



Development and Evaluation of Purple Sweet Potato and Red Bean Flour Cookies as Diabetes-Diet Snack: Organoleptic, Glucose and Crude Fiber Analysis

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Abstract: The prevalence of Diabetes Mellitus (DM) is increasing rapidly in the world, including in Indonesia, reaching about 11,7%, so proper diet management is needed to control blood glucose levels. The combination of purple sweet potato and red bean is effective for DM patient due to its low glycemic index and high fiber content that helps slow down glucose absorption and improve insulin sensitivity. This study aims to assess the organoleptic acceptability and glucose and crude fiber contents of cookies based on purple sweet potato flour and red bean flour with cinnamon. Experimental study with a Completely Randomized Design (CRD) with three formulations, namely F1 (90% purple sweet potato, 10% red beans), F2 (50% purple sweet potato, 50% red beans), F3 (10% purple sweet potato, 90% red beans) with added cinnamon. Organoleptic tests were conducted on 30 trained panelists. Samples F1, F2, and F3 were analyzed for glucose, crude fiber, and organoleptic properties. The Kruskal-Wallis statistical test was performed on the products' organoleptic results. Formulation F2 was the most preferred in terms of color, aroma, flavor, and texture. The Kruskal-Wallis test showed significant differences among the formulations for color ($p = 0.003$), aroma ($p = 0.028$), texture ($p = 0.031$), and flavor ($p = 0.001$). The glucose contents of F2 were 11.21 g/100 g and crude fiber contents of F2 were 2.35 g/100 g. Based on its organoleptic acceptability, F2 was selected as the preferred formulation and showed potential as an alternative snack for dietary management of DM.

Keywords: cookies, crude fiber, glucose, organoleptic, purple sweet potato, red bean,

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INTRODUCTION

Diabetes Mellitus (DM) is included in the category of chronic non-communicable diseases, which is a major health problem in the world. DM is characterized by impaired carbohydrate metabolism due to absolute or relative insulin deficiency, leading to chronic hyperglycemia. According to data from the International Diabetes Federation (IDF) and the World Health Organization (WHO), there were an estimated 536 million people with diabetes worldwide in 2021. This figure is projected to increase to over 780 million by 2045. Diabetes mellitus (DM) in Indonesia has increased significantly. According to the 2023 Indonesian Health Survey (SKI), the prevalence of DM among the population aged 15 years and older reached 11,7% based on blood glucose measurements, and increased from 10,9% in 2018. Meanwhile, the prevalence based on physician diagnosis was 1,7% for all ages and 2,2% for those aged 15 years and older (SKI, 2023).

Diet is one of the lifestyle factors that can influence blood glucose control in individuals with diabetes mellitus. Excessive carbohydrate intake may contribute to increased blood glucose levels when insulin is unable to adequately regulate glucose metabolism. Therefore, dietary management is an important component of diabetes management, particularly through the selection of foods that can help maintain stable blood glucose levels. Foods with a low glycemic index and adequate fiber content may help slow glucose absorption and support better glycemic control (Santoso et al., 2025). Diabetes mellitus not only affects quality of life but also imposes a substantial health burden due to long-term complications, such as kidney damage, retinopathy, neuropathy, and cardiovascular disease. Therefore, effective diabetes management is essential, including through appropriate dietary management. The consumption of foods rich in dietary fiber and with a low glycemic index is recommended as part of dietary management for people with diabetes mellitus to support stable blood glucose levels (PERKENI, 2024).

The consumption of high-fiber foods may help slow glucose absorption in the digestive tract, thereby contributing to blood glucose control. Reynolds et al., (2020) reported that higher dietary fiber intake was associated with improved glycemic control, including reductions in HbA1c and fasting blood glucose levels. Low-glycemic-index foods are digested and absorbed more slowly, which may help prevent rapid increases in blood glucose levels. Dietary fiber can also slow gastric emptying and glucose absorption, thereby supporting blood glucose control (Reynolds et al., 2020). These characteristics indicate that foods combining a low glycemic index with adequate dietary fiber may be appropriate as alternative snack options for people with diabetes mellitus. Therefore, the development of cookies using local ingredients, namely purple sweet potato and red kidney beans, may provide an additional alternative snack option that supports dietary management for people with diabetes mellitus.

Cookies, as a popular and practical snack, can be modified into a potential snack alternative for people with diabetes. The use of local food ingredients such as purple sweet potatoes, red beans, and cinnamon has the potential to be an alternative (Dimopoulou et al., 2023). The local food crop, purple sweet potatoes (*Ipomoea batatas* var. *Ayamurasaki*), is a source of complex carbohydrates rich in anthocyanins, bioactive compounds with strong antioxidant properties. Some of the carbohydrates in purple sweet potatoes are in the form of resistant starch, which is not easily digested in the small intestine. This starch functions like fiber, helping to maintain a feeling of fullness for longer and

improving insulin sensitivity. Purple sweet potatoes are ideal for diabetes patients due to their low glycemic index (44-54) and rich content of complex carbohydrate, fiber, and resistant starch, which slow down glucose absorption and minimize blood sugar spikes (Atkinson et al., 2021).

Red beans (*Vigna angularis*), are an excellent source of vegetable protein and dietary fiber. The fiber in red beans, especially soluble fiber, can slow glucose absorption and lower the glycemic index of food. Additionally, red beans contain natural antioxidants such as flavonoids and phenolic acids, which also play a role in reducing inflammation and insulin resistance (Damayanti et al., 2020). One of the ingredients that enhances the aroma and flavor is cinnamon (*Cinnamomum burmanii*), which has long been used as a spice with therapeutic effects. Bioactive compounds in cinnamon, such as cinnamaldehyde and eugenol, are known to increase glucose transport into cells, improve insulin receptor function, and lower fasting and postprandial blood glucose levels. With these characteristics, cinnamon has great potential to be developed into snack products for people with diabetes (Behbahani et al., 2020).

Previous research has utilized one of these ingredients, purple sweet potatoes, as the main ingredient for cookies as a snack for diabetes mellitus, but has not been combined with high protein sources such as red beans. Zaddana et al., (2021) Research on snack bars made from purple sweet potatoes and red beans shows that the combination of the two ingredients can produce a product with rich nutritional content. It has a complete nutritional profile, high fiber content, and a low Glycemic Index (GI) value, as well as high antioxidant activity. Rakhmayati et al., (2023) Developed chewy cookies using red bean flour and purple sweet potato, but no specific evaluation of their glucose content has been conducted.

Research by Yusrita and Tanjung (2023) showed that cinnamon has a significant effect in lowering blood sugar levels. Furthermore, a meta-analysis by (Allen et al., 2013) proved that regular cinnamon use can lower blood sugar levels in patients with type 2 diabetes. The review of the various studies above served as the basis for compiling this research as a form of developing local food innovations that support the dietary needs of DM. Thus, the novelty of this article lies in the combination of these three local ingredients as a functional cookie product, as well as a comprehensive analysis covering sensory and nutritional aspects. The purpose of this study was to determine the organoleptic test and glucose and fiber content of purple sweet potato flour and red bean flour as an alternative cookie for diabetes mellitus.

METHODS

Design

This study used an experimental study with a Completely Randomized Design (CRD) using purple sweet potato flour and red bean flour cookies with three formulas with a ratio of: F1 (90%: 10%), F2 (50 %: 50%), and F3 (10%: 90%), all of which were added with bicarbonate, eggs, cinnamon, vanilla, margarine. The process included making cookies, hedonic tests by 30 trained panelists, and proximate tests (glucose and fiber). Data analysis was carried out using the Kruskal-Wallis test, and if there were significant differences, it was followed by the Mann-Whitney test.

Table 1*Formulation of Cookies*

No	Ingridients	Formulation		
		F1	F2	F3
1	Purple sweet Potato flour (g)	90	50	10
2	Red bean flour (g)	10	50	90
3	Bicarbonate (g)	2	2	2
4	Eggs (g)	60	60	60
5	Vanilla (g)	1	1	1
6	Margarine (g)	50	50	50
7	Cinnamon (g)	5	5	5

Materials

The ingredients used in this study consist of purple sweet potato flour, red bean flour, cinnamon, bicarbonate, eggs, vanilla, margarine, and cinnamon. Cookies are made by following these steps: prepare all the necessary ingredients, then add the eggs, margarine, and cinnamon to a bowl, then mix for 5 minutes until fluffy. Add the vanilla, bicarbonate, purple sweet potato flour, and red bean flour according to the formula measurements, then mix until the dough is evenly mixed and smooth. Shape the dough, arrange it on a baking sheet, then bake at 150°C for 30 minutes.

The equipment used in this study for making cookies includes a digital scale, oven, mixer, baking pan, basin, small bowl, fork, and spatula. The tools used for testing glucose and fiber content include an air oven, desiccator containing moisture-absorbent material, cup clamp, analytical balance, Erlenmeyer flask, water bath, volumetric flask, filter paper, Buchner funnel, pH meter, beaker, and desiccator.

Organoleptic Test

Organoleptic test was conducted by 30 trained panelists, using a hedonic test method to assess the color, aroma, texture, and flavor of the product. The panelists' preference rating scale in this study ranged from 1 to 5, with 1 = strongly dislike, 2 = dislike, 3 = like slightly, 4 = like, and 5 = really like (Listyaningrum & Hidayatulloh, 2024).

Analysis of Glucose and Crude Fiber

Analysis of glucose content testing using the Luff-Schroll method (Taufik & Guntarti, 2016), fiber content testing using the gravimetric method Azis et al. (2024) which can be seen in tables 3 and 4. Testing of glucose and fiber content using 2 grams of cookie sample ingredients, distilled water, AL(OH) porridge, Na₂CO₃, Anhydrous or Na-Oxalate solution, 25 ml of Luff-Schroll solution, KI (Potassium Iodide) 20%, 25 ml, H₂SO₄ 26.5%, Iodine, Na-Thiosulfate 0.1N, Asbestos, NaOH.

RESULTS

Based on the results of the organoleptic test of cookies (Table 2), the highest average result was obtained in F2, namely 3.15. Formulation F2 (50% purple sweet potato flour and 50% red bean flour) was the most preferred formulation based on organoleptic evaluation, with preference scores of 3.5 for color, 3.3 for aroma, 3.1 for flavor, and 2.7 for texture.

Table 2*Average Value of Organoleptic Test of Cookies*

Variabel	Organoleptic test	Formulation		
		F1	F2	F3
Acceptance	Color	3	3.5	3.4
	Aroma	2.9	3.3	3.2
	Texture	2.3	2.7	2.4
	Flavor	2.4	3.1	2.9
Average		2.65	3.15	2.97

Based on the results of statistical analysis using the Kruskal-Wallis test on the organoleptic test (Table 3), carried out on treatments F1, F2, and F3, the results obtained were $p < 0.05$; there were significant differences in color, aroma, texture, and flavor in the purple sweet potato flour and red bean flour cookie formulas.

Table 3*Statistical Analysis of Organoleptic Tests*

Organoleptic test	n	Mean $\pm$ (SD)			p-value
		F1	F2	F3	
Color	30	3.03 $\pm$ (0.49) ^a	3.50 $\pm$ (0.50) ^a	3.43 $\pm$ (0.67) ^b	0.003*
Aroma	30	2.97 $\pm$ (0.49) ^a	3.33 $\pm$ (0.54) ^a	3.23 $\pm$ (0.56) ^b	0.028*
Texture	30	2.37 $\pm$ (0.49) ^a	2.70 $\pm$ (0.46) ^a	2.47 $\pm$ (0.50) ^b	0.031*
Flavor	30	2.47 $\pm$ (0.50) ^a	3.13 $\pm$ (0.77) ^a	2.93 $\pm$ (0.69) ^{ab}	0.001*

Information: *)Statistically significant data ($p < 0.05$). abc = Different letter notations indicate significant differences based on the Mann-Whitney test ($p < 0.05$); The mean value is measured on a scale of 1-5 (1 = like very much, 2 = don't like it, 3 = like it a bit, 4 = like it, 5 = like it a lot).

The glucose and fiber contents of the cookies were expressed as percentages (%) in Table 4. F1 had a glucose content of 13.63% and a fiber content of 4.02%, F2 had a glucose content of 11.21% and a fiber content of 2.35%, while F3 had a glucose content of 10.98% and a fiber content of 2.49%.

Table 4*Analysis of Glucose and Fiber Content*

Formulation	Proximate test	
	Glucose (g/100 g)	Fiber (g/100 g)
F1	13.63	4.02
F2	11.21	2.35
F3	10.98	2.49

DISCUSSION

Color

Based on the results of the study on the color acceptability of cookies made from purple sweet potato flour and red beans, formula F2 (50 grams of purple sweet potato flour and 50 grams of red bean flour) obtained the highest level of preference with a score of 3.5. The results of the statistical test obtained a p -value = 0.003. Color is the first sensory element directly observed by the panelists

and affects the appearance of the product. Food quality assessment is often based on color, where a color that matches expectations creates a positive impression for panelists. Panelists preferred formula F2 because its color was more attractive compared to F1, which tended to be dark blackish, and F3, which was brown (Fauziyah et al., 2024).

The colors in the F2 formulation look more attractive and natural than the other formulations. The combination of anthocyanin-rich purple sweet potatoes with red beans produces a bright and even reddish-purple hue, providing a strong visual appeal to panelists. The results of this study are in line with the research of Palupi et al. (2024) which showed that the quality characteristics and level of preference of high-fiber extrudate products from a combination of purple sweet potato flour and red beans were obtained. F2 is the formulation with the highest level of color acceptance because it produces the most attractive and consistent colors.

F3 cookies had a slightly browner color than the other formulations. This color may have resulted from the higher proportion of red bean flour used in F3 and may also have been influenced by browning reactions during baking. Visually, the brownish color of F3 gave the cookies a distinctive appearance and may contribute to their visual appeal (Christa et al., 2024). This was supported by the organoleptic test, in which F3 received a color score of 3.43, indicating good acceptance by the panelists.

In line with research conducted by Damayanti et al. (2020), it was shown that adding red bean flour to cookies produces a browner color. This happens because the high carbohydrate and protein content in red bean flour triggers the Maillard reaction during baking, resulting in a brown color in the cookies (Damayanti et al., 2020). Similarly, research by Christa et al. (2024) found that substitution of red bean flour in brownie cookies affected the product color, all where increasing the concentration of red bean flour resulted in darker cookies. This research supports that the non-enzymatic browning reaction due to heating of the nutritional components in red beans is the main factor in the change in cookie color.

Aroma

Aroma is a crucial element that must be considered, because the delicious aroma of food can increase the desire to eat. Aroma testing plays an important role in the food industry because it can quickly assess whether a product elicits a positive or negative response from consumers (Yuliani et al., 2024). The results of the study on the aroma acceptability of cookies from purple sweet potato flour and red bean flour showed that formula F2 (50 g purple sweet potato flour and 50 g red beans) was the most preferred with a score of 3.3. The statistical test results obtained a p-value of 0.028. Aroma is a smell produced by chemical stimuli that are smelled by the olfactory nerves in the nasal cavity; the aroma in cookies is produced by the work of lactic acid bacteria, which play a role in producing aroma and acid. Panelists liked the F2 treatment because the aroma produced by red beans and purple sweet potatoes was balanced; there was no dominant aroma from the two ingredients compared to the first and third treatments (Fauziyah et al., 2024).

The aroma of the F2 formulation is also preferred because it brings out the natural fragrance that is characteristic of both ingredients, without any strong or disturbing aroma. This combination

produces a distinctive aroma of sweet potatoes and a distinctive nutty aroma, soft, pleasant, and appetizing. According to Devi and Fitriyaningsih (2022), it was stated that the distinctive aroma of a mixture of red beans and purple sweet potatoes, organoleptic test of the aroma of MP-ASI formula with the addition of 20% treatment, the F2 aroma results were the most acceptable because they presented no different from the first treatment, the dominant aroma was the aroma of red beans. A combination of the distinctive aroma of purple sweet potatoes and the distinctive aroma of red beans, and not pungent, soft, pleasant, and appetizing.

The aroma of F3 cookies is dominated by the distinctive aroma of cinnamon, which contributes to the sensory acceptability of the product. Cinnamon contains bioactive compounds, including cinnamaldehyde and eugenol, that have been investigated for their potential metabolic and anti-inflammatory effects. Cinnamaldehyde is also an important compound contributing to the characteristic flavor of cinnamon (Camacho et al., 2015). The aroma of food plays an important role in flavor perception and can influence appetite and food acceptance (Yin et al., 2017). Therefore, the pleasant cinnamon aroma of F3 may improve the sensory appeal of the cookie without requiring additional sugar or artificial flavoring. The use of natural cinnamon as a flavoring ingredient may also provide functional value to the product.

As well as Ramdany et al. (2021) research showed that increasing the amount of red bean flour, which has a distinctive unpleasant aroma, resulted in a decrease in panelists' preference for the cookie aroma. Some panelists disliked the distinctive aroma, resulting in the cookies with the highest proportion of red bean flour, formulation F3, being the least popular (Ramdany et al., 2021).

Texture

Based on research on the acceptance of the texture of cookies made from purple sweet potato flour and red beans, formula F2 (50 grams of purple sweet potato flour and 50 grams of red bean flour) obtained the highest preference score of 2.7. Based on the results of statistical tests, the P value for the texture parameter was 0.031, which indicates the influence of panelists' preferences on the texture of cookies. Texture is the sensation of touch on the surface of an object, both physically and perceptually. Texture is also an important factor in assessing the quality of food products, such as cookies. Texture is the physical properties of food that can be felt by the sense of touch, especially through the mouth or hands, and includes several parameters such as crispness, brittleness, softness, hardness, and chewiness.

Panelists liked the F2 treatment because the resulting texture was crispier compared to the first treatment which was slightly harder and denser and the third treatment which was slightly more fragile. Substituting red bean flour affects the crispiness of the cookies. The more red bean flour added, the harder and denser the cookie texture becomes, thus reducing the panelists' level of preference for the cookie texture (Fauziyah et al., 2024).

The F2 texture was considered to be the most suitable to the panelists' preferences because it had a balance between chewiness and brittleness. The combination of these two flours produces a product that is not hard, easy to chew, and does not break easily. Palupi et al. (2024) noted that panelists tended to prefer the F2 texture because it provided a more comfortable chewing sensation

compared to other formulations regarding the quality characteristics of the combination of purple sweet potato flour and red beans. The texture of the F3 formulation tends to be soft, dense, and somewhat brittle, different from cookies made from wheat flour which are crunchy. This is influenced by the absence of gluten in the ingredients, as well as the high content of water-soluble fiber, such as pectin, inulin, and complex polysaccharides in red beans and sweet potatoes.

According to Chen et al. (2018), water-soluble fiber has the ability to form a gel in water, which can improve food texture and retain water in the dough. This texture is particularly suitable for elderly people with diabetes because it is easier to chew and swallow. Fiber also contributes to increasing the viscosity of stomach contents, which slows down the digestive process and drastically reduces glucose absorption, helping to avoid blood sugar spikes after meals (Chen et al., 2018). According to research by Aditiya and Ismawati (2023), research states that increasing the use of red bean flour causes the texture of cookies to become denser. This condition is caused by the low, or even almost non-existent, gluten content in red beans. This lack of gluten reduces the elasticity of the dough, resulting in a harder cookie texture after baking (Aditiya & Ismawati, 2023).

Flavor

The results of the research on the flavor acceptance of cookies made from purple sweet potato flour and red bean flour showed that formula F2 (50 grams of purple sweet potato flour and 50 grams of red bean flour) obtained the highest preference score of 3.1. Based on the results of the statistical test, the p value for the texture parameter obtained a p value of 0.001. This indicates the influence of panelists' preference for cookie flavor. Flavor perception occurs when the taste buds respond to neural stimuli, such as sweet, bitter, and sour sensations, as well as hot, cold, and painful sensations perceived by the taste buds. Flavor refers to the level of pleasantness of cookies as assessed through the sense of flavor. Panelists preferred the F2 treatment because it tasted better than the first and third treatments. The first formulation was the least preferred because it contained more purple sweet potato than the first and second formulations.

The F2 formulation's flavor is favored for its balance between the natural sweetness of sweet potatoes and the savory flavor of red beans, without any overpowering flavors. This creates a more complex yet harmonious flavor. Devi and Fitriyaningsih (2022) Research stated that F2 got the highest score in flavor attributes because it has a balanced composition of ingredients and does not cause a nauseating flavor.

F3 cookies offer a mild, natural sweetness with a warm, spicy touch from cinnamon. They are perfect for people with diabetes who need to limit their consumption of simple sugars. The sweetness comes from the complex carbohydrates in sweet potatoes and kidney beans, as well as the cinnamaldehyde in cinnamon, which provides a natural sweetness without significantly increasing blood glucose levels. According to Allen et al. (2013), the active components in cinnamon help improve the body's response to insulin and lower blood sugar by inhibiting enzymes that break down carbohydrates, namely α -amylase and α -glucosidase. With a mild yet pleasant flavor, F3 cookies are acceptable to consumers without placing a metabolic burden on people with diabetes (Allen et al., 2013).

According to research by Samuel, increasing the amount of red bean flour in the product contributed to a decrease in the panelists' preference level. This occurs because the red bean content produces a bitter aftertaste, caused by the acrylamide compound formed during the roasting process. Acrylamide is formed through the Maillard reaction. The addition of more red bean flour to the formula makes the red bean flavor more dominant, thus decreasing the panelists' preference level (Samuel et al., 2019).

Glucose Content

This study produced F1 cookies made with 90 grams of purple sweet potato flour and 10 grams of red bean flour, based on the results of a glucose content of 13.63 %. F2 cookies, with a balanced composition of 50 grams of purple sweet potato flour and red bean flour based on the results of the proximate test, showed a glucose content of 11.21 %. For F3 cookies using 10 grams of purple sweet potato flour and 90 grams of red bean flour based on the results of the proximate test had a glucose content of 10.98 %. From the results of the study, all formulations had glucose levels below 15%, which indicates that these cookies are safe for consumption by people with Diabetes Mellitus. This is in accordance with the recommendations of the Indonesian Ministry of Health, which states that good snacks for people with Diabetes Mellitus should have complex sugar levels (including glucose) <15% of the total weight of the food (PERKENI, 2024).

The low glucose content in these cookies is related to the type of ingredients used. Purple sweet potatoes (*Ipomoea batatas* var. *Ayamurasaki*) are known to have a low glycemic index and contain anthocyanins, which act as natural substances to lower blood sugar levels. The glucose content in purple sweet potatoes is only about 1.79 %, much lower than the carbohydrate source rice (Rijal et al., 2019). Likewise, red beans (*Vigna angriajularis*) have a very low glycemic index (<26) and are high in fiber, which physiologically inhibits spikes in blood glucose. Red beans also contain resistant starch and complex carbohydrates that take longer to digest, thus releasing glucose into the bloodstream slowly. In addition, the addition of cinnamon (*Cinnamomum burmanii*) in the formula also plays a role in lowering glucose levels. According to Allen et al. (2013), consuming cinnamon has an important effect on lowering blood sugar levels. Cinnamon contains active substances such as cinnamaldehyde and proanthocyanidin, which help improve the body's response to insulin and reduce insulin resistance (Allen et al., 2013).

Formulation F3 contains the lowest glucose, namely 10.98 %, compared to other formulations. This is important because high sugar consumption is a major cause of worsening diabetes. Foods with low glucose levels do not cause spikes. Sharp postprandial glucose spikes. These low glucose levels are achieved thanks to the use of low-glycemic ingredients, namely purple sweet potatoes and kidney beans. Furthermore, cinnamon also plays a role in inhibiting glucose absorption, making F3 an ideal formulation for people with diabetes (Hall, 2021).

Glucose metabolism is a vital process in the body for energy production, particularly for the brain and other body tissues. After eating, glucose from digestion is absorbed by the small intestine and enters the bloodstream, causing blood sugar levels to rise. This increase in glucose levels triggers the pancreas to release the hormone insulin, which helps glucose enter body cells, such as muscle, liver,

and fat tissue, to be used as energy or stored as glycogen. In people with diabetes mellitus (DM), this process is disrupted because insulin is not produced enough (type 1 DM) or the body's cells do not respond properly to insulin (type 2 DM). As a result, glucose builds up in the blood and causes hyperglycemia. Long-term hyperglycemia can cause damage to small blood vessels such as those in the eyes and kidneys, as well as large blood vessels, which can increase the risk of heart disease and stroke. Controlling blood glucose metabolism in individuals with diabetes mellitus is crucial. One approach is to consume foods with a low glycemic index and high in fiber, such as purple sweet potatoes, as these can slow glucose absorption and help maintain stable blood glucose levels (PERKENI, 2024).

Crude Fiber Content

Based on the results of the proximate analysis, F1 cookies using 90 grams of purple sweet potato flour and 10 grams of red bean flour had the highest crude fiber content of 4.02%. F2 cookies with an equal proportion of purple sweet potato flour and red bean flour (50 grams each) contain 2.35 % crude fiber. On the other hand, F3 cookies using 10 grams of purple sweet potato flour and 90 grams of red bean flour contain 2.49 % crude fiber.

Formulation F1 showed the highest crude fiber content due to the use of more purple sweet potato flour. Referring to data from the Indonesian Food Composition Table (TKPI, 2019). Purple sweet potatoes contain higher fiber, namely 4.2 grams compared to red beans, namely 2.1 grams per 100 grams. Therefore, the greater proportion of purple sweet potato flour in F1 may have contributed to its higher crude fiber content.

Although the crude fiber content in the F2 was lower (2.35%), it still provides health benefits, especially if cookies are consumed regularly as part of a fiber-rich diet. Based on the Indonesian Minister of Health Regulation No. 28 of 2019, the daily fiber requirement for adults ranges from 25 to 35 grams, while for people with Diabetes Mellitus it is recommended to consume at least 20 grams of fiber per day. Previous research by Zaddana et al. (2021) reported that cookies made from purple sweet potatoes and red beans contained 16.32% fiber and demonstrated positive physiological effects for individuals with diabetes (Zaddana et al., 2021).

In addition, according to Rakhmayati et al. (2023), cookies formulated with red beans and purple sweet potatoes have a crude fiber content of 2.38%, a result comparable to the F2 and F3 formulations in this study. Although "Ubicang Cinnamon" cookies are not high-fiber products (>5%), they are moderate-fiber products that can contribute positively to meeting daily fiber intake, especially if consumed as a healthy snack (Rakhmayati et al., 2023).

Formulation F3 contains crude fiber derived from red beans and purple sweet potatoes. This fiber provides various benefits in the diet for people with diabetes, such as slowing glucose absorption in the small intestine, reducing HbA1c levels and fasting blood glucose, improving digestive health and gut microbiota balance, and promoting a longer feeling of fullness, which contributes to weight management. According to Xie et al. (2021), in a meta-analysis of 29 RCTs, consuming 7–8 grams of soluble fiber per day can reduce HbA1c by 0.63%, and the FPG content of

0.89 mmol/L was significant. The fiber content in F3 helps meet daily fiber needs, which is important in managing the diet of people with diabetes (Xie et al., 2021).

CONCLUSION

The three cookie formulations showed significant differences in color, aroma, texture, and flavor ($p < 0.05$). Formulation F2, containing an equal proportion of purple sweet potato and red bean flours, had the highest organoleptic acceptance, with the highest mean ranks for color, aroma, texture, flavor, and an overall preference score of 3.15. Formulation F1 had the highest crude fiber content (4.02 g/100 g), while F3 had the lowest glucose content (10.98 g/100 g). Based on its organoleptic acceptability and nutritional characteristics, F2 showed potential as an alternative snack to support dietary management of Diabetes Mellitus.

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Author Contribution Statement

Yendea Dwi Agustin: Conceptualization, Methodology, Formal analysis, Investigation, Data Curation, Writing – Original Draft. **Jumiyati Jumiyati:** Conceptualization, Methodology, Supervision, Project administration, Writing, Review & Editing. **Okdi Natan:** Methodology, Software, Validation, Formal analysis. **Arie Krisnasary:** Investigation, Resources, Data Curation, Validation. **Desri Suryani:** Conceptualization, Resources. **Fatma Laili Khoirunnida:** Writing, Review & Editing. All authors have read and agreed to the published version of the manuscript.

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