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Nutritional, Sensory, and Glycemic Characterization of Functional Noodles Substituted with Beneng Taro, Red Beans, and Moringa Leaves

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ORIGINAL ARTICLES

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ABSTRACT

The increasing trend of consuming ultra-processed foods, such as instant noodles, necessitates the development of healthier and more functional food alternatives. This study aimed to develop functional dry noodles by partially substituting wheat flour with local Banten ingredients: Beneng taro, red beans, and Moringa leaves. The experiment utilized a completely randomized design (CRD) with three substitution treatment levels (F1, F2, F3) replicated three times. The nutritional quality of each formula was determined through proximate analysis and dietary fiber content. Sensory quality was assessed using hedonic and quality hedonic tests involving 30 semi-trained panelists. The selected formula was determined through a combined scoring of nutritional and sensory analysis results, followed by Glycemic Index (GI) testing. Based on the scoring, Formula F3 with a ratio of wheat flour : taro flour : red bean flour : moringa leaf flour : taro starch, namely F3 (50 g:17.5 g:17.5 g:5 g:10 g) was selected as the optimal formula, containing per 100g: 389.98 kcal energy, 13.52 g protein, 4.06 g fat, 60.93 g carbohydrate, and 11.08 g dietary fiber. Sensory evaluation showed that panelists liked the color and aroma parameters of F3, and slightly liked the texture, taste, and overall attributes. F3 meets the nutrition label claims as a "source of protein" (22.53% ALG - Acuan Label Gizi/Nutrition Label Reference) and "high in fiber" (36.93% ALG). Furthermore, F3 yielded a Glycemic Index of 62.19 (medium category) with a Glycemic Load of 18.94 (medium category). Thus, this functional dry noodle product has the potential to be a healthy food alternative, serving as a source of protein and high in fiber, while exhibiting a controlled glycemic response.

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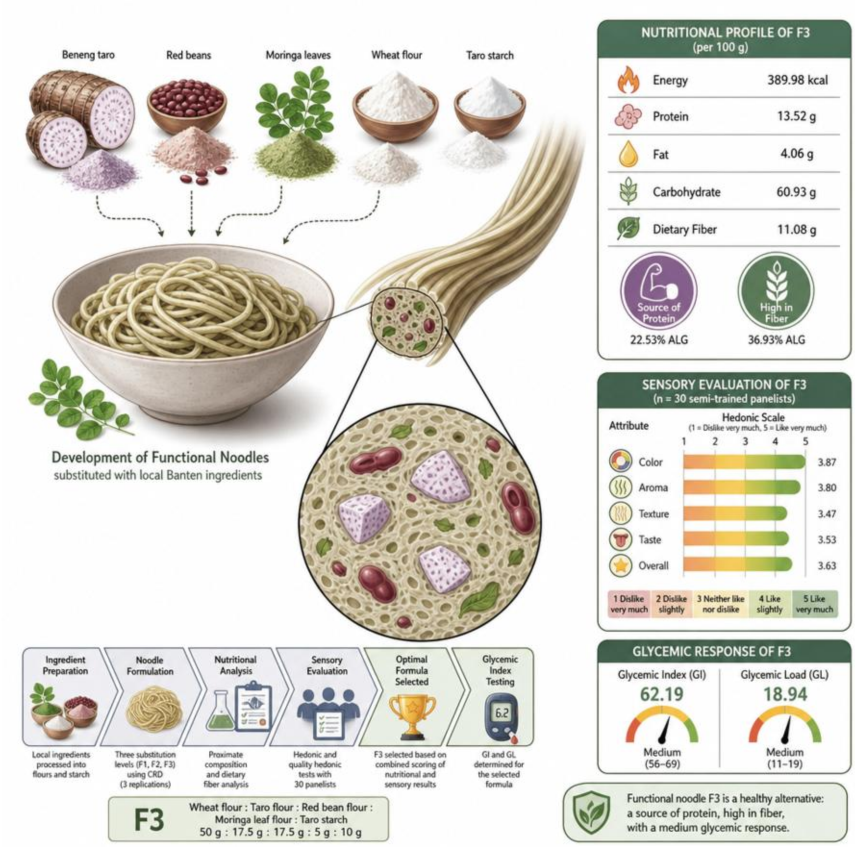
Key Messages:

- Formulating dry noodles with a partial substitution of Beneng taro, red beans, and Moringa leaves produces a healthier, sensorially acceptable alternative to standard instant noodles that is high in dietary fiber, serves as a solid source of protein, and maintains a controlled, medium glycemic response.

GRAPHICAL ABSTRACT



INTRODUCTION

The prevalence of overweight and obesity in Indonesia continues to rise, particularly in the productive age group. The consumption of ultra-processed foods, such as sweetened beverages, ice cream, and instant noodles, is one of the direct causes of weight problems. Instant noodles, a popular and convenient food, typically consist of dried noodles made from wheat flour and are high in calories but low in fiber, contributing to central obesity and hyperglycemia when consumed excessively (1). In addition, the high dependence on wheat flour in Indonesia presents an opportunity for substitution with local alternatives (2).

Globally, dried noodle consumption reached 121.2 billion servings per year in May 2023, with Indonesia being the second-largest consumer (3). To address these health concerns, developing healthier and more nutritious dried noodle alternatives is necessary. This study focused on leveraging local ingredients for substitution: Beneng taro, a local tuber from Banten, rich in carbohydrates and dietary fiber; red bean flour, source of protein and dietary fiber; and moringa leaf flour, complementing micronutrients and adding functional value.

Beneng taro flour contains 81.81% carbohydrates, 6.73% protein, and 0.17% fat (4). However, processed products made from beneng taro flour have a lower protein content compared to regular wheat flour, which ranges from 8–14% (5). Therefore, red beans can be a good legume option to increase protein content for the development of functional noodles. Red beans can increase the fiber content in dried noodles and can be used as a wheat flour substitute because they have a low glycemic index (6). The leaves of moringa contain high levels of flavonoids, phenolics acids, vitamins, and essential mineral (7). The addition of moringa leaves to the noodle formulation is necessary to enhance nutritional content and provide added value (8). This combination of ingredients is expected to offer an alternative to dry noodles that can help prevent health issues such as obesity and overweight by providing better nutritional content and helping to control blood sugar levels.

The core problem addressed by this research was how to develop functional dried noodles by substituting wheat flour with a combination of Beneng taro, red bean, and moringa leaf flours, aiming for a

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nutritious dried noodle, has a low glycemic index, and is acceptable to consumers. The specific objectives were to: develop the best formulation, analyze the chemical (proximate, fiber, GI) and sensory quality, and analyze the glycemic response of the selected formula.

METHODS

Research Type and Design

This experimental study used a completely randomized design (CRD) with three treatment levels and three replicates. The experimental unit in this study was one serving of dry noodles substituted with taro beneng flour, red beans, and moringa leaves. The treatment levels used a ratio of wheat flour : beneng taro flour : red bean flour : moringa leaf flour : beneng taro starch, namely F1 (50g:15g:22g:3g:10g), F2 (50g:21g:15g:4g:10g), and F3 (50g:17.5g:17.5g:5g:10g).

Place and Time of Research

The production of red bean flour, moringa leaf flour, and dried noodles was carried out at the Laboratory (Food Processing), Sensory Analysis (Organoleptic Laboratory), and Glycemic Index Testing (Nutritional Status Assessment Laboratory) of the Nutrition Study Program at Sultan Ageng Tirtayasa University. Proximate analysis and dietary fiber analysis were conducted at the Saraswanti Indo Genetech Laboratory. The research was conducted from May to October 2025.

Materials and Tools

The dry noodle ingredients used in this study were beneng taro flour, red bean flour, moringa leaf flour, wheat flour, beneng taro starch, eggs, salt, garlic powder, oil, and water. The raw materials included commercial wheat flour, Beneng taro flour (from UMKM Unni Talas Beneng), and self-prepared red bean and moringa leaf flours. Noodle processing involved mixing all ingredients, kneading, resting (20 minutes), sheeting, cutting, steaming (5 minutes), and drying using a dehydrator at 80°C for 3 hours to produce the dried noodles. The chemicals used for proximate analysis include methanol, ethanol, acetone, benzene, sulfuric acid, perchloric acid, diethyl ether, copper sulfate, anhydrous sulfate, mercury oxide, sodium hydroxide, hydrochloric acid, boric acid, ethanol, and distilled water. The materials used for IG testing are standard food (white bread) and test food (beneng taro noodles, red beans, and moringa leaves).

The tools for making red bean flour are a basin, a strainer bowl, a steamer pot, a food dehydrator, a flour grinder, a 100-mesh sieve, and digital scales. The tools for making moringa leaf flour are a basin, a strainer bowl, a steamer pot, a food dehydrator, a blender, an 80-mesh sieve, and digital scales. The tools for making dried noodles consist of a noodle maker for mixing ingredients, a bowl, a spoon, a ladle, a measuring cup, a steaming pot, and a food dehydrator. Sensory testing equipment consists of sensory testing forms, pens, sample containers, forks, and water containers. Chemical analysis equipment includes instruments used for proximate testing, namely vacuum ovens, metal dishes with lids, desiccators, dish clamps, analytical balances, ovens, furnaces, desiccators, Kjeldahl flasks, protein distillation, condensers, destructors, volumetric pipettes, measuring flasks, Erlenmeyer flasks, burettes, spatulas, measuring cups, Soxhlet flasks, weighing bottles, filter paper, ether (solvent), drop plates, lugol's solution, droppers, and stirrers. The tools for IG testing are the Accu-Chek Instant Glucose Meter, blood glucose test strips, disposable lancets, and alcohol swabs.

Research Procedures

This study on dried noodles refers to the research by Pitaloka et al., and is modified by using beneng taro flour, red bean flour, and moringa leaf flour. The organoleptic test used two tests, namely a hedonic test based on the parameters of color, taste, aroma, texture, and overall with a five-point hedonic scale, namely 1 (dislike very much); 2 (dislike); 3 (neutral); 4 (like); 5 (like very much). As well as a hedonic quality test on the color parameter with a scale of 1 (gray); 2 (grayish brown); 3 (faded brown); 4 (dark brown); 5 (light brown), the taste parameter with a scale of 1 (bland); 2 (not savory); 3 (somewhat savory); 4 (savory); 5 (very savory), aroma parameter with a scale of 1 (very bland); 2 (bland); 3 (somewhat bland); 4 (floury aroma); 5 (no aroma), texture parameter with a scale of 1 (very not chewy); 2 (not chewy); 3

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(somewhat chewy); 4 (chewy); 5 (very chewy), aftertaste parameter with a scale of 1 (very strong); 2 (strong); 3 (somewhat strong); 4 (not strong); 5 (very weak). The panelists used in the organoleptic test for this study were 30 people. The selected panelists were semi-trained panelists who were students at Sultan Ageng Tirtayasa University.

The proximate test procedure is the analysis of moisture content using the standard gravimetric method SNI-8217:2015. The procedure for analyzing ash content is using the standard dry furnace incineration method SNI-8217:2015. The procedure for analyzing protein content is using the titrimetric method with a Kjeldahl apparatus. The procedure for analyzing fat content is using the gravimetric method with a Soxhlet apparatus. Carbohydrate content analysis using the difference method in proximate analysis is calculated by subtracting 100 from the percentage and adding the moisture, ash, fat, and protein contents. The procedure for analyzing dietary fiber is enzymatic gravimetric analysis. Determination of the selected formulation by considering the comparison of nutritional content analysis (50%) and organoleptic testing (50%).

The glycemic response test was conducted on the optimal formula (F3) using 12 healthy female adult respondents (age 21-23, normal BMI (18.5 - 25.0 kg/m^2), and normal Fasting Blood Glucose (70-99 mg/dL). Respondents consumed the test food (40 g) or a standard food (white bread, 58.82 g), both equivalent to 25 g of available carbohydrate, after a 10-hour fast. Blood glucose levels were measured at 0, 15, 30, 45, 60, 90, and 120 minutes using an Accu-Chek Instant meter. The Glycemic Index (GI) and Glycemic Load (GL) were calculated from the incremental Area Under the Curve (iAUC).

Data Analysis

Chemical tests (moisture content, ash, carbohydrates, protein, fat, and dietary fiber) were analyzed using a one-way ANOVA test. Sensory parameters were assessed based on color, aroma, texture, taste, and overall acceptance for hedonic testing, while hedonic quality testing assessed color, aroma, texture, taste, and aftertaste in product quality. The research data were tabulated using MS Excel and then represented in mean values ± standard deviation. The data were analyzed using SPSS with the Kruskal-Wallis test, except for the hedonic quality taste parameter, which was analyzed using a one-way ANOVA test. The results of the glycemic index test were presented descriptively.

Code Of Health Ethics

The ethical clearance attributes for this study were addressed. The organoleptic (sensory) and glycemic index tests involving human subjects (panelists and respondents) were conducted only after the necessary informed consent procedures were completed. This research has been approved by the Health Research Ethics Committee of the Faculty of Health Sciences, Universitas Muhammadiyah Surakarta, and has obtained an ethics clearance letter with No. 1550/KEPK-FIK/IX/2025

RESULTS

Nutrition Content

All formulas (F1, F2, F3) met the Indonesian National Standard (SNI 8217-2015) for minimum protein content (≥10%) and maximum water content (≤13%) (9). However, all formulas (F1, F2, F3) did not meet the SNI 8217:2015 maximum ash content of 0.1% with results near 4%. Formula F3, with the highest moringa leaf flour content, showed the highest dietary fiber content at 11.08 ± 0.04%. This high ash content is directly proportional to the increased substitution concentration of local food ingredients (beneng taro flour, red beans, and moringa leaves), indicating that the mineral content in these dried noodles is significantly higher compared to the characteristics of noodles made from pure wheat flour.

Based on the one-way ANOVA results presented in the table 1, the varied substitution ratios of Beneng taro, red beans, and Moringa leaves significantly influenced ($p < 0.05$) the moisture, ash, energy, and dietary fiber contents of the dried noodles, while exerting no statistically significant effect on the carbohydrate, fat, and protein profiles ($p > 0.05$). Notably, formulation F3 yielded a significantly higher dietary fiber content (11.08%) compared to formulations F1 and F2 ($p = 0.001$), making it the most favorable option for fiber enrichment. Conversely, formulation F1 exhibited the highest total energy yield

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(391.63), which was significantly distinct from both F2 and F3 (p = 0.047), alongside demonstrating the significantly lowest moisture content (9.76%). These findings suggest that modifying the composite ingredient ratios can strategically enhance specific functional nutritional properties of the noodles—most prominently fiber concentration and caloric density—without fundamentally compromising their baseline macronutrient composition.

Table 1. Average Nutritional Content of Dried Noodles Substituted with Beneng Taro, Red Beans, and Moringa Leaves

Variable	Mean ± SD (%)	p*
Moisture Content		
F1 (50g:15g:22g:3g:10g)	9,76 ± 0,04 a	
F2 (50g:21g:15g:4g:10g)	10,22 ± 0,08 b	0,015
F3 (50g:17,5g:17,5g:5g:10g)	10,25 ± 0,09 b	
Ash Content		
F1 (50g:15g:22g:3g:10g)	3,99 ± 0,00 c	
F2 (50g:21g:15g:4g:10g)	3,86 ± 0,00 b	0,004
F3 (50g:17,5g:17,5g:5g:10g)	3,98 ± 0,02 c	
Carbohydrate Content		
F1 (50g:15g:22g:3g:10g)	62,66 ± 0,19 c	
F2 (50g:21g:15g:4g:10g)	62,89 ± 0,33 c	0,368
F3 (50g:17,5g:17,5g:5g:10g)	62,50 ± 0,06 c	
Fat Content		
F1 (50g:15g:22g:3g:10g)	9,33 ± 0,00 a	
F2 (50g:21g:15g:4g:10g)	9,39 ± 0,08 a	0,555
F3 (50g:17,5g:17,5g:5g:10g)	9,38 ± 0,02 a	
Protein Content		
F1 (50g:15g:22g:3g:10g)	14,24 ± 0,14 b	
F2 (50g:21g:15g:4g:10g)	13,63 ± 0,16 b	0,067
F3 (50g:17,5g:17,5g:5g:10g)	13,87 ± 0,16 b	
Energy		
F1 (50g:15g:22g:3g:10g)	391,63 ± 0,26 a	0,047
F2 (50g:21g:15g:4g:10g)	390,61 ± 0,05 b	
F3 (50g:17,5g:17,5g:5g:10g)	389,98 ± 0,58 c	
Dietary Fiber		
F1 (50g:15g:22g:3g:10g)	9,40 ± 0,12 a	
F2 (50g:21g:15g:4g:10g)	9,51 ± 0,09a	0,001
F3 (50g:17,5g:17,5g:5g:10g)	11,08 ± 0,04 b	

*Note: *based on one-way ANOVA test (p<0.05)*
**a,b,c Different letters in the same column indicate significant differences (p<0.05)*

Organoleptic Test

The hedonic test showed no significant difference (p > 0.05) among the three formulas for all parameters (color, aroma, texture, taste, and overall) (Table 2).

Table 2. Hedonic Test

Variable	Mean ± SD			P value
	F1	F2	F3	
Color	3,35 ± 0,59 (Neutral)	3,65 ± 0,66 (Prefer)	3,53 ± 0,61 (Prefer)	0,110
Aroma	3,51 ± 0,57 (Prefer)	3,55 ± 0,56 (Prefer)	3,55 ± 0,60 (Prefer)	0,855
Texture	3,44 ± 0,47 (Prefer)	3,43 ± 0,65 (Prefer)	3,24 ± 0,56 (Neutral)	0,316
Taste	3,53 ± 0,48 (Prefer)	3,55 ±0,53 (Prefer)	3,27 ± 0,56 (Neutral)	0,090
Overall	3,48 ± 0,48 (Prefer)	3,64 ±0,42 (Prefer)	3,42 ± 0,56 (Neutral)	0,337

Based on the hedonic quality test results presented in the table 3, the variations among formulations F1, F2, and F3 did not result in any statistically significant differences across all evaluated

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sensory attributes, including color, aroma, texture, taste, and aftertaste (p > 0.05). Although qualitative descriptive changes were observed by the panelists—such as a transition from a grayish-brown color and floury aroma in F1 to a pale brown color and slightly grassy aroma in F3, as well as a subtle enhancement in taste from "not savory" to "slightly savory"—these perceptual shifts did not reach statistical significance. Furthermore, structural and residual sensory properties remained highly consistent, with the texture uniformly described as "slightly chewy" and the aftertaste perceived as "weak" across all experimental groups

Table 3. Hedonic Quality Test

Variable	Mean ± SD			P value
	F1	F2	F3	
Color	2,38 ± 0,77 (Grayish Brown)	2,52 ± 0,77 (Grayish Brown)	2,70 ± 0,94 (Pale Brown)	0,325
Aroma	3,45 ± 0,69 (Floury aroma)	3,27 ± 0,77 (Slightly Grassy)	3,35 ± 0,72 (Slightly Grassy)	0,738
Texture	3,05 ± 0,61 (Slightly Chewy)	2,93 ± 0,62 (Slightly Chewy)	2,92 ± 0,55 (Slightly Chewy)	0,650
Taste	2,53 ± 0,65 (Not Savory)	2,66 ±0,74 (Slightly Savory)	2,74 ± 0,74 (Slightly Savory)	0,513*
Aftertaste	3,57 ± 0,59 (Weak Aftertaste)	3,58 ±0,60 (Weak Aftertaste)	3,35 ± 0,51 (Weak Aftertaste)	0,172

*One Way ANOVA Test

Optimal Formula

Based on the multiple-attribute evaluation presented in Table 4, formulation F3 emerges as the optimal formula, achieving the highest cumulative score of 71.56 when an equal 50% weighting is applied to both nutritional and sensory parameters. Although formulation F2 marginally outperformed the other prototypes in the combined hedonic and sensory quality evaluations (recording the highest Total Score 2 of 32.78), its overall ranking was superseded by F3's superior nutritional profile. Specifically, F3 attained the highest nutritional aggregate (Total Score 1 of 111.06), a result primarily driven by its markedly elevated dietary fiber content (11.08%), which effectively compensated for its slightly lower organoleptic ratings.

Table 4. Optimal Formula

Variable	F1	F2	F3
Nutrition Content			
Moisture Content (%)	9,76	10,22	10,25
Ash Content (%)	3,99	3,86	3,98
Carbohydrate Content (%)	62,66	62,89	62,50
Fat Content (%)	9,33	9,39	9,38
Protein Content (%)	14,24	13,63	13,87
Dietary Fiber (%)	9,40	9,51	11,08
Total Score 1	**109,38**	**109,5**	**111,06**
Hedonic Test			
Color	3,35	3,65	3,53
Aroma	3,51	3,55	3,55
Texture	3,44	3,43	3,24
Taste	3,53	3,55	3,27
Overall	3,48	3,64	3,42
Hedonic Quality Test			
Color	2,38	2,52	2,70
Aroma	3,45	3,27	3,35
Texture	3,05	2,93	2,92
Taste	2,53	2,66	2,74
Aftertaste	3,57	3,58	3,35
Total skor 2	**32,29**	**32,78**	**32,07**
Proporsi skor 1 (50%)	54,69	54,75	55,53
Proporsi skor 2 (50%)	16,14	16,39	16,03
Total skor 1+2	**70,83**	**71,14**	**71,56**

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Contribution to the Recommended Dietary Allowance (RDA) and Nutrition Label Reference

Based on Table 5, the nutritional profiling of the formulated product demonstrates its efficacy as a valuable dietary supplement, particularly characterized by its substantial fiber content. A standard 50 g serving yields 5.54 g of dietary fiber, fulfilling a significant 18.46% of the 30 g Recommended Dietary Allowance (RDA) established for the general population. Additionally, the formulation provides a moderate protein contribution of 6.76 g per serving, satisfying 11.26% of the daily requirement. The overall energy and carbohydrate profiles remain balanced and relatively modest, delivering 194.99 kcal (9.06% of the RDA) and 30.46 g of carbohydrates (9.37% of the RDA), respectively

Table 5. Contribution to the Recommended Dietary Allowance (RDA) for the General Population

Composition	Recommended Dietary Allowance (RDA) for the General Population	Recommended Dietary Allowance (RDA) per Serving Size (50 g)	% Recommended Dietary Allowance (RDA) for the General Population
Energy (kcal)	2150	194,99	9,06%
Protein (g)	60	6,76	11,26%
Fat (g)	67	2,03	3,02%
Carbohydrate (g)	325	30,46	9,37%
Dietary Fiber (g)	30	5,54	18,46%

Based on the nutritional profile outlined in Table 6, the processed food product demonstrates significant potential as a functional dietary component, primarily due to its elevated dietary fiber and protein concentrations per 100 g serving. The formulation yields 11.08 g of dietary fiber, which fulfills a substantial 36.93% of the Nutrition Label Reference for the general population (30 g), qualifying the product for a "High" fiber nutrition claim. Additionally, by providing 13.52 g of protein, the product meets 22.53% of the daily recommended intake (60 g), successfully surpassing the regulatory threshold to be classified as a "Source" of protein. Conversely, the product presents a moderate to low caloric and macronutrient burden in other areas, contributing only 18.13% to the daily energy requirement (389.98 kcal), 18.74% for carbohydrates (60.93 g), and a markedly minimal 6.05% for fat (4.06 g), none of which warrant additional nutritional claims.

Table 6. Contribution to the Nutrition Label Reference (ALG) for Processed Food

Composition	Nutrition Label Reference (ALG) for General Population	Nutrient Content per (100 g)	Nutrition Label Reference (ALG)	Nutrition Claim
Energy (kcal)	2150	389,98	18,13%	-
Protein (g)	60	13,52	22,53%	Source
Fat (g)	67	4,06	6,05%	-
Carbohydrate (g)	325	60,93	18,74%	-
Dietary Fiber (g)	30	11,08	36,93%	High

Glycemic Index Test

Based on the glycemic index test results presented in Figure 1, the formulated dry noodles (Test Food F3) exhibit a markedly attenuated postprandial glycemic response compared to the standard reference food (white bread). The time-course blood glucose curve demonstrates that the consumption of dry noodles resulted in an earlier and lower peak glucose concentration of 105 mg/dL at 30 minutes, followed by a rapid stabilization, whereas the white bread induced a higher, delayed peak of 120.66 mg/dL at 45 minutes. This dampened physiological response is quantitatively supported by the aggregate metrics, which reveal that the test food yielded a lower average postprandial blood glucose (GDPP) of 91.26 ± 10.34 mg/dL relative to the standard food's 101.79 ± 16.19 mg/dL. Furthermore, the incremental Area Under the Curve (iAUC) for the dry noodles was correspondingly reduced to 1806.93 ± 577.33, compared to 2062.63 ± 744.76 for the standard food. Collectively, these metabolic indicators establish that the F3 dry noodle formulation possesses a favorable, lower glycemic profile, indicating its potential utility as a functional dietary option for mitigating rapid postprandial blood sugar excursions.

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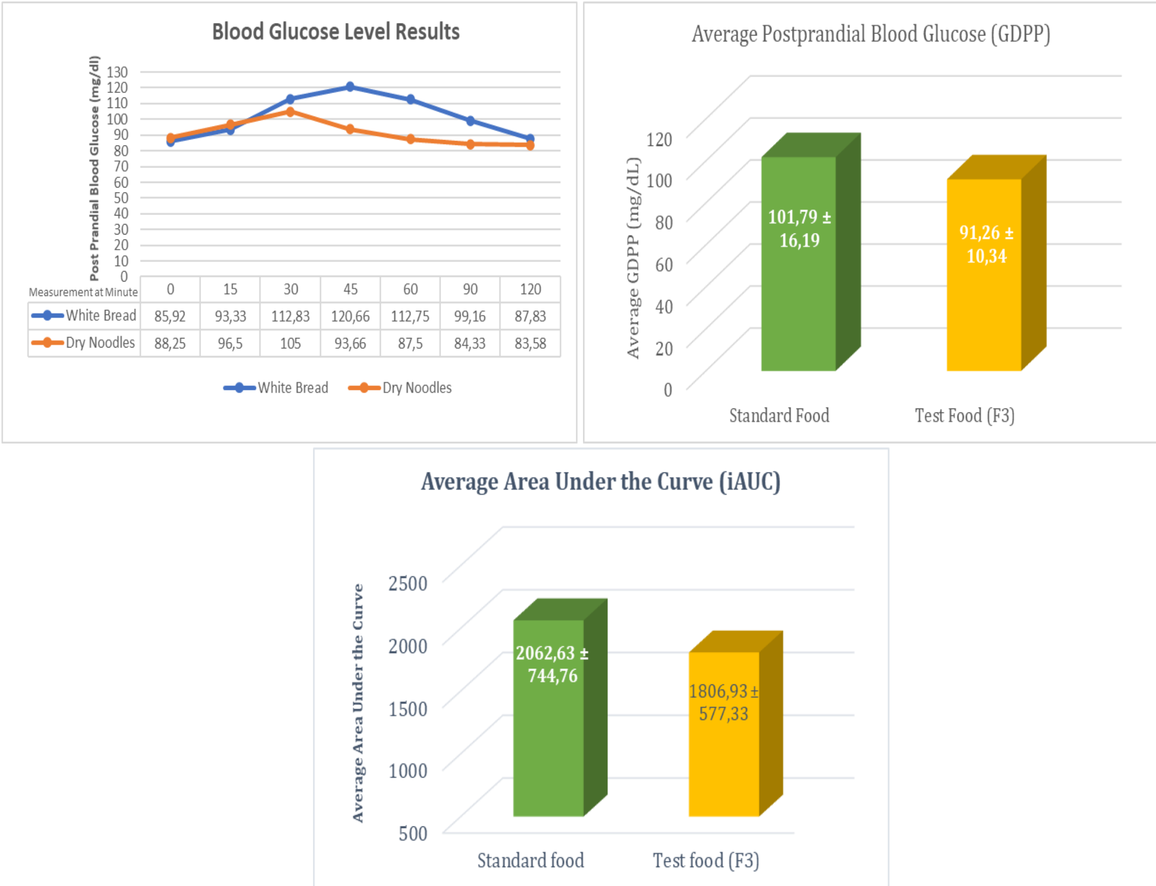

Figure 1. Blood Glucose Level Curve (A), GDPP Average Value Comparison Chart (B), Average Area Under the Curve (iAUC) chart (C)

Based on the physiological metrics detailed in Table 7, the formulated test food exhibits a markedly more favorable glycemic profile compared to the standard reference food. The analysis reveals that the test food possesses a Glycemic Index (GI) of 62.19, effectively categorizing it as a medium-GI food, which represents a substantial reduction from the high-GI classification (100) of the standard food. Concurrently, the Glycemic Load (GL)—which accounts for both the quality and quantity of carbohydrates per serving—is correspondingly lower for the test food at 18.94 (medium category), nearly halving the high glycemic burden (36) imposed by the standard counterpart.

Table 7. Glycemic Index Value and Glycemic Load Value

Sample	Glycemic Index	Glycemic Index Category	Glycemic Load	Glycemic Load Category
Standard Food	100	High	36	High
Test Food	62,19	Medium	18,94	Medium

DISCUSSION

Nutrition Content

The dried noodles successfully incorporated local flours while maintaining maximum water content standards (SNI 8217-2015). Moisture content is one of the key quality parameters of dried noodles that can affect their shelf life. Moisture content is also a very important characteristic of food products, as water can affect their appearance, texture, and flavor (10).

However, the ash content in all formulas did not meet the SNI maximum of 0.1%. Ash content can indicate the amount of minerals present in food. This high ash content is likely due to the high mineral content of the added flours, Beneng taro is a good source of minerals; it is easily digested and absorbed by the body because it contains small starch granules (11). Minerals found in taro include potassium,

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phosphorus, manganese, and copper, and taro also contains 6.92 ppm of carotenoid pigments (12). The high ash content may also be influenced by the addition of moringa leaves flour. Moringa leaves contain a relatively high ash content of approximately 9.45%, calcium at 2,003 mg, and phosphorus at 204 mg (13). The results of this study on dried noodles show a lower ash content compared to dried noodles with added mung bean flour and moringa leaf flour, which range from 4.25% to 5.29% (13).

Although the ash content in the substitute noodles made from Beneng taro, red beans, and moringa leaves exceeds the limits set by SNI 8217:2015, these products still have commercial potential. Under Law No. 20 of 2014, the application of SNI standards for dried noodles is voluntary; therefore, the product can still be marketed provided it meets BPOM food safety standards to obtain a marketing authorization. However, the product is not permitted to display the SNI logo on its packaging. This poses a unique challenge in product marketing, as SNI serves to build consumer confidence regarding the health and safety aspects of the product (14). Therefore, a review or differentiation of standards is needed to accommodate the characteristics of functional noodles, so that innovations based on local resources are not hindered by parameters designed for pure wheat noodles.

All formulas showed protein content above the 10% SNI minimum, crucial for a protein claim. The higher protein levels compared to the base ingredients are attributed to the combination of red bean flour (rich in lysine) and moringa leaf flour (rich in methionine and tryptophan), creating a more complete essential amino acid profile (15).

Based on the results of the proximate analysis, the dry noodles had fat contents of F1 (9.33%), F2 (9.39%), and F3 (9.38%). The fat content of the dry noodles increased as the proportion of red bean flour in the mixture increased. The fat content of red bean flour (2.4 g) is higher than that of moringa leaf flour (2.3 g) (15). The fat content of the product can increase if other fat-containing ingredients, such as added oil or fatty binding agents, are used during the noodle making process for example, during dough kneading or frying which can raise the fat content of the final product (16).

The carbohydrate content was determined using the by-difference method. The carbohydrate content in this study of dried noodles was lower than that reported in the study by Widiawati et al. (2022), which found a carbohydrate content of 80.04%. The carbohydrate content in these dried noodles may be influenced by several raw material compositions, such as a lower wheat flour content (50%) and the combination of other ingredients like beneng taro flour, red bean flour, moringa leaf flour, and beneng taro starch.

The energy content of dried noodles is influenced by the amount of macronutrients present in the ingredients used to make them, such as carbohydrates, fats, and proteins. Proteins and carbohydrates provide 4 kcal/g of energy, while fats provide 9 kcal/g. One of the flours used in the production of dried noodles is white taro flour. Taro flour contains 84.10% carbohydrates, 4.55% protein, and 0.45% fat (12).

The results of the dietary fiber content tests showed dietary fiber levels of 9.40% in F1, 9.51% in F2, and 11.08% in F3. The dietary fiber content of the beneng taro was 7.19%, the highest among all taro varieties (12). Beneng taro flour has a dietary fiber content of 9.52%. The total dietary fiber content of red bean flour is 23.80 g (6). Moringa leaf flour has a fairly high fiber content. Based on the results of this study, the three dry noodle formulations have varying levels of dietary fiber. The more moringa leaf flour added, the higher the dietary fiber content in the noodles.

Organoleptic Test

Color is the primary sensory attribute assessed by panelists and plays a crucial role in food evaluation (17). Hedonic testing on the color of dry noodles made from Beneng taro, red bean, and Moringa leaf flour indicated high acceptability. The resulting brown coloration in the dry noodles is primarily attributed to two mechanisms: enzymatic browning caused by Polyphenol Oxidase (PPO) in Beneng taro, and non-enzymatic browning via the Maillard Reaction during high-temperature drying. Despite the browning, the color was still acceptable to the panelists.

Aroma serves as a critical determinant of overall food product quality. The results from the hedonic assessment of aroma indicated high acceptance across all tested formulas, this slightly grassy or raw aroma ("grassy") observed in the dry noodles made from Beneng taro, red bean, and Moringa leaf flour

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is specifically traced back to the Moringa leaf component. This observation is consistent with studies by Pitaloka, et al., who attribute this raw scent to the tannin content within the Moringa leaf flour. Nevertheless, the grassy odor was not overly prominent in the final noodle product. This successful mitigation is attributed to the inclusion of a steam blanching step during the Moringa leaf flour preparation, a process intentionally employed to reduce the characteristic raw aroma (18), resulting in a barely perceptible grassy scent in the Beneng taro, red bean, and Moringa leaf dry noodles.

Texture is a crucial parameter in determining food quality. The hedonic test results for texture indicated high consumer acceptance. Generally, noodles are made from wheat flour, which contains gluten, a compound essential for imparting chewiness and resistance to breakage. Noodle breaking strength and elasticity are influenced by gluten content, the proportion of amylose and amylopectin, and the dough processing method, in addition to overall dough composition (19). It is hypothesized that the dry noodles incorporating Beneng taro, red bean, and Moringa leaf flour have a lower gluten content compared to noodles made with 100% wheat flour, consequently resulting in a texture that is less chewy than conventional noodles. This finding is consistent with previous research by Wulandari et al. (2020), which asserted that the texture of dry noodles is influenced by the presence of gluten (20). Dry noodles formulated with additions such as Beneng taro flour and modified cassava flour (mocaf) are generally anticipated to have a lower gluten content than those made exclusively from wheat flour.

The taste profile of the dry noodles made from Beneng taro, red bean, and Moringa leaf flour was characterized as slightly savory, according to the descriptive hedonic analysis. This particular result is hypothesized to stem from the manual dough kneading process utilized during the noodle production. Manual kneading may have led to an insufficient and uneven distribution of added flavor enhancers, specifically the powdered garlic and salt, resulting in a less intense and merely "slightly savory" overall taste perception.

Despite the visual changes and the slight grassy aroma from the moringa leaf flour, the overall sensory test results showed no significant difference among the formulations and generally indicated that the products were "liked" to "moderately liked". The slightly less-chewy texture in F3 compared to F1 is a typical result of reducing gluten by substituting wheat flour.

Optimal Formula

The selected dry noodle formulation was determined based on the highest score from the weighted results of the hedonic/preference test, the hedonic quality test, and the nutritional analysis. Weighting was performed by comparing the organoleptic test (hedonic test) which represents panelists' acceptance of the product with the results of the proximate analysis based on the SNI 8217:2015 standard for dried noodles, using a 50:50 ratio (13). The selection of F3 as the optimal formula (F3: 50g wheat flour, 17.5g Beneng taro, 17.5g red bean, 5g moringa leaf) was largely driven by its high dietary fiber content of 11.08% and favorable nutritional claims. The fiber content is directly correlated with the proportion of moringa leaf and red bean flours, both being high-fiber sources.

Contribution to the Recommended Dietary Allowance (RDA) and Nutrition Label Reference (ALG)

According to BPOM Regulation No. 1 of 2022 regarding claims on the Nutrition Label Reference (ALG), processed foods may be labeled as a "source of protein" if they contain 20% of the ALG per 100-gram serving (21). Dried noodle products may be labeled as a "source of protein" with a protein content of 23% per 100 grams. Regarding fiber content, based on calculations, it amounts to 37% of the ALG per 100 g, or the equivalent of 11 grams per 100 g. This dried noodle product, made with substitutions of taro flour, red beans, and moringa leaves, can be labeled as "high in" fiber per 100 g.

Glycemic Index Test

The most significant finding is the controlled glycemic response. The optimal formula (F3) has a medium Glycemic Index (GI) of 62.19 and a medium Glycemic Load (GL) of 18.94. This is notably better than the high GI (100) and high GL (36) of the white bread standard. This controlled response is primarily due to the high dietary fiber and protein content in F3. Fiber increases the viscosity of the stomach

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contents, slowing down gastric emptying and carbohydrate absorption (22). Furthermore, protein stimulates insulin secretion and promotes satiety (23). The resistant starch content in the Beneng taro flour also likely plays a role in reducing the glycemic response (24). However, the partial inclusion of wheat flour, which has a high GI, likely prevented the product from reaching the low-GI category. These findings position the functional dried noodles as a healthier food option for blood glucose control and weight management.

CONCLUSION

The comparative study successfully developed functional dried noodles using Beneng taro, red bean, and moringa leaf flours. Based on the combined analysis of chemical and sensory properties, Formula 3 (F3) was selected as the optimal formula. This formula meets the nutritional claims for a source of protein (22.53% ALG per 100g) and is high in fiber (36.93% ALG per 100g). The product demonstrates a controlled glycemic response with a medium Glycemic Index of 62.19 and a medium Glycemic Load of 18.94. This research contributes to the development of functional food alternatives based on local resources and supports dietary diversification. It makes a strategic contribution to local food security in Banten Province through the downstream processing of Beneng taro as a regional flagship commodity. Furthermore, this product has the potential to serve as a public health intervention tool in efforts to prevent degenerative diseases, such as diabetes mellitus and obesity, whose prevalence continues to rise in Indonesia. As a follow-up, future research should aim to create a formula with minimal or no wheat flour at all to further improve the nutritional quality of the product and maximize the utilization of local raw materials.

DECLARATION OF THE USE OF AI

The authors declare that no artificial intelligence (AI), AI-assisted technologies, or large language models (LLMs) were used in the conception of the study, data analysis, or the drafting, writing, and editing of this manuscript. The only exception is the graphical abstract, which was created using the design platform Illustrae (https://illustrae.co/). The authors take full responsibility for the content and accuracy of the graphical abstract and the entire manuscript.

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CONFLICTS OF INTEREST

The authors declare no conflict of interest.

REFERENCES

1. Vitale M, Costabile G, Testa R, D'Abbronzo G, Nettore IC, Macchia PE, et al. Ultra-Processed Foods and Human Health: A Systematic Review and Meta-Analysis of Prospective Cohort Studies. Advances in Nutrition. 2024 Jan;15(1):100121. doi:10.1016/j.advnut.2023.09.009
2. Sitoayu L, Harna H, Sa'pang M, Ronitawati P, Puspita Sari D. Development of Sensory Quality and Shelf Life of Dried Noodles Using Catfish Flour and Mocaf: An Alternative Supplementary Feeding Prototype. J Health Nutr Res. 2026 Apr 1;5(1):362–72. doi:10.56303/jhnresearch.v5i1.1085
3. Hidayah F. Negara dengan Konsumsi Mi Instan Terbanyak. GoodStats [Internet]. 2023. Available from: https://data.goodstats.id/statistic/negara-dengan-konsumsi-mie-instan-terbanyak-yHFXf

https://doi.org/10.56303/jhnresearch.v5i2.1179

4. Kusumasari S, Eris FR, Mulyati S, Pamela V. Karakterisasi sifat fisikokimia tepung talas beneng sebagai pangan khas Kabupaten Pandeglang. Jur Agroekotek. 2019;11(2):227–34.
5. Kusnandar F, Danniswara H, Sutriyono AE. Pengaruh Komposisi Kimia dan Sifat Reologi Tepung Terigu terhadap Mutu Roti Manis. Jurnal Mutu Pangan: Indonesian Journal of Food Quality. 2022.
6. Widiawati D, Giovani S, Liana SP. Formulasi dan karakterisasi mi kering substitusi tepung kacang merah tinggi serat. SST. 2022 Jun 2;7(2):80. doi:10.36722/sst.v7i2.1114
7. Simbolon M, Rimbawan R, Roosita K, Artika IM. Metabolite Profiling Differences of Single and Physical Mixture of Moringa Leaves (Moringa oleifera) and Red Galangal (Alpinia purpurata (Vieill) K. Schum). J Health Nutr Res. 2026 Apr 1;5(1):124–35. doi:10.56303/jhnresearch.v5i1.962
8. Hussin H, Gregory PJ. Enhancing the Nutritional Profile of Noodles With Bambara Groundnut (Vigna subterranea) and Moringa (Moringa oleifera): A Food System Approach.
9. Badan Standarisasi Nasional. SNI 8217:2015 Mi Kering. Jakarta: BSN; 2015.
10. Fadillah MF, Trisnawati D, Marlinda, Rostianti T, Mulyanah A. Implementasi Moriga Olifera Lamk Untuk Menentukan Sifat Kimia dan Organik Pada Pasta Makaroni Dari Tepung Talas Beneng. Jurnal Pertanian dan Industri Pangan. 2021;1(1).
11. Yuniarsih E, Adawiyah DR, Syamsir E. Karakter tepung komposit talas beneng dan daun kelor pada kukis. jmpi. 2019 Apr 30;6(1):46–53. doi:10.29244/jmpi.2019.6.46
12. Nurtiana W, Meindrawan B. Pelatihan pembuatan muffin talas beneng di Yayasan Ummatan Wasathon, Kecamatan Kasemen, Kota Serang sebagai pemanfaatan pangan lokal. Jurnal Sebatik. 2023;27(01).
13. Pitaloka IM, Ma'rifah B, Muhlishoh A. Analisis kandungan gizi dan organoleptik mie kering substitusi tepung kacang hijau dan tepung daun kelor untuk remaja gizi kurang. Journal Of Nutrition College. 2024;13(2):105–14.
14. Karim K, Suriyanti S, Ramlawati R. Edukasi standardisasi mutu produk bagi pelaku UMKM pada masa new normal covid 19 di Desa Paddinging, Kabupaten Takalar. Jurnal Abdi Insani. 2021;8(3):287–94.
15. Safitri OI, Komang Suwita I, Razak M. Substitusi tepung kacang merah (Phaseoulus vulgaris L.) dan tepung daun kelor (Moringa Oleifera L.) pada biskuit untuk penderita hiperkolesterolemia terhadap kadar zat gizi dan mutu organoleptik. Nutriture Journal. 2024;03(02):74–84.
16. Ajima A, Isnaini R, Suhartini W. Karakteristik fisikokimia mi kering dengan berbagai rasi ikan barakuda (Sphyraena jello) dan tepung terigu. Jurnal Teknologi Hasil Pertanian. 2024;17(2):133–46.
17. Elisa N. Pemanfaatan daun binahong dalam pembuatan mie untuk meningkatkan kandungan gizi [Skripsi]. [Makassar]: Universitas Negeri Makassar; 2022.
18. Ardianto ET, Subaktilah Y, Elisanti AD. Formulasi biskuit buah naga dan daun kelor untuk mencegah anemia. Jurnal Kesehatan. 2020;8(1):10–1.
19. Rosalina L, Suyanto A, Yusuf M. Kadar protein, elastisitas, dan mutu hedonik mie basah dengan substitusi tepung ganyong. Jurnal Pangan dan Gizi. 2018;8(1):1–10.
20. Wulandari P, Putri NA. Pengaruh Substitusi Tepung Terigu Dengan Tepung Talas Beneng dan Mocaf Terhadap Karakteristik Fisikokimia Mi Kering. Jurnal Teknologi Pangan. 2020;16(1):50–6.
21. Badan Pengawas Obat dan Makanan. Peraturan Kepala Badan Pengawas Obat dan Makanan Republik Indonesia Nomor 1 Tahun 2022 Tentang Pengawasan Klaim Pada Label dan Iklan Pangan Olahan. Jakarta: Jakarta: BPOM RI; 2022.
22. Marbun TSG, Susyani S, Podojoyo P. Pengaruh Pemberian Food Bar Tinggi Serat Terhadap Kadar Glukosa Darah Pasien Diabetes Melitus Tipe 2. Journal of Nutrition College. 2023;12(2):105–12.
23. Probosari E. Pengaruh protein diet terhadap indeks glikemik. JNH (Journal of Nutrition and Health). 2019;7(1):33–9.
24. Situmorang PM. Karakteristik kimia, fisik dan fungsional tepung talas beneng (Xanthosoma undipes K. koch) modifikasi menggunakan metode autoclaving-cooling) [Skripsi]. [Serang]: Universitas Sultan Ageng Tirtayasa; 2024.

https://doi.org/10.56303/jhnresearch.v5i2.1179