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The Effect Of Cowbean Flour Substitution (*Unguiculata Vine*) On The Physical Quality And Sensory Quality Of Hidden Peanuts

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Abstract
This study aims to analyze the effect of cowpea flour substitution on the physical quality and sensory attributes of kacang sembunyi (hidden peanuts). The research was conducted at the Pastry and Bakery Laboratory of the Culinary Arts Education Study Program, Universitas Negeri Jakarta, from May 2024 to August 2025. An experimental method was used in this study. The samples were kacang sembunyi with cowpea flour substitution at concentrations of 10%, 20%, and 30%. These samples were then tested on 45 semi-trained panelists who evaluated all aspects of sensory quality. The results showed that cowpea flour substitution had a significant effect on physical quality tests. The Duncan test results indicated a significant difference in the aspects of cooking loss and oil absorption capacity. The highest mean value for Cooking Loss was found in the 30% treatment 15.50, while the highest mean for oil absorption capacity was found in the 10% treatment 12.43. The Kruskal-Wallis test indicated that the substitution of cowpea flour did not affect the sensory attributes of color, aroma, taste, and texture. This study recommends the 30\% cowpea flour substitution for further development as an effort to optimize the utilization of cowpea as a local food ingredient.

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1. INTRODUCTION

Hidden peanuts are a snack made from peanuts coated in a wheat flour batter, giving them a crunchy, savory, and sweet texture. As the name suggests, the peanuts are hidden inside a wonton skin, which is then fried using a special technique to caramelize the outer layer. This process not only adds sweetness but also provides an extra crunch. (Ruslan et al., 2023). According to Sumiata (2020), Hidden peanuts have promising business prospects. This is due to high market demand, a simple production process, and affordable capital requirements. Hidden peanuts are highly popular among the public, both as a daily snack and as a holiday treat. This is demonstrated by a study of local industrial production in Pasangkayu Regency by Ruslan et al. (2023). In their research, each business owner in Pasangkayu is able to produce 11 million kg of hidden peanuts per year. Wonton skins are a popular and readily available dish in Indonesia. They are served in several ways in Indonesia, including boiled and fried. Wonton skins are served with a mixture of chicken, shrimp, and spices. Wonton skins have been processed into various Indonesian dishes, such as siomay, meatball accompaniments, chicken noodles, and even cuanki. Wonton skins are also used as accompaniments, crackers, and cake ingredients. (Trisnawati et al., 2023).

Indonesia's significant import dependence on the primary raw material for peanuts, wheat flour is supported by wheat import data cited in the Indonesian Ministry of Agriculture. Central Statistics Agency (2024), which shows that Indonesia's wheat and meslin imports fluctuated during the 2017-2023 period, but remained generally high, with volumes ranging from 9 to 11 million tons per year. Given the high volume of wheat imports, efforts are needed to substitute local raw materials. In line

with the government's national program to reduce dependence on wheat and increase local food consumption, food diversification efforts through local raw material substitution are needed. This is in line with the government's national program to reduce dependence on wheat and increase local food consumption. (Sabarella et al., 2024).

One local food ingredient that has great potential to replace wheat flour is cowpea flour. According to Nani & Marsono (2013), the starch content in cowpeas is 50.5-67%, consisting of 38.2% amylose and 61.8% amylopectin. Meanwhile, the starch content in wheat flour is 65%-70%, consisting of 28% amylose and 72% amylopectin. The nutritional content of cowpea flour includes 56.6 g of carbohydrates, 1.9 g of fat, and 24.4 g of protein per 100 grams, while wheat flour contains 77.2 g of carbohydrates, 1 g of fat, and 9 g of protein per 100 grams. (Ministry of Health of the Republic of Indonesia, 2017). Previous research that only focused on the formulation of savory-tasting dumpling skins, such as research conducted by Adnyana & Jayendra (2024), about fried dumpling skins substituted for taro flour. Research in April (2023), about boiled dumpling skins with oyster mushroom substitution, about fried dumpling skins with carrot puree added by Prianggorowati et al. (2015), and research by Vieri (2021), about fried wonton skins as a substitute for mocaf flour. Previous research was limited to wonton skin formulas and savory flavors, along with the high interest of Indonesians in wonton skins, which prompted the author to investigate the application of wonton skins to sweet snacks, namely, hidden nuts. One local food ingredient that has the potential to replace wheat is cowpea flour.

Based on this background, researchers are interested in conducting further research on the use of cowpea flour as a substitute for wheat flour in making peanuts. Analysis will focus on the product's physical and sensory qualities, with the hope of partially or completely replacing wheat flour.

2. METHOD

The research method used was an experiment to assess the effect of cowpea flour substitution on physical quality (cooking loss and oil absorption capacity) and sensory quality (color, aroma, taste, and texture). The sampling technique in this study used a random method (simple random sampling), which was tested on 45 panelists. The population in this study was hidden beans substituted for cowpea flour, with samples of hidden beans with percentages of 10%, 20%, and 30%.

Samples were tested on 45 semi-trained panelists, namely students of the Culinary Arts Education Study Program, Jakarta State University, to assess the sensory quality of hidden beans including color, aroma of hidden beans, taste of hidden beans, sweetness, and crispness of hidden beans, taste of hidden beans, aroma of hidden beans, and color of dumpling skin. Samples were also tested for physical quality content, including cooking loss and oil absorption capacity.

The manufacture of cowpea flour refers to research (Oktavia et al., 2022), the tools and materials used include: bowl, strainer, scale, grinder, spatula, sieve 200mesh, peanuts, water. Stages of manufacture consist of soaking, peeling skin, drying, grinding, and sieving. The process of soaking cowpeas uses raw water with a ratio of 1:3 between cowpeas and water. In the drying process, there is a modification of 4 hours at a temperature of 80 °C using an electric oven, and the cowpeas are turned every hour to prevent them from burning. Then the cowpeas are sieved using a grinder and sieved using a 200 mesh sieve. The milling process is repeated three times, each lasting 4 minutes. The following is a flowchart for making cowpea flour:

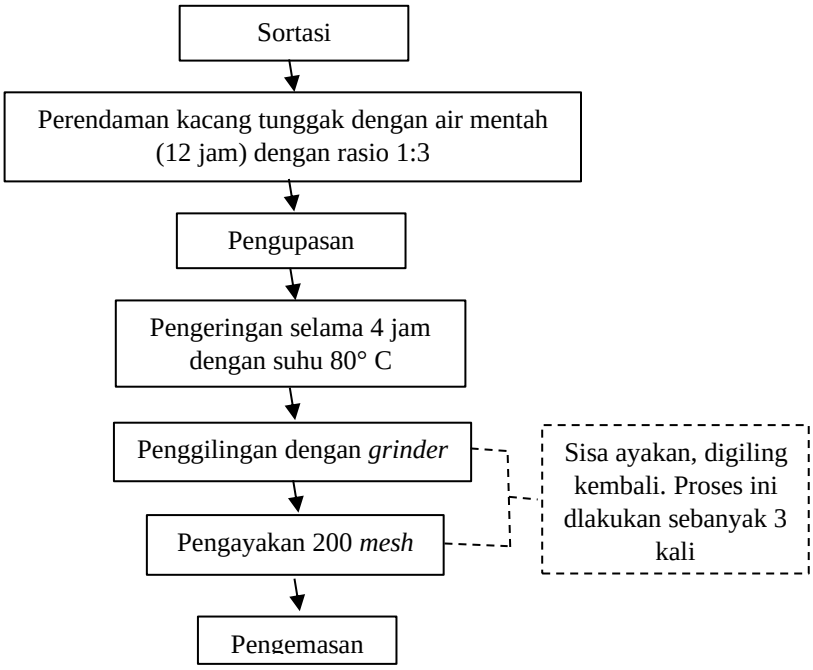

Figure 1: Flow Diagram for Making Peanut Flour

The hidden bean recipe in this study refers to (Dedik, 2020), and the dumpling skin refers to research (Apriliyanti, 2023). Making hidden bean begins with preparing the tools and ingredients, including wheat flour, cowpea flour, salt, water, roasted, peeled peanuts, and sugar. The ingredients are then prepared by mixing the wheat flour, cowpea flour, water, and salt until homogeneous and resting *the* dough for 1 hour. Then, the dough is flattened to a thickness of 0.55 mm using a pasta *maker* and formed into 5x5 cm squares. Then, each dumpling skin is stretched diagonally, filled with one peanut, and rolled. The raw peanuts are then fried in cooking oil and granulated sugar, which has caramelized during the heating process using the technique of deep *frying* for 4 minutes. Finally, drain the peanuts and pack them into a container.

Table 1 Standard Formulation of Dumpling Skin

Material	**Amount**	
	Gram	**%**
Dumpling Skin		
Flour	50	100 %
Air	25	50 %
Salt	3	6 %
Number of Dumpling Skins		23 pcs
Weight per dumpling skin		3 - 4 gram
Thickness		0.55 mm
Thickness*pasta maker*		1
Cooking oil		300 ml
Time		55 seconds
Big fire		Currently

Table 2 Standard Formulation of Hidden Beans

Material	**Amount**	
	Gram	**%**
Hide Beans		
Dumpling Skin	78	100 %
Roasted peanuts	8	10,26 %
Sugar	8	10,26 %
Number of Dumpling Skins		23 pcs
Weight per dumpling skin		3 - 4 gram
Thickness		0.55 mm
Thickness*pasta maker*		1
Cooking oil		300 ml
Time		4 minutes
Big fire		Currently

Table 3: Hidden Bean Substitution Formula

Material	Unit					
	Gram	10%	Gram	20%	Gram	30%
Flour	45	90	40	80	35	70
Peanut Flour	5	10	10	20	15	30
Air	25	50	25	50	25	50
Salt	3	6	3	6	3	6
Peanuts	8	8	8	8	8	8
Sugar	8	8	8	8	8	8

The following is a flow diagram for making dumpling skins and hidden nuts:

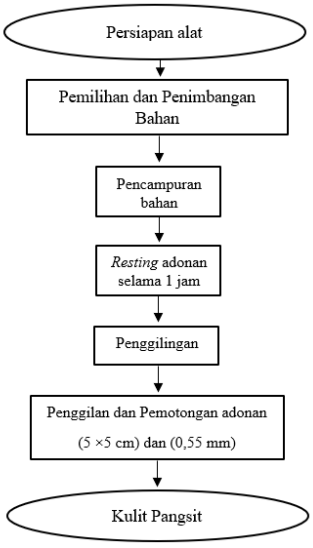

Figure 2: Flowchart of Dumpling Skin Making

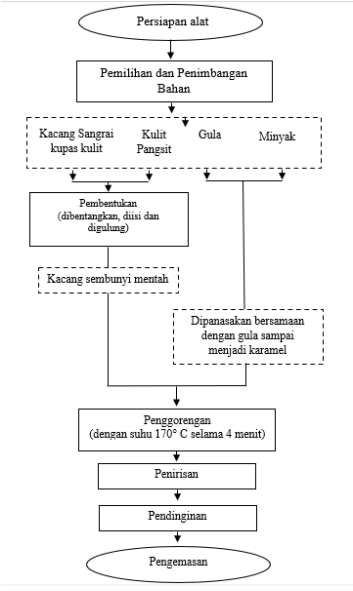

Figure 3: Flowchart of Hidden Peanut Production

3. RESULTS

Physical Quality

1. Oil Absorption Capacity

The following table shows the results of further calculations using the test. *Duncan*:

Treatment	Rate-rate	Average + DMRT	Notation
X3	3,73	7,399	a
X2	5,93	9,733	a
X1	12,43		b

Information :

X1 : Wonton skin substituted with 10% cowpea flour

X2 : Wonton skin substituted with 20% cowpea flour

X3 : Wonton skin substituted with 30% cowpea flour

Based on the table data above it shows that the three samples have a significantly different effect on oil absorption. The higher the substitution, the lower the oil absorption. The 30% treatment, with an average of 3.73, has the notation a, the 20% treatment, with an average of 5.93, has the notation a, the 10% treatment, with an average of 12.43, has the notation b. Thus, the 10% treatment shows a significant difference in the substitution of cowpea flour on the physical quality of 20% and 30% dumpling skins in the aspect of oil absorption. The dumpling skin with 10% cowpea flour substitution produces the lowest oil absorption compared to the 20% and 30% substitution treatments.

2. *Cooking Loss*

The following table shows the results of further calculations using the test of *Duncan*:

Treatment	Rate-rate	Average + DMRT	Notation
X1	11,05	14,052	a
X2	12,07	15,181	a
X3	15,5		b

Information :

X1 : Wonton skin substituted with 10% cowpea flour

X2 : Wonton skin substituted with 20% cowpea flour

X3 : Wonton skin substituted with 30% cowpea flour

Based on the table data above, the 10% treatment with an average of 11.05 has the notation a, the 20% treatment with an average of 12.07 has the notation a, and the 30% treatment with an average of 15.5 has the notation b. Thus, the 30% treatment shows a real difference in the substitution of cowpea flour on the physical quality of 10% and 20% dumpling skins in the aspects of Cooking *Loss*. Wonton skin substituted with 30% cowpea flour produces*Cooking Loss*highest compared to the 10% and 20% substitution treatments.

Sensory Quality

1. Hide Bean Color

The average value shows that the substitution of 10% of hidden beans for cowpea flour is A score of 3.5 is included in the chocolate category. Hidden beans substituted with 20% cowpea flour have a score of 3.6, which is included in the chocolate category. Hidden beans substituted with 30% cowpea flour show a score of 3.8, which is included in the chocolate category.

Based on the results of the Kruskal-Wallis test, it was shown that the substitution of cowpea flour did not affect the color aspect of the cowpea. This is shown in the valuex^2count is 0.606 <x^2table is 5.99.

Testing Criteria	x^2 count	x^2table
Hide bean color	0,606	5,991

2. Dumpling Skin Color

The average value shows that the hidden beans substituted with 10% cowpea flour have a score of 4.27, which is included in the golden brown category. The hidden beans substituted with 20% cowpea flour have a score of 4.67, which is included in the golden brown category. The hidden beans substituted with 30% cowpea flour show a score of 4.73, which is included in the golden brown category.

Based on the results of the Kruskal-Wallis test, it was shown that the substitution of cowpea flour did not affect the color of the dumpling skin. This is shown in the valuex^2count is 3,098 <x^2table is 5.99.

Testing Criteria	x^2 count	x^2table
Dumpling Skin Color	3,098	5,991

3. The aroma of cowpeas in hidden beans

The average value shows that the hidden beans substituted with 10% cowpea flour have a score of 3.67, which is included in the category of no cowpea flavor. The hidden beans substituted with 20% cowpea flour have a score of 4.13, which is included in the category of no cowpea flavor. The hidden beans substituted with 30% cowpea flour have a score of 3.9, which is included in the category of no cowpea flavor.

Based on the results of the Kruskal-Wallis test, it was shown that the substitution of cowpea flour did not affect the aroma aspect of cowpea in hidden beans. This is shown in the valuex^2count is 1.161 <x^2table is 5.99.

Testing Criteria	x^2 count	x^2table
Hidden peanut aroma	1,161	5,991

4. The Aroma of Cowpeas in Dumpling Skin

The average value shows that the hidden beans substituted with 10% cowpea flour have a score of 3.47, which is included in the category of no cowpea flavor. The hidden beans substituted with 20% cowpea flour have a score of 3.8, which is included in the category of no cowpea flavor. The hidden beans substituted with 30% cowpea flour show a score of 3.9, which is included in the category of no cowpea flavor.

Based on the results of the Kruskal-Wallis test, it was shown that the substitution of cowpea flour did not affect the aroma aspect of cowpea in dumpling skin. This is shown in the valuex^2count is 3,950 <x^2table is 5.99.

Testing Criteria	x^2 count	x^2table
Wonton Skin Aroma	3,950	5,991

5. The Taste of Peanuts on Hidden Peanuts

The average value shows that the hidden beans substituted with 10% cowpea flour have a score of 2.87, which is included in the category of slightly cowpea flavor. The hidden beans substituted with 20% cowpea flour have a score of 3.33, which is included in the category of slightly cowpea flavor. The hidden beans substituted with 30% cowpea flour show a score of 3.53, which is included in the category of slightly cowpea flavor.

Based on the results of the Kruskal-Wallis test, it was shown that the substitution of cowpea flour did not affect the flavor aspect of cowpea in hidden beans. This was shown in the valuex^2count is 2.244<x^2table is 5.99.

Testing Criteria	x^2 **count**	x^2**table**
Hide Nut Flavor	2,244	5,991

6. The Flavor of Cowpeas in Dumpling Skin

The average value shows that the hidden beans substituted with 10% cowpea flour have a score of 3.07, which is included in the category of slightly cowpea flavor. The hidden beans substituted with 20% cowpea flour have a score of 3.4, which is included in the category of slightly cowpea flavor. The hidden beans substituted with 30% cowpea flour show a score of 3.2, which is included in the category of slightly cowpea flavor.

Based on the results of the Kruskal-Wallis test, it was shown that the substitution of cowpea flour did not affect the taste of cowpea in dumpling skins. This was shown in the valuex^2count is 0.626 <x^2table is 5.99.

Testing Criteria	x^2 **count**	x^2**table**
Dumpling Skin Flavor	0,624	5,991

7. Sweet Taste

The average value shows that the hidden beans substituted with 10% cowpea flour have a score of 4.13, which is included in the sweet taste category. The hidden beans substituted with 20% cowpea flour have a score of 3.73, which is included in the very sweet taste category. The hidden beans substituted with 30% cowpea flour show a score of 4, which is included in the sweet taste category.

Based on the results of the Kruskal-Wallis test, it was shown that the substitution of cowpea flour did not affect the sweetness aspect of cowpea. This is shown in the valuex^2count is 2.244<x^2table is 5.99.

Testing Criteria	x^2 **count**	x^2table
Sweet taste of hidden nuts	1,141	5,991

8. Crispness

The average value shows that the hidden beans substituted with 10% cowpea flour have a score of 4.8, which is included in the very crispy category. The hidden beans substituted with 20% cowpea flour have a score of 4.6,7 which is included in the very crispy category. The hidden beans substituted with 30% cowpea flour show a score of 4.53, which is included in the very crispy category.

Based on the results of the Kruskal-Wallis test, it was shown thatthe substitution of cowpea flour did not affect the crispiness of the hidden beans. This was shown in the valuex^2count is 0.988 <x^2table is 5.99.

Testing Criteria	x^2 count	x^2table
Hidden Nut Crunch	0,988	5,991

4. DISCUSSION

Physical Quality

In terms of oil absorption capacity, this shows that the higher the amount of cowpea flour substitution, the higher the amount of cooking *loss* increases. This occurs because the amylose content contained in cowpea flour, according to Sumariyanti, amylose and amylopectin play an important role in reducing water content. Amylose content tends not to bind water well, so that, in line with research (Suryani et al., 2013), where the higher the addition of cowpea starch in making vermicelli, the higher the cooking loss rate, this occurs because the high amylose content in cowpea causes the vermicelli molecules to compact, and the absorption of water into the vermicelli is lower.

On the aspect of Cooking *Loss,* Fried products made from plant-based foods and containing starch will absorb more oil than other foods (Zahra et al., 2013). In addition, the low amylopectin content causes the flour to not bind water, so that pores do not form during the cooking process, resulting in low oil transfer in the pores of the dumpling skin. (Sumariyanti et al., 2020).

Sensory Quality

Regarding the color of the hidden beans, organoleptic test results showed that the three hidden bean treatments with cowpea flour substitution had a nearly uniform color, namely brown, and showed no significant differences. This is due to the product color being dominated by a caramel layer that covers the entire surface. This brown color comes from a non-enzymatic browning process called caramelization, which occurs when sugar is heated at high temperatures above 160°C (Laga et al., 2019). This heating causes the sugar to melt and form a brown polymer that coats the product (Apriyanto & Rujiah, 2017). This color uniformity is reinforced because all samples tested used the same amount of sugar, cooking time, and frying temperature. This finding is supported by research (Laga et al., 2019), which shows that the sugar caramelization process during cooking causes the surface color of the product to change to brown.

In terms of dumpling skin color, there was no significant change; this was due to two factors. According to Laurena et al. (1984 in Prihapsari & Setyaningsih, 2021), cowpeas contain polyphenol compounds or tannins, which are mainly found in the seed coat and are responsible for the color pigment. The darker the seed coat, the higher the tannin content generally. The process of making cowpea flour in this study involved soaking and peeling the skin, resulting in a brighter end result. This is supported by research by Naisali (2020), which showed a decrease in tannin levels in peeled cowpea tempeh. Although tannins have been reduced, the color of the flour can also be influenced by other factors, such as the Maillard reaction, which is a reaction between the amino groups of proteins, especially lysine, and the carbonyl groups of sugars that are triggered during the heating or roasting process of flour. The Maillard reaction can provide an additional browning effect on cowpea flour (Tunjungsari & Fathonah, 2019).

In terms of the aroma of cowpeas in hidden beans, according to Chetschik et al. (2010), there are volatile compounds in roasted peanuts that play a role in producing the typical roasted aroma of peanuts, including 2-acetyl-1-pyrroline, 2-acetylpyrazine, 2-propionyl-1-pyrroline, and 2-acetyl-2-

thiazoline. In addition, the aroma of cowpea flour is also covered due to the presence of caramel on the outer layer of the hidden beans. This is supported by research by Laga et al. (2019), where the aroma of candied tomato dates is not very clear and is replaced by the aroma of caramel originating from granulated sugar due to the caramelization process.

In terms of aroma and flavor, the cowpea dumpling skin showed an improvement, but not a significant one, due to the heat in the flour and the low substitution percentage. The unpleasant aroma and flavor of the cowpea dumpling skin are caused by enzyme activity. *This* enzyme catalyzes the formation of volatile compounds that contribute to the distinctive flavor and aroma of nuts. The activity of this enzyme and the resulting volatile compounds can be minimized through high-temperature treatment (Kanetro, 2017). Furthermore, a low substitution percentage of 10%–30% reduces the dominant flavor and aroma of cowpeas. This finding aligns with research (Sumariyanti et al., 2020).

In terms of the taste of the peanuts, according to Choong et al. (2016 in Triachdiani & Murtini, 2021The compound 5-hydroxymethylfurfural plays a role in forming flavors such as caramel and burnt sugar.*(burnt)*in sugar. Meanwhile, 2, 3-dihydro-3, 5-dihydroxy-6-methyl-4H-pyrane-4-one plays a role in imparting an astringent taste to sugar. Pyrazine compounds in roasted peanuts also produce a distinctive roasted flavor. *(roasted peanutty flavor)* (Chetschik et al., 2010).

In terms of sweetness, based on research(Iswahyudi et al., 2022), the less cowpea flour used and the more sago flour used, the less sweetness. However, the results of the hypothesis test showed that all three treatments were in the same range, namely "tasting sweet," and the results were not significant. This occurs because granulated sugar is used as the main sweetener in the same amount in each recipe. The high carbohydrate content and the intensity of the sweetness of granulated sugar create a dominant effect that masks any differences in sweetness that may arise from the flour variations.

In terms of crispiness, according to Fauzi et al. 2019 Iswhahyudi et al. (2022), the crispiness of the product is influenced by the protein content, where high protein can harden the texture, and is influenced by starch, where the higher the amylopectin, the crispier the resulting product. Cowpea flour contains 50.5-67% starch, composed of 38.2% amylose and 61.8% amylopectin. Meanwhile, wheat flour contains 65%-70% starch, with 28% amylose and 72% amylopectin (Sumariyanti et al., 2020). Amylopectin has a better water-binding capacity, triggering higher water evaporation during cooking, and producing more pores, which contribute to a crispy texture. This difference in ratio explains the observed downward trend, where the lower the cowpea substitution, the higher the crispiness level (Sumariyanti et al., 2020). Furthermore, the constant sucrose content of the sugar used also helps produce a firm and crispy product, making the difference in crispiness due to flour substitution insignificant overall (Triachdiani & Murtini, 2021).

5. CONCLUSION

In the sensory quality test, it was found that there was no significant effect of cowpea flour substitution on all aspects tested, namely the color of the hidden beans, the color of the dumpling skin, the aroma of the hidden beans, the aroma of the dumpling skin, the taste of the hidden beans, the taste of the dumpling skin, the sweetness and crunchiness.

Based on the results of the ANOVA test of physical quality ofCooking Loss Oil Absorption Capacity showed a significant effect. The results showed that 30% substitution of cowpea flour for hidden beans was the best formulation.

6. LITERATURE

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