Wet Noodles Formulation with Substitution of Purple Sweet Potato Flour and Soybean Flour as An Alternative High Fiber Food for Obese Adolescents

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ABSTRACT

Purple sweet potato flour, rich in fiber, and soybean flour, a protein source, can be utilized to create wet noodles as a high-fiber alternative food to help address adolescent obesity. This study aimed to examine the effects of substituting purple sweet potato and soybean flours on the organoleptic properties and macronutrient composition (ash, moisture, carbohydrates, fat, protein) as well as dietary fiber content of wet noodles. Conducted as an experimental study with a completely randomized design (CRD) and two repetitions, the research involved three treatment formulations with varying proportions of wheat flour, purple sweet potato flour, and soybean flour: F1 (30%:55%:15%), F2 (25%:65%:10%), and F3 (20%:75%:5%). The organoleptic quality evaluation covered both hedonic (preference test) and hedonic quality attributes, including aspects such as color, aroma, taste, texture, aftertaste, and mouthfeel. Organoleptic analysis was performed using the Kruskal-Wallis test, while macronutrient content was assessed using One Way ANOVA and the Duncan test. Results showed no significant impact of the flour substitutions on organoleptic qualities (p>0.05). However, macronutrient and dietary fiber content were significantly affected (p<0.05). The macronutrient profiles of the noodles for F1, F2, and F3 were: moisture (35.01%, 36.57%, 38.76%), ash (1.97%, 1.97%, 2.55%), fat (3.61%, 3.60%, 3.18%), protein (12.72%, 11.19%, 10.26%), carbohydrates (46.69%, 46.78%, 45.26%), and dietary fiber (5.57%, 5.90%, 6.34%). F3's nutritional composition met the recommended dietary allowance (RDA) for staple foods for adolescents aged 16–18. The high dietary fiber content in these noodles supports their potential as a high-fiber alternative staple food for obese adolescents.

Keywords: *Dietary fiber, obese adolescents, purple sweet potato flour, soybean flour, wet noodles.*

INTRODUCTION

Adolescence is a crucial period of growth and development that shapes subsequent developmental stages. Obesity during adolescence is a serious issue because it often continues into adulthood. Adolescents are considered a high-risk group for obesity (1). Obesity can be a significant problem among adolescents, contributing to degenerative conditions such as cardiovascular diseases, diabetes mellitus, and cancer (2,3).

The Basic Health Research Survey (2018) defines obesity among adolescents using BMI-for-age, with a Z-score greater than +2.0 SD. Based on this criterion, 4.3% of adolescent girls and 3.8% of boys are categorized as obese (4). One cause of obesity among adolescents is the increased consumption of junk food (5). Among the popular junk foods, instant noodles are widely consumed by adolescents, and excessive intake of these noodles can increase the risk of obesity due to their high sodium, saturated fats, and food additives (6). Instant noodles are high in calories but low in protein, minerals, and fiber, which contributes to obesity in this age group (7). Adolescents who eat instant noodles more than twice a week face an increased risk of obesity (8). The Basic Health Research Survey (2018) reveals that instant noodle consumption is common among adolescents aged 15-19: 11.2% consume them daily, 67.6% eat them 1-6 times per week, and 21.2% consume them up to three times a month (4). The Basic Health Research Survey (2018) also found that the fiber intake of adolescents aged 15-18 years was low at 10.5 g, while the Recommended Dietary Allowance (RDA) is about 34 g for ages 13-15 years and around 37 g for ages 16-18 years (4). Dietary fiber plays a role in weight loss by slowing digestion, increasing satiety through water retention in the digestive tract, and forming a thick solution (9). Additionally, fiber coats the intestinal mucosa, increasing food viscosity and slowing gastric emptying, which reduces food intake and may lead to weight loss (10).

One approach to addressing adolescent obesity is through innovative food products, such as high-fiber wet noodles made from purple sweet potato flour and soybean flour. Purple sweet potato, or *Ipomoea batatas L. poir*, is commonly found in Indonesia. It has a vibrant purple color and contains about 3 g of dietary fiber per 100 g of fresh weight (11). The Indonesian Food Composition Table (TKPI) states that purple sweet potato flour contains 0.6 g of fat, 12.9 g of fiber, 84.4 g of carbohydrates, 2.8 g of protein per 100 g (12). Its fiber content is notably high, ranging from 2.3 to 3.9 g per 100 g (13).

However, purple sweet potato is comparatively low in protein, so it should be paired with other protein-rich sources, such as soybean flour, which is high in protein among legumes. Soybean flour provides 35.9 g of protein, 20.6 g of fat, 29.9 g of carbohydrates, and 5.8 g of fiber per 100 g (12). Study by Yolanda et al. (2018), using 40% purple sweet potato flour in noodle products yielded a high dietary fiber content of 14.37% (14). Similarly, Monica et al. (2018) found that adding 82.19 g of purple sweet potato flour to dried noodle development resulted in a dietary fiber content of 14.56% on a dry basis or 12.58% on a wet basis (11). According to research by Rahmawati et al. (2020), using 20% soybean flour in cookies resulted in a high protein content of 10.4% by weight (15). Therefore, This study seeks to evaluate the effects of replacing wheat flour with purple sweet potato flour and soybean flour on the organoleptic properties and macronutrient composition of wet noodles, aiming to develop a high-fiber food alternative for obese adolescents.

MATERIAL AND METHODS

a. Design, Location and Time

This experimental study employs a Completely Randomized Design (CRD) with two replications and includes three treatment groups. F1 contain 30% wheat flour, 55% of purple sweet potato flour and 15% of soybean flour. F2 contain 25% wheat flour, 65% of purple sweet potato flour and 10% of soybean flour. F2 contain 20% wheat flour, 75% of purple sweet potato flour and 5% of soybean flour.

The formulation of wet noodles and organoleptic testing were conducted in the Nutrition Laboratory at Kusuma Husada University, Surakarta. The macronutrient content analysis was performed at the Food and Nutrition Study Center Laboratory at UGM, Yogyakarta. The organoleptic test consisted of hedonic and hedonic quality evaluations conducted by 30 semi-trained panelists. The study was conducted from August 2022 to July 2023. This research was carried out following the approval of the ethical review by the Dr. Moewardi Surakarta Hospital Research and Health Ethics Commission, under No. 947 /V/ HREC / 2023.

b. Materials and Tools

Wet noodle ingredients included purple sweet potato flour from Mama Kamu (Surabaya), soybean flour produced by Agribusiness (Bandung), mocaf flour from Club Sehat (Mojosongo), as well as wheat flour, eggs, mineral water, and salt sourced locally in Surakarta. Nutrient analysis utilized various reagents, including 8N HCl (65%), H_2SO_4, K_2SO_4, H_2O_2, $CuSO_4 \cdot 5H_2O$, 60% NaOH, 0.1N HCl, and 30% boric acid. Production tools included containers, pots, knives, scales, measuring cups, a noodle roller, a rolling pin, a stove, and gas. Sensory testing employed sensory forms, pens, sample products, and mineral water, while nutrient content analysis involved an analytical balance, oven, crucible, desiccator, Soxhlet extractor, Kjeldahl flask, and distillation apparatus.

c. Research Procedure

The research commenced with the formulation of wet noodles, followed by their production using three distinct formulation of F1, F2 and F3. The wet noodle production adhered to the HKI EC00202349985 (16). Sensory evaluations followed, assessing hedonic qualities such as color, aroma, taste, texture, aftertaste, and mouthfeel. Nutritional analysis included macronutrient evaluation of water, ash, protein, fat, carbohydrates, and dietary fiber. The methods used were gravimetric for moisture (AOAC 925.10) and ash content (AOAC 923.03), Kjeldahl for protein (AOAC 960.52), Soxhlet for fat (AOAC 963.15), the difference method for carbohydrates (AOAC 2005), and the enzymatic method for dietary fiber (AOAC 2005).

d. Selected Formulation

Optimal formulation selection utilized the Exponential Comparison Method (MPE) based on sensory and macronutrient analysis (water, ash, fat, protein, carbohydrates, dietary fiber) (17). The nutritional adequacy of the chosen noodle formula was then assessed according to the 2019 Recommended Dietary Allowances (RDA) for adolescents aged 16-18, including energy, protein, fat, carbohydrates, and dietary fiber. Fiber content claims were evaluated based on BPOM standards (3 g for a source of fiber, 6 g for high fiber) as outlined in BPOM Regulation No. 9 of 2016 on Nutrition Label Reference and No. 13 of 2013 on Processed Food Labeling.

e. Data Analysis

Data from organoleptic auality and macronutrient analyses were processed using Microsoft Excel 2013 and SPSS 23.0 for Windows. For the organoleptic quality testing, normality and homogeneity tests indicated that the data were neither normal nor homogeneous, so the Kruskal-Wallis test was used for analysis. Since no significant differences were found, additional Mann-Whitney testing was not required. However, macro-nutrient tests, showing normal and homogeneous data, were analyzed using One-Way ANOVA, which revealed significant effects of flour substitution, followed by Duncan's post-hoc test. The level of statistical significantly different was at $p<0,05$.

RESULT

1. Organoleptic Test

This research explored the effects of substituting purple sweet potato flour and soybean flour on the organoleptic qualities of wet noodles by evaluating three formulations: F1, F2, and F3. The organoleptic quality evaluation covered both hedonic (preference test) and hedonic uality attributes, including aspects such as color, aroma, taste, texture, aftertaste, and mouthfeel. The results of the organoleptic quality analysis are presented at table 1 and 2.

Table 1. Hedonic test of wet noodle

Sensory Attibute	Treatment			P-Value
	F1 (30%:55%: 15%)	F2 (25%:65%: 10%)	F3 (20%:75%: 5%)	
Color	3.33 ± 0.66[a]	3.50 ± 0.73[a]	3.33 ± 0.84[a]	0.665
Aroma	3.13 ± 0.90[a]	3.00 ± 0.91[a]	3.07 ± 0.91[a]	0.875
Taste	3.03 ± 0.89[a]	3.23 ± 0.97[a]	3.07 ± 0.74[a]	0.728
Texture	3.13 ± 1.01[a]	3.30 ± 0.84[a]	3.17 ± 1.18[a]	0.680
Aftertaste	3.23 ± 0.82[a]	3.27 ± 1.02[a]	3.23 ± 0.86[a]	0.889
Mouthfeel	3.10 ± 0.96[a]	3.13 ± 0.97[a]	2.93 ± 1.05[a]	0.396

Note: [a] Mean values followed by different letters in the same row indicate significant differences (p<0.05)
Scale: 1 = really dislike , 2 = dislike , 3 = somewhat like, 4 = like, and 5 = really like

Table 2. Hedonic quality test of wet noodle

Sensory Attibute	Treatment			P-Value
	F1 (30%:55%: 15%)	F2 (25%:65%: 10%)	F3 (20%:75%: 5%)	
Color	3.20 ± 0.96[a]	3.34 ± 0.90[a]	3.33 ± 0.96[a]	0.396
Aroma	3.17 ± 0.87[a]	3.03 ± 0.99[a]	2.97 ± 1.07[a]	0.732
Taste	2.93 ± 0.69[a]	3.17 ± 0.87[a]	3.13 ± 0.86[a]	0.573
Texture	3.07 ± 0.94[a]	3.03 ± 0.99[a]	3.07 ± 0.98[a]	0.954
Aftertaste	3.30 ± 0.84[a]	3.33 ± 0.84[a]	3.07 ± 0.83[a]	0.390
Mouthfeel	3.00 ± 0.83[a]	2.97 ± 1.03[a]	2.87 ± 0.97[a]	0.790

Note: [a] Mean values followed by different letters in the same row indicate significant differences (p<0.05)
Color : 1 (brownish) to 5 (purple), Aroma : 1 (very not beany) to 5 (very beany), Taste 1 (very unpleasant) to 5 (very pleasant), Texture : 1 (very not chewy) to 5 (very chewy), Aftertaste : 1 (very strong) to 5 (very not strong), Mouthfeel 1 (very not chewy) to 5 (very chewy)

According to Table 1, the Kruskal-Wallis test results showed that purple sweet potato flour and soybean flour substitution did not have a significant effect on the organoleptic quality (both hedonic and hedonic quality) across all sensory attributes (p>0.05). The hedonic test findings reveal the average preference scores for the 6 attributes (color, aroma, taste, texture, aftertaste, mouthfeel) is included categorized in somewhat like with a score of 3 - < 4. According to Table 2 showed that in the hedonic quality assessment, the average color quality ratings were F1 (3.20: brownish-purple), F2 (3.34: brownish-purple), and F3 (3.33: brownish-purple). The hedonic quality test rated aroma as F1 (3.17: moderately beany), F2 (3.03: moderately beany), and F3 (2.97: beany).

For taste quality, the ratings averaged F1 (2.93: unpleasant), F2 (3.17: moderately unpleasant), and F3 (3.13: moderately unpleasant). The texture quality ratings were F1 (3.07: moderately chewy), F2 (3.03: moderately chewy), and F3 (3.07: moderately chewy). The aftertaste quality ratings were F1 (3.30: moderately strong), F2 (3.33: moderately strong), and F3 (3.07: moderately strong). Meanwhile, in the hedonic quality test, the average quality assessment scores for the mouthfeel of wet noodles were as follows: F1 (3.00: moderately chewy), F2 (2.97: not chewy), and F3 (2.87: not chewy).

2. Macronutrient Analysis

The analysis of macronutrient content in wet noodles substituted with purple sweet potato flour and soybean flour involved proximate testing, which included measurements of moisture, ash, fat, protein, carbohydrate, and dietary fiber content.

As shown in Table 3, the One Way ANOVA test results revealed a significant effect of substituting purple sweet potato flour and soybean flour on the macronutrient and dietary fiber content (p<0.05). The average moisture content for the formulations was F1 (35.01%), F2 (36.47%), and F3 (38.76%). The results of the study showed that increasing the use of purple sweet potato flour increased the moisture with F2 and F3 surpassing the moisture quality standard set by the

Indonesian National Standard (SNI) for wet noodles.

Table 3. Macronutrient characteristics of wet noodle

Parameter	Treatment F1	Treatment F2	Treatment F3	p-value	SNI
Moisture (%)	35.01 ± 0.12[a]	36.47 ± 0.87[b]	38.76 ± 0.15[c]	0,000*	Maks. 35
Ash (%)	1.97 ± 0.02[a]	1.97 ± 0.400[a]	2.55 ± 0.25[b]	0,000*	Min 0.05
Fat (g/100g)	3.61 ± 0.00[a]	3.60 ± 0.01[a]	3.18 ± 0.01[b]	0,000*	-
Protein (g/100g)	12.72 ± 0.25[a]	11.19 ± 0.15[b]	10.26 ± 0.25[c]	0,000*	Min. 9
Carbohydrate (g/100g)	46.69 ± 0.30[a]	46.78 ± 0.15[a]	45.26 ± 0.19[b]	0,000*	
Soluble Dietary Fiber (g/100g)	5.31 ± 0.65[a]	5.61 ± 0.55[b]	5.91 ± 0.45[c]	0,000*	
Insoluble Dietary Fiber (g/100g)	0.22 ± 0.35[a]	0.29 ± 0.01[a]	0.32 ± 0.010[b]	0,003*	
Total Dietary Fiber (g/100g)	5.57 ± 0.75[a]	5.90 ± 0.50[b]	6.24 ± 0.70[c]	0,000*	

Note:
*Significant difference based on the One Way ANOVA test (p<0,05)
[a,b,c] Mean values followed by different letters in the same row indicate significant differences (p<0.05)

The average ash content was F1 (1.97%), F2 (1.97%), and F3 (2.55%). The ash content in all treatments met the SNI 2987-2015 quality standards for wet noodles, which specify a minimum of 0.05% (w/w). The average fat content in the noodles was F1 (3.61%), F2 (3.60%), and F3 (3.18%). The average protein content results were F1 (12.72%), F2 (11.19%), and F3 (10.26%). Increasing the use of purple sweet potato flour reduces protein levels but still meets SNI standard for wet noodles, which requires a minimum protein content of 9% (w/w). The carbohydrate content results showed averages of F1 (46.69%), F2 (46.78%), and F3 (45.26%). The average dietary fiber content results were F1 (5.57%), F2 (5.90%), and F3 (6.24%).

3. Selected Formulation

The selected formulation was determined based on weighting calculations conducted in accordance with the quality requirements for wet noodles, referencing SNI (2987: 2015) and using the MPE (method. The best formulation is the third formulation, F3. The organoleptic test results for F3 show favorable acceptance in the hedonic test, with average scores for the following attributes: color (3.33), aroma (3.07), texture (3.17), aftertaste (3.23), and mouthfeel (2.93). The macronutrient composition of F3 includes 38.76% moisture, 2.55% ash, 3.61% fat, 10.25% protein, 45.26% carbohydrates, and 6.24% dietary fiber.

Table 4. Contribution to Recommended Dietary Allowanced (RDA)

Nutrient	Wet Noodle (80 g) (Adolescent Male)	Wet Noodle (65 g) (Adoles-cence Female)	%RDA for Adoles-cence 16-18 y.o (Male)	%RDA for Adoles-cence 16-18 y.o (Female)
Energy (kcal)	200.6	162.9	7.56	7.76
Fat (g)	2.54	2.07	2.43	2.95
Protein (g)	8.21	6.67	8.89	10.26
Carbohy-drate (g)	36.21	29.42	7.36	9.80
Dietary Fiber (g)	4.99	4.06	10.97	14

Based on Table 4, the serving size of wet noodles (80 g) contributes 7.56% of the daily energy requirement for male adolescents, while a 65 g serving offers 7.76% for female adolescents. For obese adolescents, following the "T plate" approach—where ¼ of the plate represents a carbohydrate source—each meal should supply approximately 7.5% of their daily calorie needs (based on 30% for lunch, with ¼ allocated to carbohydrates). Thus, an 80 g portion of wet noodles fulfills the energy requirement for male adolescents, while a 65 g portion meets the needs for female adolescents.

The nutritional content for an 80 g serving of wet noodles includes 200.6 kcal of energy, 2.07 g of fat, 6.67 g of protein, 36.21 g of carbohydrates, and 4.99 g of dietary fiber, suitable for male adolescent needs. In contrast, a 65 g serving provides 162.96 kcal of energy, 2.07 g of fat, 6.67 g of protein, 29.42 g of carbohydrates, and 4.06 g of dietary fiber, suitable for female adolescents.

Table 5. Contribution to Nutrition Label References

Nutrient	Food Label Reference	Nutrient content (100g)	%Food Label Reference	Claim
Energy (kcal)	2150	250.7	11.66	-
Fat (g)	67	3.18	4.74	-
Protein (g)	60	10.26	17.10	-
Carbohydrate (g)	325	45.26	13.92	-
Dietary Fiber (g)	**30**	**6.24**	**20,80**	**High**

Based on Table 5, one serving of wet noodles (100 g) contributes 11.66% of daily energy needs, 4.74% of daily fat, 17.10% of daily protein, 13.92% of daily carbohydrates, and 20.80% of daily dietary fiber according to general nutritional guidelines. With 6.24 g of dietary fiber per 100 g, wet noodles provide 20.80% of the daily fiber intake, qualifying them as a high-fiber product. This meets BPOM (2016) standards, which state that a solid food can be labeled high in fiber if it contains at least 6 g of fiber per 100 g.

DISCUSSION

The results of the statistical test indicated that the color assessment was generally favorable, as the wet noodles exhibited a brownish purple hue. This color was primarily due to the substitution of purple sweet potato flour, as the natural purple color in the noodles comes from the anthocyanin pigment in purple sweet potato flour (18,19). The brownish color of the noodles was also influenced by the inclusion of mocaf flour, which aligns with the findings of Umri et al. (2017), who noted that adding mocaf flour to wet noodles tends to produce a brownish color. Additionally, the protein content in soybean flour also contributed to the color (20). This is consistent with Jaya's study (2019), which found that the brown color of cookies was attributed to the protein in soybean flour, which initiated the Maillard reaction (21). During cooking, the Maillard reaction occurs between reducing sugars and amino groups, and prolonged exposure to high temperatures can lead to a non-enzymatic browning reaction (22).

The statistical test results showed that the aroma assessment was somewhat favorable but also described as somewhat unpleasant. This trend occurred because as the proportion of purple sweet potato flour substitution increased, panelists' preference for the aroma of the wet noodles decreased, leading to an unpleasant aroma in the F3 batch (18). Purple sweet potatoes are known for their distinctive, sometimes off-putting aroma, which can affect panelists' acceptance (23). The strong aroma of purple sweet potatoes is attributed to the degradation of anthocyanin pigments during the drying process (24). Besides the influence of purple sweet potato flour, the aroma was also impacted by the substitution of soybean flour. In the F1 and F2 treatments, the aroma was still somewhat unpleasant, which was due to the inclusion of soybean flour, leading to a reduced panelist preference (25). This finding aligns with research by Rahmawati et al. (2020), which concluded that increasing the amount of soy flour decreased panelists' aroma preference for cookies, as soybean flour contains lipoxygenase and long-chain unsaturated fatty acids. The lipoxygenase enzyme accelerates the peroxidation of unsaturated fatty acids, resulting in a rancid aroma that is disliked by panelists (26).

The statistical test results also indicated that taste was rated as somewhat pleasant and flavorful, influenced by both purple sweet potato flour and soybean flour. Purple sweet potatoes impart a sweet taste, which comes from starch converted into maltose and dextrin (18). The addition of salt in each treatment created a savory taste in the noodles (27). However, the taste of the noodles was also affected by soybean flour. F1, which had the highest proportion of soybean flour, exhibited a more bitter taste due to the bitterness associated with soybean flour (28). This finding is supported by research by Fatmala and Adi (2017), which states that higher proportions of purple sweet potato and soybean flour in biscuits lead to a more bitter taste (29), primarily due to the presence of soyasaponins and sapogenol, glycoside compounds in soybeans. Moreover, the taste was also influenced by the addition of eggs, which enhance flavor and savory qualities (30). Egg yolks contain lecithin, which contributes to a richer taste (31). The addition of mocaf flour also contributed to a tastier flavor, as reported by Arsyad (2016), who found that mocaf flour improved the taste of biscuits (32).

The statistical test results indicated that the texture of the wet noodles was generally well-liked and fairly chewy, which can be attributed to the inclusion of wheat flour. Wheat flour contains gluten, which helps bind water and create a chewy texture in the noodles. The addition of purple sweet potato flour, however, reduces the gluten content in the noodles (23). The chewiness of wet noodles is determined by the balance between the gluten and amylopectin in wheat flour (33). Typically, noodles are chewy, but in this study, the noodles were particularly chewy due to the lower gluten content from the addition of purple sweet potato flour (34). As purple sweet potato flour is low in gluten, it must amylopectin, helping to improve the chewiness of gluten-free noodles (35). Additionally, the texture of the wet noodles made with purple sweet potato and soybean flour was influenced by the inclusion of eggs and soy protein isolate. Eggs contribute to a firmer texture, increasing the noodles' chewiness (36). The lecithin in egg yolks has water-binding properties, which aid in hydrating the dough (31). Egg whites help form a strong, adhesive layer when the noodles are stretched, preventing them from breaking easily (37). Eggs also act as emulsifiers, binding starch molecules and making the texture of the noodles softer, smoother, and more elastic (38). The addition of soybean protein isolate also played a role in making the noodles chewy and less likely to break.

The results of the statistical test showed that the assessment of the aftertaste was quite pleasant and quite strong. This shows that the aftertaste produced in wet noodles with purple sweet potato flour and soybean flour substitution is still acceptable to the panelists. The aftertaste produced is a bitter taste caused by soybean flour and soybean protein isolate and a sweet taste in purple sweet potato flour. This is in line with the research of Rahmawati et al., (2020) which states that the more substitution of purple sweet potato flour and soybean protein isolate in cookies, the more bitter the aftertaste will be in the cookies (15). The bitter taste that arises from the addition of soybean protein isolate is caused by soyasaponin and sapogenol which are glycoside compounds in soybean flour (39). In addition, aftertaste can arise due to the heating process in cooking wet noodles, causing a Maillard reaction. Maillard reaction can cause a bitter aftertaste from the release of amino acids that give a bitter taste (40).

Statistical test results indicated that panelists rated the mouthfeel as quite favorable and chewy, which is attributed to the reduced proportion of wheat flour. The chewy texture of the noodles is influenced by two factors: the gluten protein and amylose content in both wheat flour and mocaf flour (20). Wheat flour contains 25% amylose and 75% amylopectin, while mocaf flour has amylose levels ranging from 21.04% to 29.2% and amylopectin levels between 79.6% and 78.8% (41). Wheat flour contains 25% amylose and 75% amylopectin, while mocaf flour has amylose levels ranging from 21.04% to 29.2% and amylopectin ranging from 79.6% to 78.8%. Wheat flour contains gluten, which contributes to a chewy texture in wet noodles by creating a tighter bond between starch granules, leading to a stronger and more resistant gel (42). The higher the proportion of wheat flour used, the chewier the texture of the noodles becomes (43). In addition to the influence of wheat flour, mocaf flour also contributes to the chewy mouthfeel. Mocaf flour serves as a suitable substitute for wheat flour due to its similar texture (44). The presence of soy protein isolate in wet noodle production further enhances the chewy texture, as soybean protein isolate makes the dough firmer and less prone to breaking (45). Using soy protein isolate helps achieve a chewier texture overall (46).

The study on wet noodles made with purple sweet potato flour and soybean flour showed that the water content increased with each treatment. The average scores for F2 and F3 exceeded the SNI wet noodle quality standards. The rise in water content was influenced by the water content in the purple sweet potato flour; the higher the proportion of this flour, the greater the water content (34, 47). In addition to the purple sweet potato flour, the use of soy protein isolate also contributed to the higher water content in the noodles due to the increased protein levels (48). Furthermore, mocaf flour played a role in increasing the water content, as it contains lecithin, a hydrophilic substance that helps bind water (32).

The study on wet noodles showed that the ash content of the noodles is primarily influenced by the amount of purple sweet potato flour used (23). As the proportion of purple sweet potato flour increases, the ash content in the noodles also rises. Purple sweet potatoes are rich in minerals such as potassium, magnesium, calcium, copper, and zinc. Additionally, a higher ash content can affect the color of the noodles, making them darker, which results in a purple-brown hue due to the elevated ash levels (49). High ash content may also lead to the breakdown of gluten, which negatively impacts the noodle's quality, making them more prone to breaking and less elastic (50). The ash content in wet noodles is also affected by mocaf flour, which has a high ash content of 1.3% per 100 g, including 60 mg of calcium, 64 mg of phosphorus, and 15.8 mg of iron (12).

The fat content in wet noodles is affected by the inclusion of ingredients such as wheat flour, soybean flour, and eggs. Purple sweet potato flour contains

0.81% fat, while wheat flour has a fat content of 1.3% (50, 51). The fat content in F1 is the highest compared to F2 and F3, which is attributed to the substitution of soybean flour. This finding aligns with research by Safira et al. (2022), which indicates that increasing soybean flour substitutions raises the fat content (25). According to the Indonesian Food Composition Table, soybean flour contains 20.6 g of fat per 100 g. Additionally, the fat content in the noodles is influenced by the use of eggs, which have a fat content of 10.9% by weight (23).

The protein content in the wet noodles meets the SNI standards, which require a minimum of 9% by weight. The high protein levels in the noodles can be attributed to the use of high-protein wheat flour (23). Additionally, the inclusion of soybean flour contributes to the increased protein content, as soybean flour contains 35.9 g of protein per 100 g, according to the Indonesian Food Composition Table (12). Eggs, which are also a rich source of protein with high bioavailability (90.9% of egg protein is digestible), further enhance the protein content, with eggs containing 12.9 g of protein per 100 g (12,41).

Regarding carbohydrates, the study found a decrease in carbohydrate levels from F2 to F3 as the proportion of wheat flour used in the noodles decreased. Carbohydrates are the main nutrient in wet noodles, and are predominantly sourced from tubers and wheat. Purple sweet potato flour has a higher carbohydrate content than wheat flour—84.4% compared to 77.2% per 100 g (12). As more purple sweet potato flour is substituted, the carbohydrate content typically increases (14). However, the findings in this study do not align with prior research, as the carbohydrate content showed a decrease from F2 to F3. This discrepancy is likely due to the different method used to determine carbohydrate content in this study, where it was calculated rather than analyzed directly. Other factors, such as water, ash, protein, and fat, can also influence carbohydrate levels (52).

The study on wet noodles showed that the dietary fiber content increased with each treatment as the proportion of purple sweet potato flour used in the noodles increased (18). The more purple sweet potato flour substituted, the higher the dietary fiber content in the noodles. This is because purple sweet potato flour contains 3.23% dietary fiber, according to chemical analysis. In addition to the contribution of purple sweet potato flour, the dietary fiber content in wet noodles is also enhanced by the inclusion of mocaf flour. According to the Indonesian Food Composition Table, mocaf flour provides 6 g of fiber per 100 g, along with 350 kcal of energy, 1.2 g of protein, 0.6 g of fat, and 85 g of carbohydrates (12).

CONCLUSION

1. The organoleptic tests, which assessed color, aroma, taste, texture, aftertaste, and mouthfeel, did not show significant differences. However, the analysis of macronutrient content—such as moisture, ash, fat, protein, carbohydrates, and dietary fiber—indicated that substituting purple sweet potato flour and soybean flour altered the composition of the wet noodles.
2. The chosen formulation in this study was F3, which received the following average organoleptic scores: 3.33 for color (liked), 3.07 for aroma (liked), 3.07 for taste (liked), 3.17 for texture (liked), 3.23 for aftertaste (liked), and 2.93 for mouthfeel (disliked).
3. The nutritional content of F3 included 38.76% moisture, 2.55% ash, 3.18% fat, 10.26% protein, 45.26% carbohydrates, and 6.24% dietary fiber.

4. The macronutrient and dietary fiber levels in F3 met the %RDA nutrient requirements for adolescents aged 16-18 years.
5. Additionally, the dietary fiber content of the wet noodles qualifies for a high-fiber claim based on general dietary guidelines (20.8%).

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REFERENCES

1. Kurdanti W, Suryani I, Syamsiatun NH. Faktor-faktor yang mempengaruhi kejadian obesitas pada remaja. *Jurnal Gizi Klinik Indonesia*. 2015;11(4):179-190.
2. Masriadi, Basri M, Pratiwi I. Pengaruh senam aerobik terhadap penurunan berat badan remaja obesitas di SMP Katolik Rajawali Makasar tahun 2017. *Jurnal Kesehatan*. 2018; 1(2):76.
3. Makaryani RY. Hubungan konsumsi serat pangan dengan kejadian overweight pada remaja putri SMA Batik 1 Surakarta. Skripsi. Universitas Muhammadiyah Surakarta, Surakarta, 2013.
4. Kementerian Kesehatan Republik Indonesia. Riset Kesehatan Dasar (Riskesdas). Jakarta : Kemenkes RI, 2018.
5. Silalahi AM. Pola konsumsi junk food dan soft drink pada siswa yang overweight Di SMP Negeri 2 Lubuk Pakam. Skripsi. Politeknik Kesehatan Medan, Sumatera Utara, 2019.
6. Park S. Instan noodles, processed food intake, and dietary *pattern are associated with atipic dermatitis in a adult population. Asia pac* J Clin Nutr. 2016;25(3):602-613.
7. Mayanti S, Ferinawati F. Pengaruh kebiasaan makan dan aktivitas fisik terhadap kejadian obesitas pada remaja Di Sekolah Menengah Atas Negeri 1 Kecamatan Kota Juang Kabupaten Bireuen. *Jurnal of Healthcare Technology And Medicine.* 2018;4(2):242-257.
8. Wicaksono K. Bahaya mie instan bagi kesehatan. Kementerian kesehatan RI : Direktorat Bina Gizi, 2015.
9. Marsyusman T, Imtihanah S, Firdausa NI. Kombinasi diet tinggi serat dan senam aerobic terhadap profil lipid darah pada pasien dislipidemia. *Jurnal Gizi Indonesia*. 2020; 43 (2) : 67-76.
10. Herminingsih A. Manfaat serat dalam menu makanan. Universitas Mercu Buana, Jakarta, 2010.
11. Monica L, Giriwoni PE, Rimbawan. Pengembangan mie kering berbahan dasar tepung ubi jalar ungu (*Ipomoea batatas* l) sebagai pangan fungsional tinggi serat. *Jurnal Mutu Pangan*. 2018;5(1):17-24.
12. Kementerian Kesehatan RI. Tabel Komposisi Pangan Indonesia Jakarta: Badan Penelitian dan Pengembangan Kesehatan Kementerian RI, 2020.
13. Ginting E, Utomo JS, Yulifianti R, Jusuf M. Potensi ubi jalar ungu sebagai pangan fungsional.*Jurnal Iptek Tanaman Pangan*. 2011;6(1):116-138.
14. Yolanda RS, Dewi DP,Wijanarka A. Kadar serat pangan, proksimat, energy pada mie kering substitusi tepung ubi jalar ungu (*Ipomoea Batatas. L Poir*). Jurnal Ilmu Gizi Indonesia. 2018;2(1):1-6.
15. Rahmawati L, Asmawati, Saputrayadi A. Inovasi Pembuatan Cookies Kaya Gizi dengan Proporsi Tepung Bekatul dan Tepung Kedelai. *Jurnal Agrotek Ummat.* 2020;7(1):30-36.

16. Andayani F, Ma'rifah B, *et al*.. Metode pembuatan mie basah substitusi tepung ubi ungu dan tepung kedelai sebagai alternatif pangan fungsional untuk remaja obesitas. HKI No. EC00202349985, 2023.
17. Depiyana T, Kusumawati D, Ma'rifah B. Analisis kandungan gizi dan organoleptik krakers substitusi tepung ubi jalar ungu dan tepung tempe sebagai alternatif PMT balita gizi kurang. *Jurnal Teknologi Pangan dan Gizi*. 2023;23(1):8-17.
18. Nintami AL, Rustanti N. Kadar serat, aktivitas antioksidan, amilosa dan uji kesukaan mie basah dengan substitusi tepung ubi jalar ungu (*Ipomoea Batatas Var Ayamurasaki*) bagi penderita Diabetes Mellitus Tipe 2. *Journal of Nutrition College*. 2012;1(1):382-387.
19. Aurelia L, Ma'rifah B, Muhlishoh A. Snack bar tinggi serat dan antioksidan berbahan dasar ubi jalar ungu dan beras hitam sebagai alternatif selingan penderita Diabetes Melitus. *Jurnal Gizi dan Pangan Soedirman*. 2023;7(2):196-216.
20. Umri AW, Nurrahman HW. Kadar protein, tensile strength dan sifat organoleptik mie basah dengan substitusi tepung mocaf. *Jurnal Pangan dan Gizi*. 2017;7(1):39-47.
21. Jaya IKS. Pengaruh penambahan tepung kedelai terhadap cita rasa dan kadar air cookies ubi jalar ungu. *Jurnal Gizi Prima*. 2019;1(1): 2656-2480.
22. Sariana A, Suranadi L,Sofiyanti R. Pengaruh substitusi tepung kedelai terhadap sifat organoleptik soybeans cookies. *Jurnal Gizi Prima*.2019;7(1): 1-7.
23. Triastuti D. Sifat fisikokimia dan sensori mie basah dengan substitusi tepung ubi jalar ungu. *Scientific Timeline*. 2021;1(2):70-85
24. Salma, Rasdiansyah, Muzaifa M. Pengaruh penambahan tepung ubi jalar ungu dan karagenan terhadap kualitas mie basah ubi jalar ungu (*Ipomoea Batatas*). *Jurnal Ilmiah Mahasiswa Pertanian*. 2018;3(1):357-366.
25. Safira SA, Gumilar M, Dewi M, Mulyo GE. Sifat organoleptik dan nilai gizi cookies soygreen formula tepung kacang hijau dan tepung kacang kedelai. *Jurnal Kesehatan Siliwangi*. 2022;2(3):1028-1040.
26. Mandal S, Dahuja A, Kar A, Santha IM. In vitro kinetics of soybean lipoxygenase with combination fatty substrates and its fungsional significance in flavour development. *Food Chemistry Journal*. 2014;146(1): 394- 403.
27. Kurniawan A, Estilasih T, Nurgrahini NI. Mie dari umbi garut (*Maranta arudinacea L*). *Jurnal Pangan dan Agroindustry*. 2015;3(3):847-854.
28. Puspita D, Harini N, Winarsih S. Karakteristik kimia dan organoleptik biscuit dengan penambahan tepung kacang kedelai (*Glycine Max*) dan tepung kulit buah naga merah (*Hylocereus Costaricensis*). *Jurnal Technology Dan Halal Science*. 2021;1(1):52-65.
29. Fatmala IG, Adi AC. Daya terima dan kandungan protein biscuit substitusi tepung ubi jalar ungu dan isolat protein kedelai untuk pemberian makanan tambahan ibu hamil KEK. *Jurnal Media Gizi*. 2017;12(2):156-163.
30. Rosiana NM, Nisah RQ. Pengaruh penambahan telur terhadap elastisitas dan penerimaan mie basah bebas gluten. *Jurnal Kesehatan*. 2021;9(3): 150-156.
31. Biyumna UI, Windrati WS, Diniyah N. Karakteristik mie kering terbuat dari sukun (*Artocarpusa altilis*) dan

penambahan telur. *Jurnal Agroteknologi*. 2017;11(1):23-34.
32. Arsyad M. Pengaruh penambahan tepung mocaf terhadap kualitas produk biskuit. *Jurnal Agropolitan*. 2016;3(3): 52-61.
33. Nurnanfitrisni A, Wijayanti A, Rahman P. Mie basah ubi jalar. *Jurnal Teknologi Pengolahan Serealia, Kacang-Kacangan dan Hasil Perkebuna*n. 2011; 3(2): 145-151.
34. Daulay HA, Yusmarini, Zalfiatri V. Pemanfaatan tepung ubi jalar ungu dan tepung kelapa sebagai bahan pensubstitusi terigu dalam pembuatan mie instan. *Jurnal Teknologi Pertanian*. 2018;17(2):18-27.
35. Indrianti N, Kumalasari R, Ekafitri R, Darmajana DA. Pengaruh penggunaan pati ganyong, tapioca, dan mocaf sebagai bahan substitusi terhadap sifat fisik mie jagung instan. *Jurnal Agrotek.* 2013; 33 (4) : 391-398.
36. Padalino L, Conte, Nobile MAD. Overview on the general approacheh to improve gluten-free pasta and bread. *Journal Foods*. 2016;5(87):1-18
37. Rosida R, Risky DW. Mie dari tepung komposit (terigu, gembili, labu kuning) dan penambahan telur. *Jurnal Teknologi Pangan*. 2013;17(1): 32-27.
38. Hardoko, Tasia C, Mastuti TS. Pembuatan mie singkong karakterisasi: mie singkong hasil penambahan jenis protein dan rasio tepung singkong terhadap tapioca. *Jurnal Sains dan Teknologi*. 2021;5(1):58-72.
39. Purwanto, Hersoelistyorini W. Studi pembuatan makanan pendamping asi (MP-ASI) menggunakan campuran tepung kecambah kacang kedelai, kacang hijau dan beras. *Jurnal Pangan dan Gizi*. 2011; 2(3):43-54.
40. Yu M, He S, Tang M, Zhang Z, Zhu Y, Sun H. Antioxidant activity and sensory characteristics of maillard reaction product derived from different peptide fractions of soybean meal hydrolysate. *Food Chemistry Journal*. 2018;8146 (17):249-257
41. Risti Y, Rahayani A. Pengaruh penambahan telur terhadap kadar protein, serat, tingkat kekenyalan dan penerimaan mie basah bebas gluten berbahan baku tepung komposit (tepung komposit : tepung mocaf, tapioka dan maizena). *Jurnal of Nutrition College*. 2013;2(4):696-703.
42. Safriani N, Ryan M, Ferizal. Pemanfaatan pasta sukun (*Artocarpus Altilis*) pada pembuatan mie kering. *Jurnal Teknologi dan Industry Pertanian Indonesia*. 2013;5(2):17-24.
43. Pertiwi AD, Widanti YA, Ahmad M.Substitusi tepung kacang merah (*Phaseolus Vulgaris L*) pada mie kering dengan penambahan ekstrak bit. *Jurnal Ilmiah Teknologi dan Industri Pangan Unisri*. 2017;2(1):67-73.
44. Khotimah K, Sayuqi A, Akbar, Zamroni A. Pengaruh substitusi tepung mocaf (*Modified Cassava Flour*) terhadap sifat fisik dan sensori bolu kukus. *Journal Bulletin Loupe*. 2019;15 (1):16-23.
45. Sukamto S, Azizah R, Suprihana S, Karim F. Produksi mie protein tinggi terigu yang difortifikasi tepung kompoait dan protein kacang hijau. *Prosiding Seminar Nasional Lahan Suboptimal*. 2019;10(1):487-495.
46. Ilma, Andana PR, Nocianitri KA, Hapsari NM. Pengaruh penambahan isolate protein kedelai terhadap karakteristik kamaboko ikan barramundi (*Lates Calcalifer*). *Jurnal Ilmu dan Teknologi Pangan*. 2019;8(3):313-322.
47. Hasmawati. Analisis kualitas mie basah dengan penambahan daun ubi jalar ungu (*Ipomoea batatas*). *Jurnal*

Pendidikan dan Teknologi Pertanian. 2020;6(1):97-100.

48. Setyawati R, Dwiyanti, Siwanto AR. Karakteristik fisikokimia dan sensori mie ubi kayu dengan suplementasi isolate protein kedelai. *Jurnal Agroteknologi*. 2020;5(1):32-39
49. Utomo JS, Yulifianti. Karakteristik mie berbahan baku terigu lokal dan ubi jalar ungu. *Prosiding Seminar Hasil Penelitian Tanaman Aneka Kacang dan Umbi.* 2011;768-775.
50. Rahmah A, Hamzah F, Rahmayuni. Penggunaan tepung komposit dan tepung terigu, pati sagu, dan tepung jagung dalam pembuatan roti tawar. *Jurnal Online Mahasiswa Faperta.* 2017;4(1):1-14.
51. Paramita O.Identifikasi kandungan gizi tepung umbi-umbian lokal Indonesia. *Journal Boga*. 2011:6(1):1-16.
52. Nurcahyo E, Amanto BS, Nurhartadi E. (2014). Kajian penggunaan tepung sukun (*Artocaspus Communis*) sebagai substitusi tepung terigu pada pembuatan mie kering. *Jurnal Teknologi Pangan*. 2014;3(2):57-65.