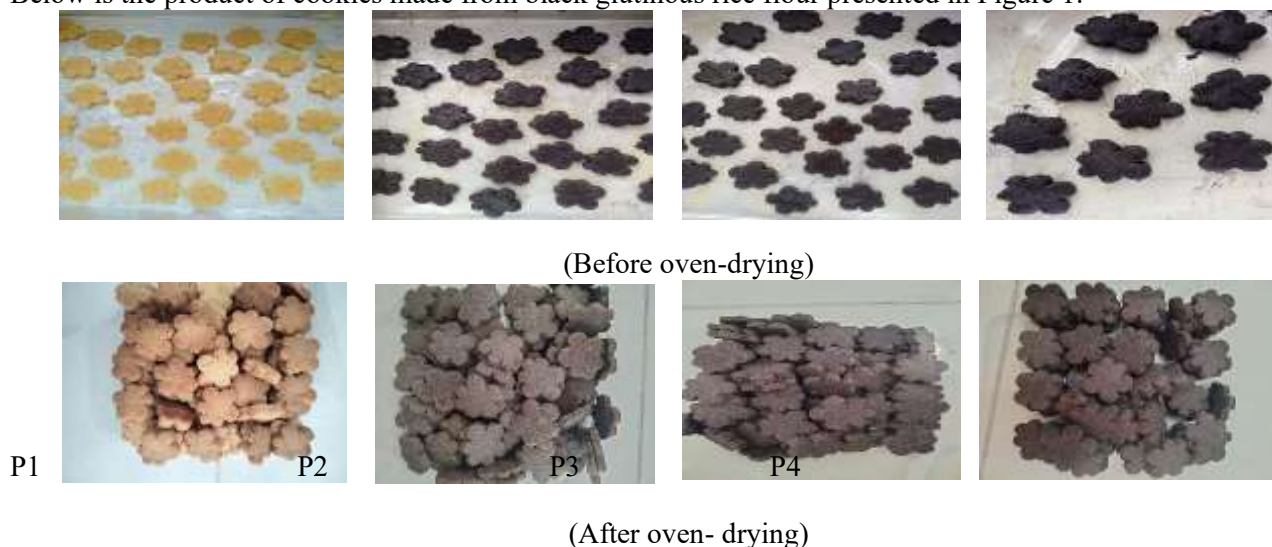


Figure 1. Black glutinous rice flour cookies before baking and after baking

1.1 Analysis of Acceptance

The acceptability analysis in this study includes an organoleptic assessment of essential parameters, namely colour, taste, aroma, and texture. Each parameter plays a crucial role in determining the sensory quality and the extent to which the panellists accept the product. The results of the acceptability analysis of cookies substituted with black glutinous rice flour are presented in Table 1.

Table 1. Acceptability analysis of cookies substituted with black glutinous rice flour

parameter	Treatment				P-value
	P1	P2	P3	P4	
Color	4,17±0,83 ^b	3,36±0,96 ^a	4,00±0,95 ^b	3,91±1,05 ^b	0.000
Aroma	4,30±0,57 ^b	4,07±0,80 ^{ab}	3,96±0,86 ^{ab}	3,80±0,86 ^a	0.004
Taste	4,23±0,82 ^c	3,76±0,86 ^b	3,61±1,04 ^{ab}	3,20±0,99 ^a	0.000
texture	4,01±0,89 ^a	3,79±0,81 ^a	3,69±0,84 ^a	3,69±1,03 ^a	>0,05
Crunchiness	4,04±0,97 ^c	3,87±0,92 ^{bc}	3,57±0,93 ^{ab}	3,40±1,01 ^a	0.000

The data presented consists of mean ± standard deviation. Significant differences ($P < 0.05$) are indicated by different letter notations in the same column and row. The results showed that for the parameters of colour, aroma, taste, and crunchiness, there was a significant effect of adding black glutinous rice flour ($P < 0.05$). However, for the texture parameter, it was found that the addition of black glutinous rice flour had no significant effect ($P > 0.05$).

1.2 Selection of Preferred Formulation

In this test, the preferred formulation was evaluated using a scoring test. The results are presented in Table 2.

Table 2. Selection of Preferred Formulation Based on Hedonic Test Results of Black Glutinous Rice Cookies

Organoleptik	Treatment			
	P1	P2	P3	P4
Color	4	1	3	2
Aroma	4	3	2	1
Taste	4	3	2	1
texture	4	3	1	2
Crunchiness	4	3	2	1
Total	20	13	10	7

Note: Numbers 1-4 indicate that the larger the number, the higher the rating of black glutinous rice cookies based on the established parameters. Based on the scoring test results, the selected products are treatment P1 (control) and treatment P2 (50% black glutinous rice flour), with total scores of 20 and 13, respectively

1.3 Nutritional Content Analysis

a. Moisture Content

The results show the moisture content of cookie products substituted with black glutinous rice flour in four different treatments, namely P1, P2, P3, and P4. From the results displayed, it is evident that the moisture content undergoes significant variations. P1 has a moisture content of 6.31%, and then the moisture content decreases to 4.98% in P2. After that, the moisture content increases again in P3 with a value of 6.24% and reaches the highest moisture content in P4, which is 7.27%

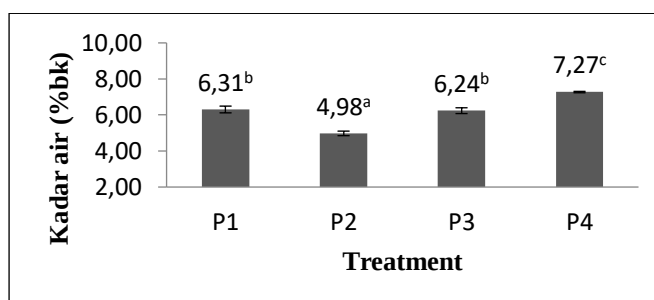


Figure 2. Total moisture content in black glutinous rice cookies

b. Ash Content

The results of the total ash content analysis of black glutinous rice flour cookies are presented in Figure 8. The results show the ash content of cookie products substituted with black glutinous rice in various treatments (P1,

P2, P3, and P4). It can be seen that the ash content increases with the treatment, with the lowest value in P1 (1.80%) and the highest in P4 (2.36%).

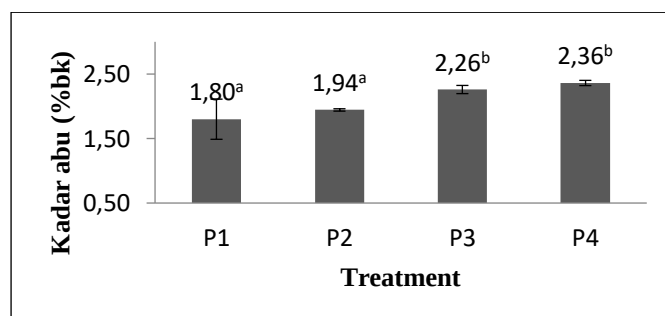


Figure 3. Total ash content in black glutinous rice cookies

c. Fat Content

The results of the total fat content analysis of black glutinous rice flour cookies are presented. The results show the fat content of cookie products substituted with black glutinous rice in various treatments (P1, P2, P3, and P4). The results indicate that the fat content increases with the treatment, from 23.00% in P1 to the highest values in P3 (27.27%) and P4 (27.21%). The difference in letter notation among the treatments indicates a significant difference between groups, where the increase in fat content occurs significantly from P1 to P2, and from P2 to P3 and P4.

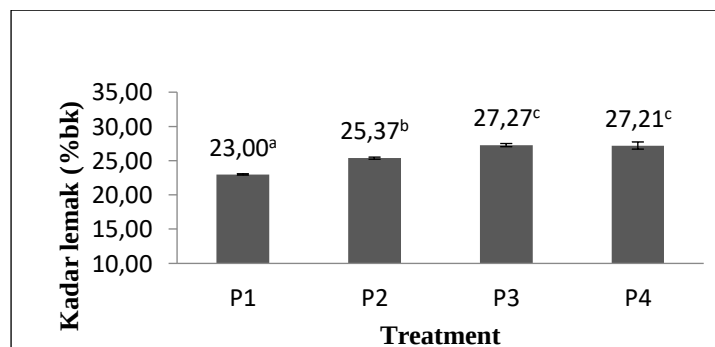


Figure 4. Total fat content in black glutinous rice cookies

d. Protein Content

The results of the total protein content analysis of black glutinous rice flour cookies are presented. The results show the protein content of cookie products substituted with black glutinous rice in two treatments, namely P1 and P2. The results displayed show that the protein content in P1 (control) is 8.18%, while in P2 (50% black glutinous rice flour) it is slightly lower, at 8.09%. The difference in protein content between the two treatments is minimal, indicating that substituting black glutinous rice for white rice in the cookie formulation has no significant impact on the protein content in the final product because black glutinous rice flour has higher fiber and lower protein content compared to wheat flour.

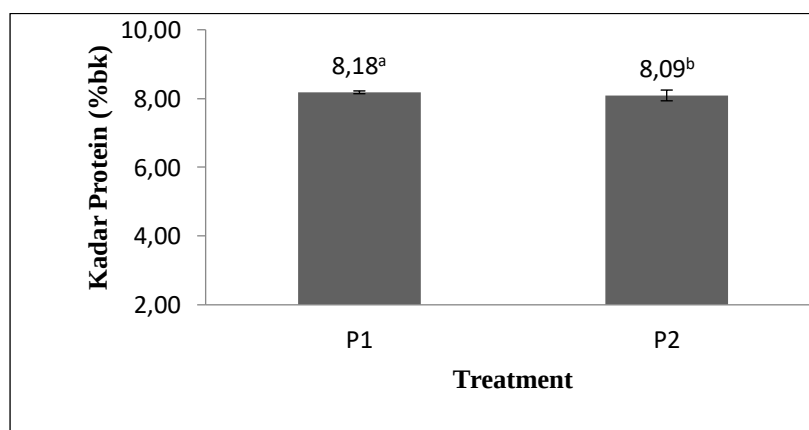


Figure 5. Total protein content in black glutinous rice cookies

d. Carbohydrate Content

The results of the total carbohydrate content analysis of black glutinous rice flour cookies are presented. The results show that the carbohydrate content of cookies made with black glutinous rice flour differs significantly ($P < 0.05$) between the two treatments. Treatment 1 has a carbohydrate content of 60.66%, while Treatment 2 has a carbohydrate content of 59.63%. The difference in carbohydrate content is indicated by different notations, which suggests a significant difference between the two treatments. It shows that substituting black glutinous rice flour can affect the carbohydrate composition in cookies

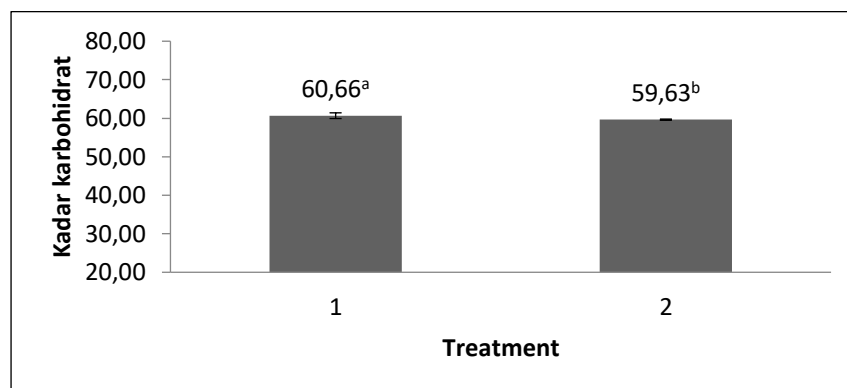


Figure 6. Total Ash Content in Black Glutinous Rice Cookies

A. Analysis of Acceptance

1. Color

Colour is an essential factor in individual assessment to determine the quality of food ingredients (Ilham Sukti et al., 2022). Based on the analysis of colour parameters, significant differences in panellist preference levels ($P < 0.05$) were observed between P1 and P2, P2 and P3, and P2 and P4. However, the differences were not significant between P1 and P3, P1 and P4, and P3 and P4. Table 4 shows that the panellists' assessment of the colour aspect gave the highest score to P1 with an average of 4.17 (liked category). In contrast, the lowest score was found in P2 with an average of 3.36 (slightly disliked category), which had a pale black colour. Panellists preferred the colour of the original cookies (without black glutinous rice flour). Cookies made without black glutinous rice flour received an average score of 4.17, indicating a higher level of preference compared to cookies substituted with black glutinous rice flour, which were less preferred by panellists with an average score of 3.36 due to their blackish colour. It is supported by the statement of Nailufar et al. (2012), which states that black glutinous rice contains an anthocyanin pigment that functions as a natural food colouring. The dark purple colour of black glutinous rice is caused by the presence of anthocyanin in its epidermal cells. Anthocyanin itself is a water-soluble pigment belonging to the flavonoid group

2. Aroma

Aroma is the smell produced by a food product and can be detected by the sense of smell. If a food product has an overpowering or bland aroma (abnormal), it can affect consumer interest and reduce their willingness to try the product (Arinachaque et al., 2023). Based on the analysis of aroma parameters, significant differences in panellist preference levels ($P < 0.05$) were observed between P1 and P4. However, the differences were not significant between P1 and P2, P1 and P3, P2 and P3, P2 and P4, and P3 and P4. Table 4 shows that the panellists' assessment of the aroma aspect gave the highest score to P1, with an average of 4.30 (in the 'liked' category). In contrast, the lowest score was found in P4, with an average of 3.80 (in the 'slightly disliked' category). Panellists preferred the aroma of original cookies (without black glutinous rice flour). Cookies made with black glutinous rice flour received an average score of 4.30, indicating a higher level of preference compared to cookies substituted with black glutinous rice flour, which were less preferred by panellists with an average score of 3.80 due to the distinctive aroma of black glutinous rice. It is supported by the statement of Febriana (2014), which states that black rice has a distinctive aroma that tends to be stale, and this aroma persists even after cooking

3. Taste

Taste is a crucial factor in product acceptance by consumers. Even if a product meets the criteria in terms of appearance, nutritional value, price, and safety, it can still be rejected if the taste is not liked (Winantea, 2019). Based on the analysis of taste parameters, significant differences in panellist preference levels ($P < 0.05$) were observed

between P1 and P2, P1 and P3, P1 and P4, and P2 and P4. However, the differences were not significant between P2 and P3, and P3 and P4. Table 4 shows that the panellists' assessment of the taste aspect gave the highest score to P1, with an average of 4.23 (in the 'liked' category). In contrast, the lowest score was found in P4, with an average of 3.80 (in the 'slightly disliked' category). However, there seems to be a discrepancy in the text where it says "Panelis lebih menyukai aroma cookies original", which translates to "Panelists preferred the aroma of original cookies", but the context is about taste. Assuming the correct sentence should be "Panelis lebih menyukai rasa cookies original", which translates to "Panelists preferred the taste of original cookies". Cookies without black glutinous rice flour received an average score of 4.23, indicating a higher level of preference compared to cookies substituted with black glutinous rice flour. According to Nanik (2013), black glutinous rice contains anthocyanin, a type of flavonoid that belongs to the polyphenol group and has biological effects in food. Additionally, black glutinous rice includes sugars such as glucose and galactose, which, when roasted, produce a distinctive taste characteristic of black glutinous rice. Therefore, it is suspected that the decrease in panellist preference for the taste parameter in products P2, P3, and P4 is due to the distinctive taste produced by the black glutinous rice flour.

4. Texture

According to Purwasih et al. (2011), texture encompasses all aspects related to the sense of touch, sight, and hearing, including assessment of hardness, roughness, dryness, and softness of a food material or product. Based on the analysis of texture parameters, the differences in panellist preference levels were not significant ($P > 0.05$).

5. Crunchiness

Crunchiness is one of the primary factors influencing food product acceptance, which is determined by the level of hardness and the force required to break down the product during chewing. Recent studies show that crunchiness is related to the level of satisfaction and acceptance of a food product (Saita et al., 2021). Based on the analysis of crunchiness parameters, significant differences in panellist preference levels ($P < 0.05$) were observed between P1 and P4, P1 and P3, and P2 and P4. However, the differences were not significant between P1 and P2, P2 and P3, P2 and P4, and P3 and P4. Table 4 shows that the panellists' assessment of the crunchiness aspect gave the highest score to P1, with an average of 4.04 (in the 'liked' category). In contrast, the lowest score was found in P4, with an average of 3.40 (in the 'slightly disliked' category). According to Ates and Elmaci (2019), moisture content can also affect the hardness or crunchiness of cookies. Additionally, Fatiyan et al. (2016) stated that the more water bound in a food material, the less crispy the biscuit texture will be. It is supported by the results of the moisture content analysis (Figure 7), which show an increase in moisture content with the addition of black glutinous rice flour at 50% (P2), 75% (P3), and 100% (P4). Therefore, it is suspected that the decrease in crunchiness in products P2, P3, and P4 is due to the increase in moisture content in these products.

CONCLUSION

Based on the results of the organoleptic test and nutritional content analysis, the study on black glutinous rice cookies yielded the following conclusions. The organoleptic test yielded significant results for the parameters of colour, taste, aroma, and crispness ($P < 0.05$). However, the texture parameter showed non-significant results ($P > 0.05$). The highest preference was obtained for the product with 50% black glutinous rice flour addition (P2). The moisture content of cookies made with black glutinous rice flour varied, with the lowest value in P2 (4.98%), which is closest to the SNI standard (maximum 5%), indicating better shelf life potential. The ash content increased with the addition of black glutinous rice flour, reaching its highest value in P4 (2.36%), which exceeded the SNI standard limit (maximum 1.8%). The fat content increased with the substitution of black glutinous rice flour, but still within the limits allowed by SNI (maximum 35%). The protein content decreased slightly in P2 (8.09%) compared to P1 (8.18%), indicating that the substitution of black glutinous rice flour did not significantly increase the protein content. The carbohydrate content of cookies decreased with the increase in black glutinous rice flour substitution, with a significant difference between P1 (60.66%) and P2 (59.63%).

REFERENCES

- Adam, I., Bait, Y., & Antuli, Z. (2022). The Effect of Variation in Concentration of Modified Black Glutinous Rice Starch (HMT) on Chemical and Organoleptic Characteristics of Analog Sausage Edible Coating. *Jambura Journal of Food Technology*, 4(1), 89–99

- Aini, F. Y., Affandi, D. R., & Basito, B. (2016). Study on the Use of Sorbitol Sweetener as a Substitute for Sucrose on Physical and Chemical Characteristics of Corn Flour-Based Biscuits (*Zea mays*) and Red Bean Flour (*Phaseolus vulgaris* L.). *Journal of Food Technology*, 9(2).
- Alfariqi, A. (2023). Consumer Preference Level for Chicken Nuggets with Different Storage Times Aburizal Alfariqi and Joko Purdiyanto. *Maduranch*, 8, 13-18.
- Ariani, Williana. "Substitution of Black Glutinous Rice Flour as a Substitute for Wheat Flour in the Production of Diet Cookies." *Journal of Culinary Management* 3.1 (2024): 128-132.
- Asfar, Andi Muhammad Irfan Taufan, et al. "Dissemination of Black Glutinous Rice Dodol Processing Based on Smart Production in the Maddaung Farmer Group." *Journal of Community Service UNDIKMA* 3.3 (2022): 390-400.
- Ayyumi, L. A. S., Nazaruddin., S. Cicilia. 2021. Antioxidant Activity of Iwel from Black Glutinous Rice Flour and Purple Sweet Potato. *Journal of Food Technology*. 15(1): 56-70.
- Central Statistics Agency of Indonesia. 2020. Indonesian Rubber Statistics 2020. Indonesia Central Statistics Agency.
- Central Statistics Agency. (2019). Indonesia's Wheat Imports (link unavailable)
- Febriana, A. 2014. Evaluation of Nutritional, Functional, and Sensory Properties of Salak Luwak with Variation of Red Rice Flour as an Alternative Healthy Food. *Journal of Food Technology*. vol 3 (2): 28-38.
- Hairiyah, N., & Nuryati, N. (2020). Application of Black Glutinous Rice (*Oryza sativa* var glutinous) and Honey as Raw Materials for Body Scrub Production. *Journal of Agricultural Technology Andalas*, 24(2), 114-121.
- Ministry of Agriculture. 2018. Food Consumption Statistics 2018. Center for Agricultural Data and Information Systems Ministry of Agriculture.
- Nailufar, Aini Amalia, Basito, Dan Choirul Anam. 2012. Study on the Characteristics of Black Glutinous Rice (*Oryza Sativa Glutinosa*) in Various Packaging Types During Storage. *Journal of Food Technology*, Vol 1 No 1 October 2012. Department of Food Science and Technology, Sebelas Maret University Surakarta.
- Nanik, 2013. Antioxidant Activity of Anthocyanin from Black Glutinous Rice During Fermentation. Department of Agricultural Technology. Faculty of Agricultural Technology. Slamet Riyadi University Surakarta. Gajah Mada University Yogyakarta. Surakarta-Yogyakarta. *Journal*
- National Standardization Agency.
- Raya, Indah, Gelora Augustyn, and Cynthia Lopulalan. "Chemical and Sensory Characteristics of Cookies Made from Mocaf Flour with Addition of Yellow Corn Puree." *MARSEGU: Journal of Science and Technology* 1.1 (2024): 38-48.
- Syifahaque, A.-N., Siswanti, S., & Atmaka, W. (2023). Effect of Sorghum Flour Substitution on Chemical, Physical, and Organoleptic Characteristics of Cookies with Avocado as Fat Substitute. *Journal of Food Technology*, 15(2), 119-133.