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Analysis of Acceptability, Proximate Composition, and Dietary Fiber Content of Cookies Made with Sorghum Flour (*Sorghum bicolor* L.) and Winged Bean Seed Flour (*Psophocarpus tetragonolobus* L.) Substitution

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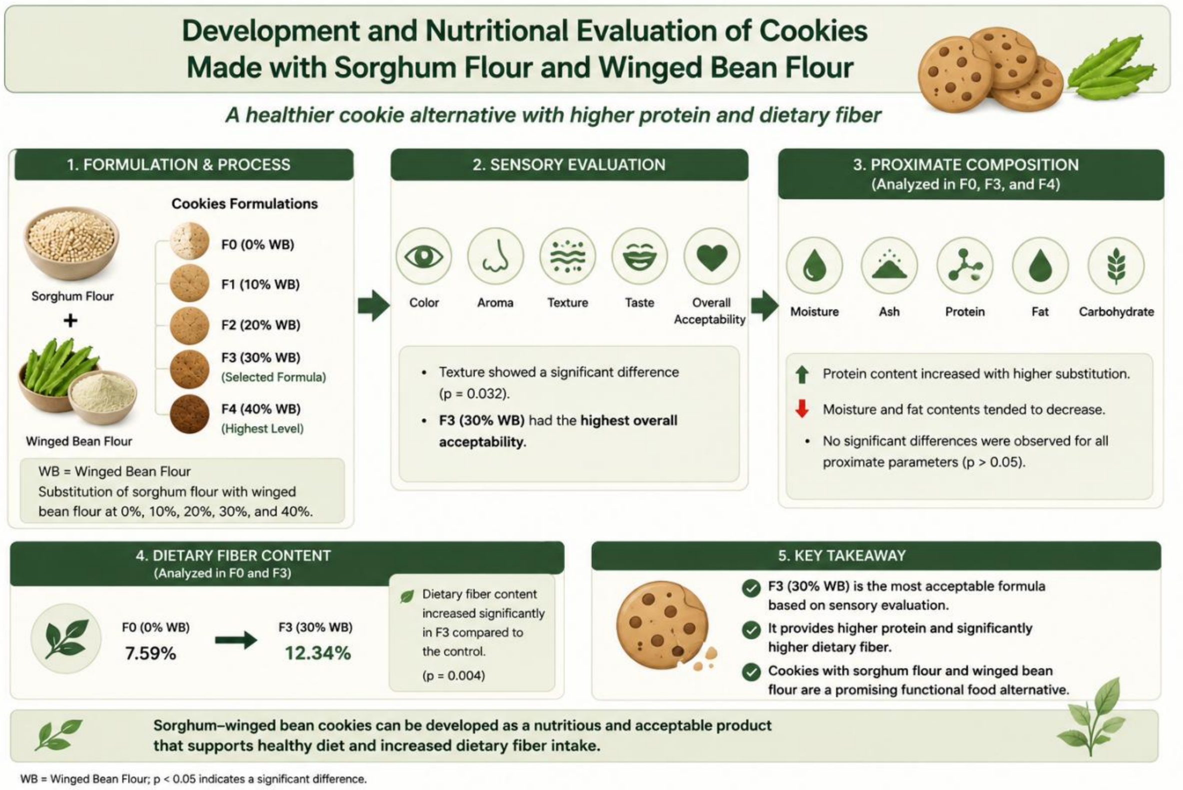
ABSTRACT

The high consumption of wheat flour has increased wheat import dependency. In addition, wheat contains gluten, which may trigger digestive disorders in susceptible individuals. Sorghum (*Sorghum bicolor* L.) and winged bean seed (*Psophocarpus tetragonolobus* L.) flours, which are rich in protein and dietary fiber and naturally gluten-free, have the potential to be used as alternative ingredients in cookie production. This study aimed to evaluate the organoleptic properties, determine the best formulation, and analyze the proximate composition and dietary fiber content of cookies substituted with sorghum flour and winged bean seed flour. This experimental study employed a Completely Randomized Design (CRD) consisting of five formulations. Organoleptic evaluation was conducted by 30 untrained panelists. Organoleptic data were analyzed using the Kruskal–Wallis and Mann–Whitney tests, while proximate composition and dietary fiber data were analyzed using One-Way ANOVA followed by Duncan's Multiple Range Test (DMRT). The results showed that only the texture parameter differed significantly among the formulations, whereas color, aroma, and taste showed no significant differences. Formulation F3 (50% sorghum flour and 30% winged bean seed flour) was selected as the best formulation based on the highest overall organoleptic score. The proximate composition of F3 consisted of 2.60% moisture, 2.16% ash, 15.76% protein, 35.83% fat, and 46.35% carbohydrates, with a dietary fiber content of 12.34%. The substitution significantly increased the dietary fiber content but did not significantly affect the proximate composition. In conclusion, the substitution of sorghum flour and winged bean seed flour improved the dietary fiber content of cookies while maintaining acceptable sensory characteristics, with a significant effect observed only on texture.

Key Messages:

- Sorghum and winged bean seed flour substitution increased the dietary fiber content of cookies.
- The F3 formulation showed the highest overall organoleptic acceptability.
- The findings support the use of local gluten-free flours as alternatives to wheat flour in cookie production.

GRAPHICAL ABSTRACT



INTRODUCTION

Wheat flour is one of the most widely consumed food ingredients in Indonesia. According to the Indonesian Ministry of Agriculture, wheat flour consumption reached approximately 6.75% during the 2022–2023 period and continues to increase by around 2–3% annually. As wheat cannot be cultivated commercially in most regions of Indonesia, the increasing demand has resulted in greater dependence on imported wheat. This situation highlights the need to develop alternative food products based on locally available crops to support food diversification and reduce reliance on imported raw materials (1).

In addition to economic concerns, excessive wheat consumption may also present health challenges. Wheat contains gluten, a storage protein that provides desirable baking characteristics but may trigger adverse reactions in individuals with celiac disease or gluten sensitivity (2,3). Gluten consumption has also been associated with gastrointestinal disorders and may aggravate behavioral symptoms in certain individuals with autism spectrum disorder and attention-deficit/hyperactivity disorder (ADHD) (4).

Sorghum (*Sorghum bicolor* L. Moench) is a promising cereal crop that can be cultivated under tropical and drought-prone conditions, making it suitable for many regions of Indonesia (5). Sorghum is naturally gluten-free and contains dietary fiber, phenolic compounds, and antioxidants that may provide health benefits. Furthermore, sorghum has a relatively low glycemic index, making it a suitable ingredient for individuals requiring better glycemic control (6).

Winged bean (*Psophocarpus tetragonolobus* L.) is another indigenous crop with considerable nutritional potential. Its seeds contain high levels of protein, dietary fiber, minerals, and essential nutrients, with a nutritional profile comparable to soybean (7). Nevertheless, winged bean remains an underexploited food resource despite its potential to improve the nutritional quality of processed food products. The incorporation of winged bean flour into cereal-based products may enhance protein and dietary fiber contents while promoting the utilization of local agricultural commodities (8).

Cookies are widely consumed snack products due to their convenience, long shelf life, and high consumer acceptance. Their formulation also allows partial substitution of wheat flour with alternative flours without substantially affecting product quality. Consequently, cookies provide an appropriate food matrix for

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incorporating sorghum flour and winged bean flour to produce value-added products with improved nutritional quality (SNI-2973-2022).

Previous studies have demonstrated the successful application of sorghum flour in cookies and biscuits, while winged bean flour has been incorporated into brownies, tempeh, and other food products to improve nutritional value. Cookies containing 50% sorghum flour have been reported to achieve favorable sensory acceptance, whereas winged bean flour has been shown to increase protein content in several processed foods (8–10). However, limited studies have investigated the combined substitution of sorghum flour and winged bean flour in cookies while simultaneously evaluating sensory acceptability, proximate composition, and dietary fiber content. This represents an important research gap in the development of nutritious bakery products based on local ingredients.

Therefore, this study aimed to evaluate the sensory acceptability, determine the optimum formulation, and analyze the proximate composition and dietary fiber content of cookies prepared with sorghum flour and winged bean flour substitution. The findings are expected to contribute to the development of high-protein and high-fiber cookies utilizing local food resources while supporting food diversification and reducing dependence on imported wheat flour.

METHODS

This experimental study employed a Completely Randomized Design (CRD) consisting of five cookie formulations with different proportions of sorghum flour (*Sorghum bicolor* L.) and winged bean flour (*Psophocarpus tetragonolobus* L.). This study was conducted from October 2024 to June 2025. Sorghum and winged bean seeds were obtained from local farms in Bandung, West Java, Indonesia. Cookie preparation was carried out in a home kitchen under standardized processing conditions. Organoleptic evaluation was conducted at the Organoleptic Laboratory. Proximate analyses, including moisture, ash, protein, fat, and carbohydrate contents, were performed at the Nutrition Laboratory. Dietary fiber analysis was conducted at PT Saraswanti Indo Genetech (SIG Laboratory), Banyumanik, Semarang, Indonesia.

Five cookie formulations (F0–F4) were prepared using different substitution levels of wheat flour with sorghum flour and winged bean flour, while the amounts of the remaining ingredients were kept constant (Table 1). F0 served as the control formulation containing 100% wheat flour. In F1–F4, sorghum flour was maintained at 50% of the total flour, whereas winged bean flour substitution increased from 10% to 40%, resulting in a proportional decrease in wheat flour content.

The organoleptic evaluation involved 30 untrained panelists selected to assess consumer acceptance. Each panelist evaluated the cookie samples for color, aroma, taste, and texture using a 5-point hedonic scale, where 1 = strongly dislike, 2 = dislike, 3 = moderately like, 4 = like, and 5 = strongly like. Drinking water was provided between samples to minimize sensory bias. Each panelist evaluated the five coded cookie samples presented in a randomized order. Each panelist evaluated all five cookie formulations.

The formulation with the highest overall sensory acceptance was selected for laboratory analysis. Proximate analysis included determination of moisture content, ash content, protein, fat, and carbohydrate. Moisture content was determined using the oven drying method, ash content by dry ashing in a muffle furnace, protein content by the Kjeldahl method, fat content by the Soxhlet extraction method, and carbohydrate content was calculated by difference according to the Association of Official Analytical Chemists (AOAC, 2005) procedures. Total dietary fiber was determined using the AOAC (1992) enzymatic–gravimetric method.

Sensory data were analyzed using IBM SPSS Statistics. Since the hedonic data were ordinal, differences among formulations were analyzed using the Kruskal–Wallis test, followed by the Mann–Whitney U test for pairwise comparisons when significant differences were observed. Proximate composition and dietary fiber data were analyzed using one-way analysis of variance (ANOVA) under a Completely Randomized Design. Significant differences among treatments were further analyzed using Duncan's Multiple Range Test (DMRT) at a significance level of $p < 0.05$.

Formal ethical approval was not required for this study because it involved only sensory evaluation of food products by healthy adult volunteers and did not involve patients, medical interventions, or animal experiments. Before participating, all panelists received an explanation of the study procedures and voluntarily provided informed consent. Participation was voluntary, and all responses were kept confidential.

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Table 1. *Formulation of cookies with sorghum flour and winged bean flour substitution.*

Ingredient	F0 (Control)	F1	F2	F3	F4
Margarine (g)	115	115	115	115	115
Granulated sugar (g)	65	65	65	65	65
Palm sugar (g)	65	65	65	65	65
Chicken egg (g)	55	55	55	55	55
Chocolate chips (g)	30	30	30	30	30
Baking soda	½ tsp	½ tsp	½ tsp	½ tsp	½ tsp
Vanilla	½ tbsp	½ tbsp	½ tbsp	½ tbsp	½ tbsp
Wheat flour (g)	185 (100%)	74 (40%)	55.5 (30%)	37 (20%)	18.5 (10%)
Sorghum flour (g)	0 (0%)	92.5 (50%)	92.5 (50%)	92.5 (50%)	92.5 (50%)
Winged bean flour (g)	0 (0%)	18.5 (10%)	37 (20%)	55.5 (30%)	74 (40%)

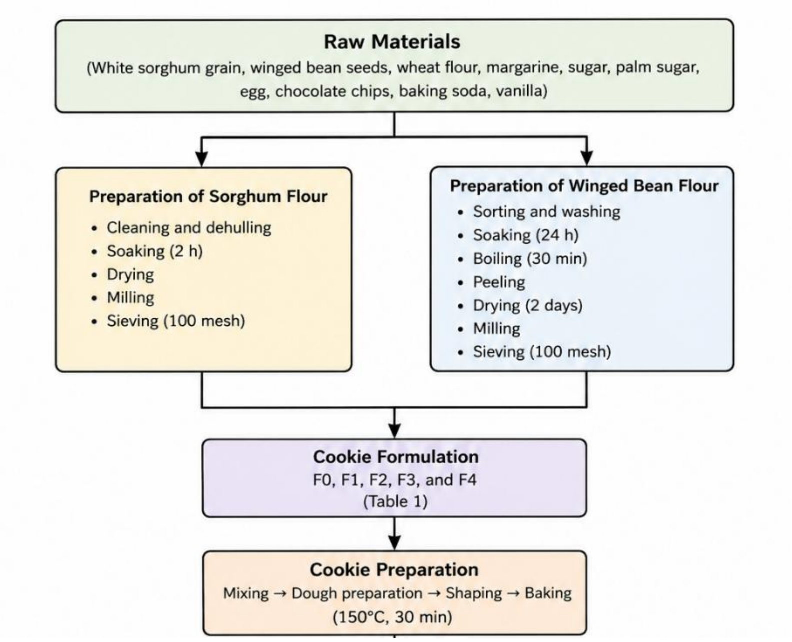

Figure 1. *Cookies Making Procedure*

RESULTS

The physical appearance of the cookies produced from each formulation is presented in Figure 1. Visual observation showed noticeable differences in color among the formulations as the proportion of winged bean flour increased. The control formulation (F0) exhibited a light brown color, while the substituted formulations (F1–F4) gradually developed a darker brown appearance. Despite these color variations, all formulations produced cookies with a uniform round shape, smooth surface, and compact structure, indicating that the substitution of sorghum flour and winged bean flour did not adversely affect the overall physical quality of the cookies. Cookies product development resultare presented in Figure 2.

Figure 2. *Cookies Product Development Result*

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The sensory evaluation was conducted to assess consumer acceptance of cookies formulated with different proportions of sorghum flour and winged bean flour. The evaluated sensory attributes included color, aroma, texture, taste, and overall acceptability. The mean sensory scores and statistical analysis are presented in Table 2.

Table 2. *Mean Sensory Scores Of Cookies Formulations*

Parameter	F0	F1	F2	F3	F4	p-value
Color	4.37±0.61	4.20±0.80	4.37±0.80	4.27±0.90	4.10±0.99	0.820
Aroma	4.20±0.88	3.87±0.86	3.93±0.78	4.00±0.69	3.60±0.89	0.089
Texture	4.03±0.81	3.87±0.94	4.07±0.91	4.43±0.73	4.40±0.81	0.032*
Taste	4.20±0.89	4.03±1.00	4.33±0.71	4.27±0.87	3.37±1.20	0.289
Overall	4.20±0.57	3.99±0.70	4.17±0.57	4.24±0.60	3.95±1.72	0.390

Significant at $p < 0.05$.

The sensory evaluation showed that only texture differed significantly among formulations ($p = 0.032$). Formulations F3 and F4 obtained the highest texture scores, while no significant differences were observed for color, aroma, taste, or overall acceptability ($p > 0.05$). Overall, F3 showed the highest consumer preference.

Proximate analysis was performed only on selected cookie formulations based on the sensory evaluation results. The control formulation (F0) was included as a reference, F3 was selected because it demonstrated the highest overall sensory acceptability, and F4 was included to represent the formulation with the highest level of winged bean flour substitution (40%). This selection was intended to compare the nutritional composition of the control, the most acceptable formulation, and the formulation with the maximum substitution level. The results of the proximate analysis are presented in Table 3.

Table 3. *Proximate Composition of Selected Cookie Formulations*.

Parameter	F0	F3	F4	p-value
Moisture (%)	3.20±0.20	2.60±0.20	2.80±0.53	0.178
Ash (%)	1.50±1.32	2.16±1.26	3.66±0.76	0.136
Protein (%)	7.70±1.73	13.04±4.51	16.54±8.23	0.221
Fat (%)	41.83±6.44	35.83±3.64	36.83±1.76	0.278
Carbohydrate (%)	45.76±8.73	46.35±2.16	40.48±6.60	0.510

Protein content increased with higher substitution of winged bean flour, reaching the highest value in F4 (16.54%). Meanwhile, moisture and fat contents tended to decrease compared with the control formulation. However, no statistically significant differences were observed among formulations for moisture, ash, protein, fat, or carbohydrate contents ($p > 0.05$).

Dietary fiber analysis was conducted only on the control formulation (F0) and the selected formulation (F3). The F3 formulation was chosen because it achieved the highest overall acceptability in the sensory evaluation and was considered the most suitable formulation for further nutritional evaluation. Due to budget limitations, dietary fiber analysis was not performed on all formulations. The results are presented in Table 4.

Table 4. *Dietary Fiber Content of Cookies.*

Formulation	Dietary Fiber (%)
F0	7.59±0.23^{a}
F3	12.34±0.38^{b}

P = 0,004
Note: Different superscript letters (a, b) indicate significant differences between formulations ($p < 0.05$).

Formulation	Dietary Fiber (%)	p-value
F0	7.59±0.23	
F3	12.34±0.38	0.004*

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Dietary fiber content increased significantly after substitution with sorghum and winged bean flours. F3 contained significantly higher dietary fiber (12.34%) than the control (7.59%) ($p = 0.004$).

The nutritional composition of the cookies was compared with the requirements of the Indonesian National Standard (SNI 2973:2022) and the Indonesian Food and Drug Authority regulation regarding high-fiber claims. The comparison is presented in Table 5.

Table 5. Comparison of Laboratory Results with Indonesian National Standard (SNI 2973:2022).

Parameter	F0	F3	F4	SNI Requirement
Moisture (%)	3.20	2.60	2.80	≤5%
Ash (%)	1.50	2.16	3.66	≤1.5%
Protein (%)	7.70	13.04	16.54	≥4.1%
Fat (%)	41.83	35.83	36.83	-
Carbohydrate (%)	45.76	46.35	40.48	-
Dietary Fiber(%)	7.59	12.34	-	≥6 g/100 g (High fiber claim)

Based on Table 5, all formulations met the moisture and protein requirements specified by SNI 2973:2022. In addition, the selected formulation met the Indonesian criteria for a high-fiber food claim, containing more than 6 g of dietary fiber per 100 g of product.

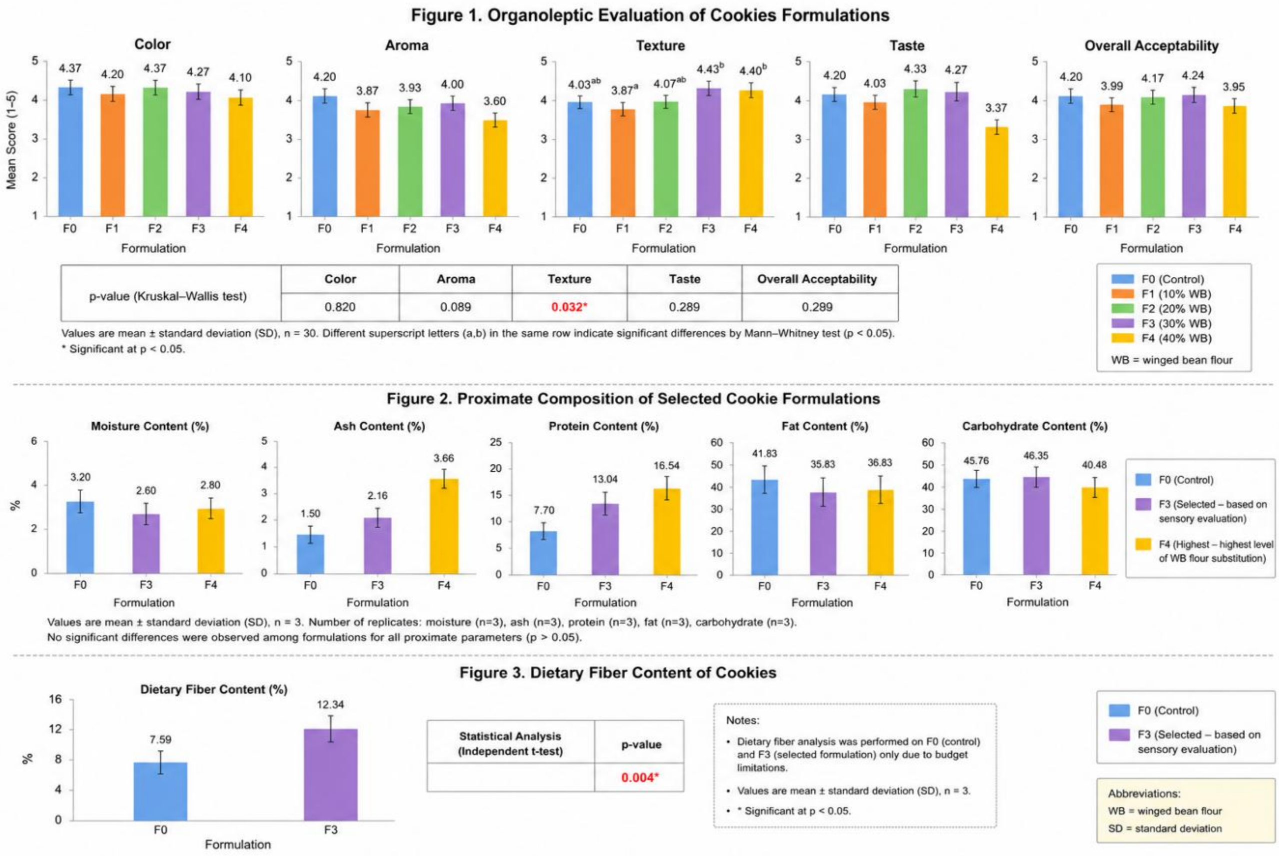

Figure 3. *Summary of the Sensory Evaluation, Proximate Composition, and Dietary Fiber Content of Cookies Formulated with Sorghum Flour and Winged Bean Flour*

DISCUSSION

The present study evaluated the sensory acceptability and nutritional composition of cookies formulated with partial substitution of wheat flour by sorghum flour (*Sorghum bicolor* L.) and winged bean flour (*Psophocarpus tetragonolobus* L.). Overall, the findings demonstrate that the substitution successfully improved

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the nutritional quality of the cookies while maintaining acceptable sensory characteristics. The organoleptic evaluation showed that the substitution of wheat flour with sorghum flour and winged bean flour significantly influenced the sensory characteristics of the cookies. Among the five formulations, F3 (20% wheat flour, 50% sorghum flour, and 30% winged bean flour) obtained the highest overall acceptance score and was therefore selected as the optimum formulation. The formulation achieved high consumer preference across the evaluated attributes, including color, aroma, taste, and texture.

The superior acceptance of F3 indicates that the combination of 50% sorghum flour and 30% winged bean flour provided a balance between improved nutritional quality and desirable sensory properties. Although increasing the proportion of winged bean flour enhanced the nutritional profile, excessive substitution, as observed in F4 (40% winged bean flour), tended to reduce consumer acceptance. This decline may be associated with the characteristic beany flavor of winged bean and the darker color produced by higher concentrations of sorghum flour (11). Higher substitution levels slightly reduced taste preference, particularly in F4, probably due to the characteristic beany flavor produced by lipoxygenase activity in legumes (12).

The darker appearance of the substituted cookies is mainly attributed to the natural pigments present in sorghum and to the Maillard reaction occurring during baking (13). Meanwhile, winged bean flour contributes a distinctive aroma that becomes more noticeable as its concentration increases. These findings indicate that moderate substitution levels can improve nutritional value while maintaining acceptable sensory quality.

The results of this study align with previous research, which reported that cookies with a 50% sorghum flour substitution achieved the highest sensory acceptability (14). Furthermore, products made from winged bean seeds are still acceptable to consumers if the substitution level is well controlled (15). Therefore, this study confirms that the combination of sorghum flour and winged bean flour has the potential to produce cookies with better nutritional quality without reducing consumer preference. The absence of significant differences may also be explained by the use of untrained panelists and the relatively small sample size, which reduced the sensitivity for detecting subtle differences among formulations (13).

Partial substitution of wheat flour with sorghum flour and long bean flour substantially improved the nutritional composition of the cakes. The moisture content remained below the maximum limit specified by the Indonesian National Standard (SNI 2973:2022), indicating that all cake formulations met national quality standards. Low moisture content is important because it contributes to a crispy texture and extends the product's shelf life by inhibiting microbial growth.

The relatively low moisture level can be explained by the baking process, during which water evaporates efficiently. Sorghum flour also exhibits a lower gluten content than wheat flour, which affects its water-binding capacity during baking. The dietary fiber content of both flours is also affected because fiber has the ability to absorb water. However, during the baking process, products with higher fiber content tend to experience greater water loss due to their lower water-holding capacity after drying (16).

Ash content increased slightly with increasing substitution levels, reflecting the higher mineral content naturally present in sorghum and winged bean flour. Although the increase was relatively small, it indicates improved mineral availability in the substituted formulations. This observation is consistent with previous studies reporting that sorghum and legumes generally possess higher mineral concentrations than refined wheat flour (17).

Protein content increased significantly with increasing proportions of winged bean flour, reaching its highest value in F4. Winged bean is known to be an excellent source of vegetable protein, containing over 30% protein with a favorable amino acid profile. Furthermore, the combination of cereal protein from sorghum with legume protein from winged bean can improve overall protein quality through complementary amino acid compositions. Consequently, F3 and F4 can be considered protein-enriched cookies compared to conventional wheat cookies. Protein content increased substantially with increasing levels of winged bean flour substitution. The control formulation (F0) contained 7.70% protein, while the selected formulation (F3) reached 13.04%, and the highest substitution (F4) reached 16.54% protein. Compared to the control, protein increased by approximately 54% in F3 and 58% in F4, indicating that winged bean flour functions as an effective protein enhancer.

This increase is primarily due to the high protein content of winged bean flour, which contains approximately 30–35 g of protein per 100 g, significantly higher than wheat flour. Sorghum flour also contributes protein, although its quality is affected by the presence of the protein kafirin. Consequently, the combination of

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sorghum flour and winged bean flour produces cookies with significantly better nutritional value. This finding aligns with research showing increased protein content after the addition of winged bean flour to several products, such as bakery products (15,18).

In this study the control cookies (F0) contained 41.83% fat, whereas F3 and F4 contained 35.83% and 36.83%, respectively. Although the statistical difference was not significant, a decreasing trend in fat content was observed after wheat flour was partially replaced with sorghum and winged bean flours. The reduction in fat content may be attributed to the higher dietary fiber content of sorghum and winged bean flours, which can bind lipids within the food matrix and reduce their extractability during Soxhlet analysis (16). In addition, part of the lipid fraction may exist as bound fat, which is associated with proteins and fiber, making it less accessible to non-polar solvents (13,19). These findings are similar to studies that observed that increasing fiber content reduces the amount of fat extracted from cookies (20). These results suggest that substituting wheat flour with sorghum and winged bean flours can increase the nutritional value of cookies without significantly affecting their fat content.

Carbohydrates are the major macronutrient in cookies and serve as the primary source of energy. The carbohydrate content was 45.76% in the control cookies (F0), 46.35% in F3, and decreased to 40.48% in F4. Although no significant difference was observed, the highest substitution level (F4) showed a lower carbohydrate content than the control. The decrease in carbohydrate content at higher substitution levels attributed to the replacement of wheat flour, which is rich in starch, with sorghum and winged bean flours that contain relatively higher amounts of protein and dietary fiber. Consequently, the proportion of digestible carbohydrates in the formulation decreased (12)

Dietary fiber is an important functional component that provides various health benefits, including improving digestive health and reducing the risk of metabolic diseases (3). The control cookies (F0) contained 7.59% dietary fiber, whereas the selected formulation (F3) reached 12.34%, representing an increase of approximately 63%. This result demonstrates that the incorporation of sorghum and winged bean flours effectively enhanced the functional value of the cookies.

The increase in dietary fiber is attributed to the naturally high fiber content of both sorghum and winged bean flours. Winged bean flour is rich in insoluble fiber, including cellulose and lignin, while sorghum contains arabinoxylan and other hemicellulose fractions that contribute to total dietary fiber. These fiber components are relatively heat stable, allowing them to be retained during baking (12). Based on the Indonesian National Agency of Drug and Food Control (21), foods containing at least 6 g of dietary fiber per 100 g may be classified as high-fiber foods. Therefore, the F3 formulation meets the criteria for a high-fiber product and has the potential to serve as a functional snack with improved nutritional quality.

The present findings demonstrate that sorghum flour and winged bean flour can effectively replace a substantial proportion of wheat flour while maintaining acceptable sensory quality and significantly improving nutritional value. The selected formulation (F3) offers an appropriate balance between consumer preference and enhanced protein and dietary fiber contents. These findings support the utilization of locally available crops as functional food ingredients, contributing to food diversification, strengthening national food security, and reducing dependence on imported wheat.

CONCLUSION

This study demonstrated that partial substitution of wheat flour with sorghum and winged bean flours can improve the nutritional quality of cookies while maintaining acceptable sensory characteristics. Among the formulations tested, F3, containing 20% wheat flour, 50% sorghum flour, and 30% winged bean flour, was the most preferred and showed the highest dietary fiber content, reaching 12.34%, which meets the Indonesian criterion for high-fiber food. These findings indicate that sorghum and winged bean flours have potential for developing cookies with improved dietary fiber content and acceptable sensory characteristics. However, this study had several limitations, including the use of only 30 untrained panelists for sensory evaluation and the limited analysis of dietary fiber in only two formulations due to budget constraints. Future studies should involve a larger and more diverse panel, assess shelf life and other functional properties, and evaluate additional nutritional parameters such as mineral composition and antioxidant activity.

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CONFLICTS OF INTEREST

The authors declare that there is no conflict of interest associated with this study.

REFERENCES

1. Kementerian Pertanian Republik Indonesia. Statistik Konsumsi Pangan. Jakarta: Pusat Data dan Sistem Informasi Pertanian; 2023.
2. Shewry P. What Is Gluten—Why Is It Special? Front Nutr. 2019;6:101. doi:10.3389/fnut.2019.00101
3. Verma AK. Nutritional Deficiencies in Celiac Disease: Current Perspectives. Nutrients. 2021;13(12):4476. doi:10.3390/nu13124476
4. Bagaskorowati R, Ayesadira M, Ramadhanti F, Sumantri VAR. Urgensi Diet Gluten Dancasein Freepadahiperaktivitas Individu Autisme dan Adhd. J Innov Research Knowl. 2022;1(10):1399–404.
5. Wulandari E, Sukarminah E, Lembong E. Sosialisasi Diversifikasi Produk Pangan Fungsional Berbasis Sorgum di Desa Cimanggu Kecamatan Pameungpeuk Kabupaten Banjaran. Dharmakarya. 2020;9(4):232. doi:10.24198/dharmakarya.v9i4.19783
6. Rahmawati YD, Wahyani AD. Sifat Kimia Cookies dengan Substitusi Tepung Sorgum. J Teknol Agro-Industri. 2021;8(1):42–54. doi:10.34128/jtai.v8i1.135
7. Kementerian Kesehatan Republik Indonesia. Tabel Komposisi Pangan Indonesia. Jakarta: Kementerian Kesehatan Republik Indonesia; 2018.
8. Fitri N. Uji Daya Terima dan Nilai Kandungan Gizi Biskuit dari Tepung Sorgum Modifikasi Tepung Ubi Jalar Ungu [skripsi]. Medan: Universitas Islam Negeri Sumatera Utara; 2020.
9. Mukhlishah N, Mahi F, Herawaty H. Kandungan Protein dan Penilaian Panelis terhadap Brownies Tepung Biji Kecipir dengan Penambahan Bubuk Kayu Manis. JSSHA ADPERTISI J. 2023;3(1):1–8. doi:10.62728/jsshha.v3i1.440
10. Hermeni H, Jumiyati J, Yulianti R. Daya Terima, Mutu Hedonik dan Profil Nilai Gizi Kukis Substitusi Tepung Sorgum (Sorghum bicolor). Ghidza J Gizi dan Kesehat. 2023;7(2):234–44. doi:10.22487/ghidza.v7i2.1036
11. Haryasyah C, Nurwitri C, Budijanto S. Produksi Konsentrat Biji Kecipir serta Analisis Sifat Fisikokimia dan Fungsionalnya [skripsi]. Bogor: Institut Pertanian Bogor; 2009.
12. Ijarotimi OS, Esho FR, Adeoti OA. Nutritional, functional and organoleptic evaluation of cookies made from wheat flour and fermented groundnut–Bambara groundnut flour blends. Heliyon. 2018;4(10):e00848. doi:10.1016/j.heliyon.2018.e00848
13. Damodaran S, Parkin KL. Fennema's Food Chemistry. 5th ed. Boca Raton: CRC Press; 2017. doi:10.1201/9781315372914
14. Chen S, Wang L, Ni D, Lin L, Wang H, Xu Y. Characterization of Aroma Compounds in Cooked Sorghum Using Comprehensive Two-Dimensional Gas Chromatography-Time-of-Flight Mass Spectrometry and Gas Chromatography-Olfactometry-Mass Spectrometry. Molecules. 2021;26(16):4796. doi:10.3390/molecules26164796
15. Santosa AP, Nugroho B, Ningtyas A. Peningkatan Nilai Gizi dan Daya Terima Sensoris Pada Tempe Biji Kecipir (Psophocarpus tetragonolobus L) dengan Penambahan Biji Wijen. Agritech J Fak Pertan Univ Muhammadiyah Purwokerto. 2019;21(1):74. doi:10.30595/agritech.v21i1.4727
16. Sharma P, Gujral HS, Singh B. Nutritional and quality characteristics of cookies prepared from sorghum flour. J Food Sci Technol. 2016;53(1):739–47. doi:10.1007/s13197-015-2032-5
17. Ojo MO, Ogunlakin GO, Ade OO. Nutritional and functional properties of flour and cookies from germinated and fermented winged bean (Psophocarpus tetragonolobus). Food Sci Nutr. 2017;5(3):776–83. doi:10.1002/fsn3.449
18. Rasunah, Ahadi NM. Potensi Tepung Biji Kecipir (Psophocarpus tetragonolobus) sebagai Alternatif Nutrisi Protein dalam Pembuatan Kue Brownies Berbasis Ecogreen dan Daya Terima. Lentera Karya J Ilm Pendidikan, Sejarah, dan Hum. 2021;5(5):47–56.
19. Dwi WK, Wulandari A. Analisa Proksimat Cookies dengan Substitusi Tepung Lokal. Agrointek J Teknol Ind Pertan. 2022;16(1):96–103. doi:10.21107/agrointek.v16i1.12562

https://doi.org/10.56303/jian.v1i2.1586

20. Mubarok AZ, Winata A. Pengaruh Substitusi Tepung Terigu dengan Tepung Umbi Dahlia dan Konsentrasi Baking Powder terhadap Karakteristik Fisik Cookies Kaya Serat. J Apl Teknol Pangan. 2020;9(4):175–80. doi:10.17728/jatp.5864
21. Badan Pengawas Obat dan Makanan Republik Indonesia. Peraturan Badan Pengawas Obat dan Makanan Nomor 22 Tahun 2019 tentang Informasi Nilai Gizi pada Label Pangan Olahan. Jakarta: Badan Pengawas Obat dan Makanan Republik Indonesia; 2019.

https://doi.org/10.56303/jian.v1i2.1586