

# The Characteristics of “Keropok Pilus” Which the Tapioca Flour was Substituted by Purple Sweet Potato (*Ipomoea batatas* L.) Flour

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**Abstract:** “Keropok pilus” is a traditional snack food in Indonesia, it’s made from tapioca flour and the main characteristic is crispiness. Purple sweet potato flour has potency as starch and anthocyanin source, the anthocyanin can be used as natural antioxidant in food. The objective of this research was to know how much whole or peeled purple sweet potato flour ratio can be used to substitute tapioca flour in “keropok pilus” being acceptable by panelist and to know the effects of substitution to the physical characteristic and the anthocyanin content of “keropok pilus”. The research was started from making of purple sweet potato flour (whole and peeled tuber). The chemical characteristics (moisture content, starch content, amylose content, total sugar content and anthocyanin content) and physical characteristic (Water Holding Capacity = WHC) of the purple sweet potato flour were observed. The next step was preparing the “keropok pilus” formula. The substitution ratios of tapioca flour with purple sweet potato flour were 100:0; 75:25; 50:50; 25:75 and 0:100. The organoleptic test of “keropok pilus” was done by Hedonic test. The physical characteristics and the anthocyanins content of preferable “keropok pilus” then were analysed. The result shows that maximum substitution of purple sweet potato flour (whole and peeled) to produce preferable “keropok pilus” was 50%. The characteristics of accepted “keropok pilus” were brown colour, good taste, sweet, crispy and specific flavor of sweet potato. Anthocyanins content of “keropok pilus” with 50% purple whole and peeled sweet potato flour substitution were 32.36 mg/100 g dry weight and 31.06 mg/100 g dry weight, respectively.

**Key words:** Tapioca flour, purple sweet potato, anthocyanins, “keropok pilus”.

## 1. Introduction

“Keropok pilus” is a traditional snack food in Indonesia, which was using tapioca flour as raw material. The main characteristic of “keropok pilus” is its crispiness [1]. “Keropok pilus”-making process includes the stages of dough-making, shaping and frying. “Keropok pilus” great demand because it can be enjoyed at any time and the price is cheap. Tapioca flour has 12 percent amylose content and 82 percent amylopectin content [2], while purple sweet potato starch has 20 percent amylose content and 80 percent

amylopectin content [3], so it can be used to substitute of tapioca flour in “keropok pilus” making. The study of Ref. [1] shows that purple sweet potato was containing of anthocyanin (110.51 mg/100 g dry matter). Anthocyanin is one of the polyphenol compounds which have antioxidant activity, so it plays a role in preventing aging, cancer and degenerative diseases such as arteriosclerosis [4]. So, if tapioca flour was substituted by purple sweet potato flour in the “keropok pilus” making, the “keropok pilus” can be used as functional food. The aims of this research were to determine the level of substitution tapioca flour with whole and peeled purple sweet potato flour, that can produce “keropok pilus” which

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preferred by panelists as they know the effect of substitution on physical characteristic and the anthocyanin content of “keropok pilus”.

## 2. Materials and Methods

### 2.1 Materials

Materials used in this research is “Mount Kawi” purple sweet potato, oval shaped and has a purple color on the skin and flesh, tapioca and other additional ingredients (chicken eggs, margarine, Na-bicarbonate, cooking oil and spices).

### 2.2 Purple Sweet Potato Flour Making

The process of purple sweet potato flour making is done by modifying the method of Yudawati [5]. Flour-making process includes washing, peeling or without peeling, slicing, drying, seiving and milling. Flow sheet of purple sweet potato flour making presented as Fig. 1.

### 2.3 Formula of “Keropok Pilus” Making

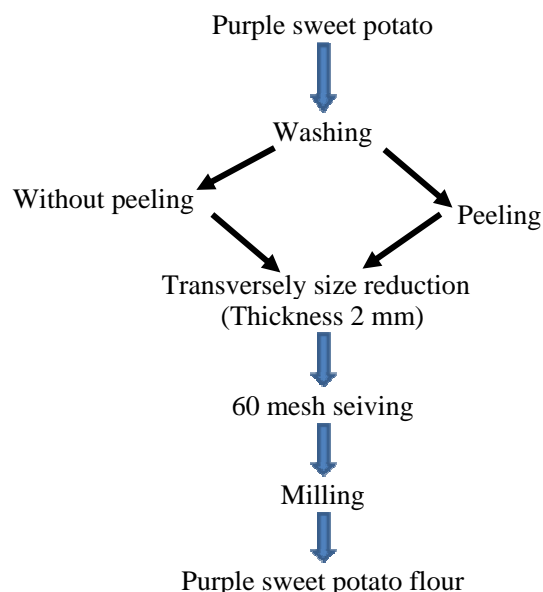
“Keropok pilus” is made using a modified formula from Suprapti [6]. Base and modified formula can be seen in Table 1.

## 3. Results and Discussion

### 3.1 The Chemical Composition and Water Holding Capacity of Tapioca and Purple Sweet Potatoes Flour

Results of chemical and Water Holding Capacity analysis of tapioca, whole and peeled purple sweet potato flour can be seen in Table 2 and Table 3, respectively.

Starch and its amylose content of tapioca, whole and peeled purple sweet potato flour is an important component in the manufacture of its “keropok pilus” because it can affect the texture of the product. It can be seen from Table 2 that the whole purple sweet potato flour has starch content greater than the peeled purple sweet potato flour. This shows that the polysaccharide contained in the skin is quite high. Other components that affect the characteristics of the



**Fig. 1** Simplified flow sheet of making purple sweet potato flour.

“keropok pilus” are the total sugar and anthocyanin. Total sugar content and anthocyanin content of whole purple sweet potato flour greater than the peeled purple sweet potato flour. Totals sugar content of flour will affect the color of “keropok pilus” by high temperature heating due to the non-enzymatic browning reaction. In Table 2, the total sugar content of purple sweet potato flour is greater than the total sugar tapioca.

Water Holding Capacity (WHC) is one parameter for testing the quality of flour which states its ability to bind water, measured unity flour [7]. In Table 3, it indicates that the whole and peeled purple sweet potato flour has a greater WHC than tapioca. This happens because the biggest component of tapioca flour is starch, whereas the purple sweet potato flour, there are still other components beside starch which is a protein, fiber and simple sugars [8]. WHC whole purple sweet potato flour is greater than the peeled purple sweet potato flour, because it has group liking water more than the peeled purple sweet potato flour.

### 3.2 Organoleptic Properties of “Keropok Pilus”

The data of test results favorite panelist of the color, flavor, aroma, texture and overall preference on “keropok pilus” produced can be seen in Table 4.

**The Characteristics of “Keropok Pilus” Which the Tapioca Flour was Substituted by Purple Sweet Potato (*Ipomoea batatas* L.) Flour**

**Table 1 Basic and modified recipes of “keropok pilus” making.**

Basic recipe		Modified recipe	
Material	Component	Material	Component
Tapioca	100 g	Substituted flour	100 g
Milk	100 mL	Water	Adjusted
Margarine	30 g	Margarine	30 g
Eggs	20 g	Eggs	20 g
Baking soda	0.25 g	Baking soda	0.25 g
Pecan	5 g	Pecan	5 g
Salt	2.5 g	Salt	2.5 g
Powder sugar	1.75 g	Garlic	8 g
		Cooking oil	3 × dough weight

The amount of water was used in modified recipe depending on the Water Holding Capacity of the whole or peeled purple sweet potato flour. The substituted flour will be done by using the ratio tapioca with whole purple sweet potato flour or peeled purple sweet potato flour, were 100:0; 75:25; 50:50; 75:25 and 0:100, respectively.

**Table 2 Chemical composition of tapioca and purple sweet potato flour.**

Materials	Water content (%) wb)	Starch content (%) db)	Amylose content (% db)	Total sugar content (% db)	Anthocyanin content (mg/100 g)
Tapioca	11.90 <sup>b</sup>	-	-	1.33 <sup>c</sup>	-
Purple sweet potato flour					
Whole	7.11 <sup>a</sup>	64.08 <sup>a</sup>	24.78 <sup>a</sup>	11.97 <sup>a</sup>	877.31 <sup>a</sup>
Peeled	7.18 <sup>a</sup>	61.63 <sup>b</sup>	24.01 <sup>a</sup>	10.02 <sup>b</sup>	709.70 <sup>a</sup>

Means without the same letters are significantly different at  $P < 0.05$  as the same as below tables.

**Table 3 Results analysis of water holding capacity (WHC) of tapioca and purple sweet potato flour.**

Sample	WHC (%)
Tapioca	86.66 <sup>a</sup>
Purple sweet potato flour	
Whole	200.84 <sup>c</sup>
Peeled	173.17 <sup>b</sup>

**Table 4 The color, taste, flavor, texture and overall preference of “keropok pilus”.**

Treatment	Ratio tapioca: sweet potato flour	purple	Color	Taste	Flavor	Texture	Overall
Tapioca	100:0		6.40 e	5.85 d	5.45 d	5.60 f	5.75 e
Whole	75:25		5.05 cd	5.10 c	5.10 cd	5.15 def	4.95 cd
	50:50		4.75 cd	5.05 c	5.00 cd	4.55 bcde	5.00 cd
	25:75		4.35 bc	4.05 b	4.10 ab	3.90 ab	3.95 ab
	0:100		3.40 a	2.75 a	3.85 a	3.40 a	3.45 a
Peeled	75:25		5.25 d	5.30 cd	5.00 bc	5.35 ef	5.15 de
	50:50		5.10 c	4.60 cd	4.85 cd	4.95 cdef	4.85 cd
	25:75		4.25 bc	4.25 b	4.20 ab	4.35 bcd	4.40 bc
	0:100		3.55 ab	4.10 b	4.05 ab	4.25 bc	3.95 ab

### 3.2.1 Color Preference

Color of “keropok pilus” which is made from tapioca flour substituted with purple sweet potato flour, has a value significantly different from the tapioca “keropok pilus”. The higher use of purplesweet potato flour in the manufacture of “keropok pilus” the decrease in panelist's favorite color, because color is more brown than tapioca “keropok pilus”. “Keropok

pilus” which is made from 100% whole purple sweet potato flour, is least preferred because of the intensity of brown color is highest. The high intensity of this brown color is attributed to the high content of anthocyanin and also caused by the total sugar and protein content of sweet potato flour. Total sugar content in purple sweet potato flour is greater than the tapioca so that caramelization reactions that occurred

greater. Protein in flour contributes to the Maillard browning reaction “keropok pilus” through. Purple sweet potato flour substitution (whole or peeled) of 25%-50% produced “keropok pilus” brown color still accepted by panelists.

### 3.2.2 Taste Preference

In Table 4, shows that the addition of purple sweet potato flour until the concentration of 50%, still generates a distinctive purple sweet potato that panelists preferred. However, the addition of a higher level, panelists commented that the taste of sweet potato was too strong so that it becomes the “keropok pilus” bitter. According to the panelists, “keropok pilus” with the substitution of whole purple sweet potato flour is more bitter than sweet potato flour peel, this shows that the bitter taste of sweet potato purple contained in the skin.

### 3.2.3 Flavour Preference

Substitution tapioca flour with sweet potato purple flour at a concentration of 25%-50% showed typical aroma of purple sweet potato that is still preferred. Panelists could not distinguish the smell of ‘keropok pilus’ of tapioca flour substituted with whole purple sweet potato flour and peeled purple sweet potatoes flour.

### 3.2.4 Texture Preference

In the “keropok pilus”, texture parameter is its crispiness. The crispiness is one of the texture properties that are important in the determining consumer acceptance of “keropok pilus” that are fried or processed foods which have low water levels. The crispness related to the level of expansion, reflects the level of product expansion. Purple sweet potato flour, the main component is a carbohydrate, which easily bind water, so water is bound in the process of mixing with hot water and trapping more of the other components in the matrix that cause the texture to be more robust than the main component, tapioca starch, which is expanding when heated. Favorite panelist of “keropok pilus” made from tapioca flour substituted with purple sweet potatoes peeled up to 100% and

whole purple sweet potato flour up to 50% did not differ significantly and have a crispy texture.

### 3.2.5 Overall Preference

Results of analysis show that the overall favorite “keropok pilus”, preferred by panelists is the substitution of whole or peeled purple sweet potato flour by 25%-50%. Panelists like the “keropok pilus” tapioca because the color yellow, savory taste and crispy texture. Favorite panelist of pilus with 25%-50% substitution of whole purple sweet potato flour is not significantly different with peeled purple sweet potato flour at the same concentration.

## 3.3 Crispiness of “Keropok Pilus”

Testing of crispiness of “keropok pilus” selected can be seen in Table 5, it shows that unlike crispiness tapioca “keropok pilus”, however crispiness “keropok pilus” that substituted with peeled purple sweet potato flour by as much as 50% did not differ significantly with crackers “keropok pilus” substituted with whole purple sweet potato flour as much as 50%. This can occur because the ratio of amylose: amylopectin in the both flour did not differ (Table 2). Besides influenced by the ratio of amylose: amylopectin, crispiness of “keropok pilus” may also be influenced by the interaction of other substances in purple sweet potato flour that contribute to the solidity dough pilus structure.

## 3.4 Content of Anthocyanins “Keropok Pilus”

Results of analysis anthocyanins “keropok pilus” can be seen in Table 6, the anthocyanin content of whole purple sweet potato flour pilus are relatively larger than the peeled purple sweet potato flour. The higher the substitution tapioca with purple sweet potato flour, anthocyanin content in the dough increased. The content of anthocyanin in the “keropok pilus” with the rate of substitution whole purple sweet potato flour by 25% is not significantly different with “keropok pilus” purple sweet potato peel 50%. This occurs because the content of anthocyanin whole

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**Table 5** Crispiness of “keropok pilus”.

Treatment	Ratio of tapioca:purple sweet potato flour	Crispiness (N)
Tapioca	100:0	39.33 a
Purple sweet potato flour		
Whole	75:25	79.11 c
	50:50	100.32 d
Peeled	75:25	62.28 b
	50:50	89.73 cd

**Table 6** Content of anthocyanins ‘keropok pilus’.

Treatment	Ratio of tapioca:purple sweet potato flour	Anthocyanin contents (mg/100 g dry mater)
Purple sweet potato flour		
Whole	75:25	28.60 b
	50:50	32.36 c
Peeled	75:25	25.52 a
	50:50	31.06 b

purple sweet potato flour is relatively larger than the peeled purple sweet potato flour (Table 2).

#### 4. Conclusion

“Keropok pilus” which was the tapioca substituted by whole or peeled purple sweet potato flour up to 50%, are still preferred by panelist with anthocyanin content of 32.36 mg/100 g dry matter and 31.06 mg/100 g dry matter, respectively. The “Keropok pilus” had color brown, savory, sweet flavor, and the texture was crispiness.

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