



# Optimization of wheat flour and purple sweet potato flour proportions on the organoleptic properties of dry noodles

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## Abstract

Noodles are a widely consumed food product in Indonesia, especially dry noodles, which have a low water content, are long-lasting, practical, and affordable. However, the main raw material for dry noodles is wheat flour, which is still largely dependent on imports. Therefore, efforts are needed to utilize local food ingredients as an alternative substitute. Purple sweet potato has the potential to be used because it contains anthocyanins and antioxidants that are beneficial for health. This study aims to determine the effect of adding purple sweet potato flour on the organoleptic quality of dry noodles. The manufacturing process is carried out through drying in an oven and cooking in a steamer. The results of the analysis of variance (ANOVA) showed that differences in the level of substitution of purple sweet potato flour did not have a significant effect ( $P < 0.05$ ) on the overall acceptance of the panelists. In general, the control noodles without substitution had the highest level of preference, while the highest substitution showed the lowest preference value, but the difference was not dominant. Thus, the addition of purple sweet potato flour is still acceptable, as long as the amount does not exceed the optimum limit. Further research is needed to determine the best formulation and encourage the use of local food ingredients that have the potential to reduce dependence on imports.

## Article History

Received October 22, 2025

Accepted December 1, 2025

Published December 10, 2025

## Keywords

Functional foods,  
Noodles, Purple  
sweet potatoes.

## 1. Introduction

The introduction should One of the processed food products that is widely loved by people from all walks of life is noodles made from wheat flour. Indonesians often eat noodles at least once a day. Noodle products are generally divided into two types, namely wet noodles and dry noodles. Dry noodles are one of the most popular products among the public, both as a main dish and as a side dish, because they are affordable and practical to serve. Dry noodles have a moisture content of less than 10%, making them durable and an easily stored source of carbohydrates. The main ingredient in dry noodles is wheat flour, most of which is sourced through wheat imports of 4.5–5 million tons per year. This situation highlights the need to reduce dependence on imported wheat flour by developing local food ingredients and incorporating them into daily life (1).

Efforts to reduce dependence on wheat flour in noodle production are carried out by substituting some of the basic ingredients with sweet potato flour, one of which is purple sweet potato flour (*Ipomoea batatas L.*), which has physical properties and nutritional content similar to wheat flour. The use of sweet potato flour as a substitute for wheat flour is considered effective because it is high in carbohydrates and has the ability to gelatinize during the steaming process, resulting in a chewy noodle texture that does not break easily, similar to the characteristics of wheat flour noodles. In addition, sweet potato flour can also provide

functional added value that can improve the nutritional quality of instant noodles while making them a functional food (2).

Processing purple sweet potatoes into noodle products is done to reduce dependence on imported wheat flour while increasing added value and diversifying local foods. Purple sweet potato flour is high in carbohydrates, dietary fiber, and anthocyanin compounds that function as natural antioxidants and provide health benefits, such as fighting free radicals. In addition, the use of purple sweet potato flour can produce noodles with a natural purple color, soft texture, and better nutritional content (3).

The formulation of the ratio between wheat flour and purple sweet potato flour still requires further study to obtain the optimal composition. The use of excessive amounts of purple sweet potato flour is known to reduce the physical quality, texture, and consumer acceptance of noodle products. Therefore, this study was conducted to determine the most appropriate purple sweet potato flour substitution formulation that produces noodle products with the best quality. To find out what the best food ingredients are that are suitable for use in noodle products based on the best organoleptic values

## 2. Materials and Methods

### 2.1. The process of making sweet potato flour

The process of making purple sweet potato flour is carried out by preparing 2 kilograms of purple sweet potatoes that have been peeled and washed with running water until clean. Next, the sweet potatoes are thinly sliced using a slicer with a thickness of approximately  $\pm 1$  mm to produce chip-shaped pieces. The chips are then dried in an oven at 70°C for 40 hours until they reach a low moisture content and a brittle texture. After the drying process is complete, the dried chips are ground using a blender and sifted using an 80-mesh sieve to obtain flour with uniform particle size. This method of making purple sweet potato flour refers to previous research results that have been proven to provide the best response and quality of flour in terms of color, texture, and shelf life (4).

### 2.2. Sweet potato noodle making process

The process of making purple sweet potato flour noodles is done by mixing purple sweet potato flour and wheat flour according to the specified proportions. The mixture of the two flours is added with 10 grams of salt, then stirred using a dough mixer (noodle machine) with a dough hook for 1 minute. After that, 150 ml of water and 100 grams of eggs are added, then the dough is kneaded again for 15 minutes until a smooth and even dough is formed. The prepared dough is then rolled out into sheets using a rolling pin and continued with printing using a manual noodle making machine to produce noodle sheets with uniform thickness. Next, the extruded noodles are boiled in boiling water until cooked, then drained and dried in an oven at 60°C for 8 hours to produce dried purple sweet potato noodles with a firm texture, ready for testing (4).

### 2.3. Organoleptic analysis

The noodle products that were produced were then analyzed through organoleptic testing involving 25 panelists as assessors using the hedonic test method to determine the panelists' level of liking for the product based on five parameters, namely taste, color, aroma, chewiness, elasticity, and overall acceptance. The hedonic test used a seven-point rating scale, namely 7 (strongly like), 6 (like), 5 (somewhat like), 4 (neutral), 3 (somewhat dislike), 2

(dislike), and 1 (strongly dislike). The testing stage was carried out by boiling the dry noodles for 3-5 minutes in boiling water, then serving them in test containers for evaluation by the panelists. Each panelist was given 10 types of noodle samples, accompanied by plain water as a flavor neutralizer and an organoleptic test assessment sheet. The color parameter was assessed before the noodles were cooked, as color is considered an initial indicator that influences consumer perception of product quality. All test data were statistically analyzed using Analysis of Variance (ANOVA) with a 5% confidence level, and if significant differences were found, a Tukey HSD (BNJ) post-hoc test was conducted to determine the treatment that yielded the best results.

### 3. Results and Discussion

#### 3.1. Noodle purple sweet potato

Noodles are a type of flour-based food widely known by most Indonesians. They are popular among many people, primarily due to their practicality, ease of preparation, and speed. Noodles are a popular alternative food to rice (5). Dried noodles are defined as fresh noodles that have been dried to a moisture content of approximately 8-10%. This drying process is generally carried out using an oven or by drying in the sun. The main characteristic of dried noodles is their low moisture content, which provides two main advantages: a relatively long shelf life and easy handling. Standard dried noodles generally refer to the Indonesian National Standard (SNI) 8217:2015, which stipulates several quality requirements, including a maximum moisture content of 13%, a minimum protein content of 10%, and a maximum ash content of 0.1% (6).

The texture of wet noodles is chewy and highly dependent on the concentration of wheat flour, due to the gluten content in them, which other flours do not have, which functions to form an elastic matrix. The chemical properties of noodles contain dietary fiber, which is a carbohydrate that cannot be digested by human enzymes but is beneficial for health (7).



Figure 1. Noodles made from wheat flour (8)

#### 3.2. Purple sweet potato

Purple sweet potato (*Ipomoea batatas L. Poir*) is a sweet potato variety commonly found in Indonesia and is characterized by its deep purple flesh. This purple color indicates a high anthocyanin content, a water-soluble, safe-to-consume antioxidant pigment often used as a natural food coloring (9). Deep purple sweet potatoes have a much higher anthocyanin content, at around 61.85 mg/100 g, compared to light purple sweet potatoes, which only contain around 3.51 mg/100 g. This high anthocyanin content is influenced by the presence

of acyl groups in their structure, where acyl-group anthocyanins are the main form in purple sweet potatoes and are known to have strong antioxidant potential. These anthocyanin compounds play an important role in warding off free radicals and preventing cell damage due to oxidation reactions in the body (10).

In addition to anthocyanins, purple sweet potatoes also contain various beneficial nutrients, including 1.1% fiber, 18.2% starch, 0.4% reducing sugar, 0.6% protein, 0.70 mg iron, 20.1 mg vitamin C, and a total of around 150.7 mg anthocyanins. Other antioxidant compounds found in this tuber include vitamin C, vitamin E, lutein, zeaxanthin, and beta-carotene, which are included in the carotenoid group. In addition to its high nutritional content, purple sweet potatoes have a sweet taste, making them very suitable as a raw material in making various snacks with a delicious taste and are loved by the public (9).



Figure 2. Noodles made from wheat flour (10)

### 3.3. Organoleptic properties of purple sweet potato noodles

#### 3.3.1. Colour

The results of the analysis of variance (ANOVA) statistically prove that there is a very significant effect ( $P < 0.01$ ) of the substitution ratio of purple sweet potato flour to wheat flour on the panelists' preference for noodle color. The highest color acceptance level was achieved in formula P2, which used an equal ratio of 50% purple sweet potato flour and 50% wheat flour. In contrast, formula P1, which contained the highest proportion of purple sweet potato flour (75%:25%), produced the lowest color preference level among all treatments. The low preference scores for formulas with high purple sweet potato flour content indicate that panelists disliked the dark color intensity. This condition occurred because the high concentration of anthocyanin pigments caused the noodles to turn dark purple, deviating from consumer preferences for instant noodles, which are generally bright yellow in color (4).

#### 3.3.2. Aroma

Based on variance analysis (ANOVA), the comparison of proportions between purple sweet potato flour and wheat flour proved to have no significant effect ( $P > 0.05$ ) on the panelists' level of preference for the aroma of the noodles produced. However, descriptively, treatment P2 (50% purple sweet potato flour) received the highest preference score, while the control treatment P4 (100% wheat flour) received the lowest score. These non-significant results indicate that different formulations did not create different aroma preferences among the panelists. The main hypothesis is that during the preparation process, namely boiling, the elimination or dissolution of volatile aroma-forming compounds from sweet potato noodles occurred, causing the panelists to perceive a similar aroma in all samples (4).

### 3.3.3. Taste

The results of the analysis of variance (ANOVA) showed that differences in the substitution ratio of sweet potato flour to wheat flour had a significant effect ( $P < 0.05$ ) on the panelists' level of preference for the taste of purple sweet potato noodles. The highest level of preference was achieved in formula P1, with a dominant concentration of purple sweet potato flour of 75%. Conversely, the control treatment P4, which contained only 100% wheat flour, recorded the lowest level of preference. These data indicate that the addition of purple sweet potato flour significantly increased the acceptance of the noodle flavor, as reflected in the significant difference between treatments P4 (0% sweet potato) and P1 (75% sweet potato). However, although P1 had the highest score, there was no significant difference between P1, P2, and P3. This implies that after reaching a certain proportion (i.e., above 50%), a continued increase in the concentration of purple sweet potato flour no longer resulted in an increase in the panelists' liking of the resulting noodle flavor (4).

### 3.3.4. Chewiness

The results of the analysis of variance (ANOVA) showed that the difference in the substitution ratio between sweet potato flour and wheat flour had a very significant effect ( $P < 0.01$ ) on the panelists' preference for the chewiness of purple sweet potato noodles. Specifically, the treatment with the highest liking score for chewiness was P4 (control noodles, 0% sweet potato: 100% wheat flour). Conversely, the treatment with the lowest liking score was P1 (75% sweet potato: 25% wheat flour), which used the highest proportion of sweet potato flour. These findings clearly indicate that increasing the proportion of purple sweet potato flour in noodle formulations tends to decrease panelists' liking for chewiness. The best chewiness was found in noodles made with pure wheat flour, while noodles with the highest purple sweet potato flour content were rated as having the worst chewiness. This is consistent with the function of gluten in wheat flour, which plays a role in forming an elastic matrix that gives noodle products their chewiness (4).

### 3.3.5. Elasticity

Analysis of variance (ANOVA) showed that differences in the substitution ratios of sweet potato flour and wheat flour had no significant effect ( $P > 0.05$ ) on panelists' preference for the stretchability of purple sweet potato noodles. Descriptively, the P4 control noodles (0% sweet potato: 100% wheat) recorded the highest preference score, while the P1 treatment (75% sweet potato: 25% wheat) recorded the lowest. Despite the variation in descriptive scores, these non-significant results suggest that panelists rated the stretchability of all noodle treatments as similar or similar. This lack of difference in preference is strongly suspected because stretchability is not a quality factor generally considered by consumers when consuming noodles. The stretchability assessment conducted by pulling the noodles to the breaking point is a technical testing method not commonly used by panelists in their daily consumption experience (4).

### 3.3.6. Overall acceptance

The results of the analysis of variance (ANOVA) showed that the difference in substitution ratio between purple sweet potato flour and wheat flour did not have a significant effect ( $P < 0.05$ ) on the overall acceptance (general preference) of the panelists for the noodles produced. Descriptively, the control noodle P4 (0% sweet potato: 100% wheat) recorded the highest level of preference. In contrast, treatment P1 (75% sweet potato: 25%

wheat), with the highest concentration of sweet potato flour, produced the lowest level of preference. Although numerically the control noodle P4 was preferred, this non-significant statistical result implies that no noodle treatment was dominantly preferred by the panelists overall compared to the other treatments. The varying concentrations of purple sweet potato flour did not produce a large enough difference to influence the panelists' final decision to accept or reject the noodle product in general (4).

### 3.4. Differences in food ingredients added to noodle products

Based on the results above, noodles with low organoleptic value and chemical and physical properties were obtained. Therefore, various types of natural food ingredients are needed to improve the organoleptic value and low chemical and physical properties as follows.

Table 1. Effects of various flour substitutions on the quality characteristics of noodles.

Substitute Materials	Best treatment	Chemical properties	Organoleptic results	Physical properties	Ref.
Tuna fish flour and porang flour	P2: 120gr: 100gr: 30gr (wheat flour: porang flour: tuna fish).	Water content 42.94%, carbohydrate 40.21%, ash content 8.32%, crude protein 7.46%, and crude fat 1.29%.	Yellowish white color, noodle aroma, distinctive noodle taste, chewy texture and easy to crumble	Cooking time will be faster if you add a lot of water, the water absorption capacity will increase.	(11)
Moringa leaf flour	P1: 95% wheat flour: 5% moringa leaf flour	Protein and calcium content increased by 3.723 g and 32.755 mg in 100 g	-	The breaking power of noodles increases	(8)
Taro flour	P2: 80% taro flour + 20% wheat flour P1: 100% wheat flour	Antioxidant activity decreased to an IC50 value of 225.82µg/ml, water content below 35%, protein content (5.02%) and ash content below 3%, namely (1.85%).	-	P2: water absorption and cooking loss. For P1: elasticity and cooking time, the higher the taro flour content, the lower the consumer acceptance of taro flour noodles.	(12)

Carrots and mocaflour	P4: 30g carrots and 10g mocaflour	Kadar air 9.34475%, $\beta$ -carotene 5951.323925 $\mu$ g per 100g.	The organoleptic value of color is 5.5, texture is 5.2, and taste is 6.4.	Breaking strength value 0.17050 Mpa, rehydration strength 1.120575	(13)
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#### 4. Conclusions

The conclusion that can be obtained from various articles related to the application of various natural food ingredients in noodle products to support organoleptic value, physical and chemical properties, namely the use of natural food ingredients added to noodle products should not exceed the specified limit. If the addition of natural food ingredients is excessive, it will affect the quality of noodle products, so further research is needed in achieving noodle product formulations that consumers like. The suggestion in this review article is the need to use food ingredients that are by-products so that they can reduce food product waste, for example jackfruit seeds.

#### Acknowledgements

Not Applicable.

#### Author Contributions

A.H.A.A conceived and designed the experiments; performed the experiments; analyzed the data; contributed reagents/materials/analysis tools; and wrote the paper.

#### Funding

This research received no external funding.

#### Institutional Review Board Statement

Not applicable.

#### Data Availability Statement

Available data are presented in the manuscript.

#### Conflicts of Interest

The author declares no conflict of interest.

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