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## Gluten-Free Cake Formulation Using Mocaf and Several Types of Flour from Local Food Ingredients

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# Gluten-Free Cake Formulation Using Mocaf and Several Types of Flour from Local Food Ingredients

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**Abstract.** Modified Cassava Flour (Mocaf) was expected to replace that of wheat, until presently, its (Mocaf) application to cake products is still very limited. Local foodstuffs such as arrowroot, breadfruit, and pumpkin are being used as substitutes for Mocaf-based products, to increase nutritional value, functional properties, and improve sensory characteristics. The aim of this study was to make the right formulation of sponge cake products with Mocaf and other substitutes, such as arrowroot, breadfruit, and pumpkin flour. Also, the research design used was a complete factorial randomized type with two factors, namely the ratio of Mocaf to substitute flour (60:40, 50:50, and 40:60), and the types of powdered alternative consisting of arrowroot, breadfruit, and pumpkin flour. Furthermore, the results showed that the most preferable sponge cake panelists were those with the use of 40% Mocaf and 60% arrowroot flour. The nutritional composition of the product was 22.48% water, 0.93% ash, 7.25% protein, 13.83% fat, and 55.51% carbohydrate contents by difference. Therefore, the product had the sensory properties of a pale-yellow color, little Mocaf taste, very soft and smooth texture, a small aftertaste, and off-flavor.

## 1. Introduction

The increasing wheat flour consumption is one of the phenomena bringing about the high dependence on imported wheats in Indonesia. Moreover, local food potentials are still having less concern and development. Part of the factors resulting in the wheat flour preference are few right formulas, which are identified to generate other products having quality and competitive price, as that of the powdered grains (wheat flour).

Due to its different characteristics from wheat flour, the application of Mocaf to processed products seems to be encountering challenges. Prayitno, Tjiptaningdyah, and Hartati [1], that used composite flours from wheat and Mocaf to make steamed brownies, observed that the application of modified cassava flour (Mocaf) affected softness and smoothness. Also, they discovered that according to the effectiveness test of steamed brownies, the ratio of Mocaf to wheat flour (40:60) was the most recommended. Furthermore, Napitupulu, Nurmalia, and Purba [2], applied composite flours from Mocaf, banana starch, and powdered wheat to other sponge cake products. In terms of taste, the products made from composite flours of Mocaf, banana starch, and powdered wheat were not significantly different from those made from 100% grain flour (wheat).

Also, the incorporation of Mocaf with other types of flour aims to rectify product characteristics, and elevate nutritional values. Alice et al. [3], further argued that the substitution level of breadfruit flour above 50%, applied to cake products, indicated a significant difference in the product sensory quality. However, breadfruit flours at an application of 60%, are used to produce brownies, with better sensory properties [4].

Pumpkins have for long been identified to possess good sensory properties, which are likely to be



processed into various products. Besides that, they also have pre-eminent nutritional values, especially  $\beta$ -carotene (provitamin A). As regards sweet bread, the application of composite flours from that of pumpkin and wheat at a ratio of 10:90, engenders the product, with the degree of dough development and overall acceptability score at 2.51% and 3.70 (preferable), respectively [5].

Furthermore, the arrowroot flour has been discovered to be used in bakery products, especially cookies. Arrowroot flour is equipped with sufficient nutritional value and processed into various types of food, i.e., wet and dry noodles, with cookies [9]. Also, the composition of nutrition in 100 grams of arrowroot flour consists of 355 kcal energy, 0.7 g protein, 0.2 g fats, 85.2 g carbohydrate, 8 mg calcium, 22 mg phosphorus, and 1.5 mg iron. Due to carbohydrate being the predominant component, arrowroot flour is therefore considered a good source of starch [10]. Some studies that applied arrowroot flour as the main ingredient or substitute, yielded products with higher fiber content [11]. Furthermore, arrowroot flour is sensorially acceptable in vermicelli products [12]. Arrowroot starch has a higher proportion of amylopectin than amylose, resulting in a crunchy texture in biscuit products.

Composite flours from Mocaf, pumpkin, breadfruit, and arrowroot powders are an advocated formulate, when applied to non-wheat-flour cake products. This further results in non-wheat flour cake products with good chemical, physical, and sensory characteristics. Therefore, this study is a preliminary research on Mocaf, which is expected to be developed into gluten-free premix flour, easily used by consumers.

## **2. Materials and Methods**

### *2.1. Research Design*

This research used a completely randomized factorial design comprising two factors, which were, Factor 1: the ratio of Mocaf to substitute flour (40:60, 50:50, and 60:40), Factor 2: the types of substitute flour (pumpkin, breadfruit, arrowroot).

### *2.2. Instruments*

The instruments used in this research were COSMOS Hand Mixer, GETRA Gas Oven, Stainless Cake Pan, Spatula, Cabinet Dryer, Sieve, SHIMADZU Moisture Analyzer, THERMCONCEPT Muffle Furnace, MEMMERT Oven, Weighing Bottle, Porcelain Cup, Burette, LABTRONICS Spectrophotometer, and Other Glass Instruments.

### *2.3. Materials*

The materials used in this research were Mocaf Solusindo, pumpkin (under the brand Hasil Bumiku), breadfruit (under the brand Hasil Bumiku), and arrowroot (purchased at Toko Bahan Kue Ramajaya Solo) flours, eggs, sugar, cake emulsifier, and margarine (under the brand Palmia).

### *2.4. Research Flow*

#### *2.4.1. Making of Composite Flours*

Mocaf was incorporated with pumpkin flour at a ratio of 40:60, 50:50, and 60:40. With the same ratio, Mocaf was also incorporated with other types of flour, i.e., the breadfruit and arrowroot. Therefore, nine type of composite flours were generated, and used as part of the ingredients of sponge cake.

#### *2.4.2. Application of Composite Flours to Cake*

The process of sponge cake involves mixing the ingredients of eggs (200 g), sugar (130 g), and cake emulsifier (15 g) together, by using a mixer for 10 mins until the mixture becomes thick and stiff. After the mixture process, place the composite flour according to the treatment (total weight 100 g), and shake at low speed for 3 mins until blended. Furthermore, the melted margarine (50 g) is to be placed into the dough, and beaten with a mixer for 1 min, until evenly distributed. The mixed dough is to be poured into the pan, and baked in the oven, at 180°C for 30 mins.

### 2.4.3. Analysis of Chemical, Physical, and Sensory Characteristics of Cake

The analysis included the measurement of protein, fat, carbohydrate, and crude fiber contents, through the use of Micro-Kjehdal, Soxhlet, Carbohydrates, and Acid-Base methods, respectively [14]. Further analysis involved several sensory tests of color, Mocaf taste, soft and smooth texture, and overall acceptability, using the level of preference measurement with that of scoring [15].

### 2.4.4. Data Analysis

Data were analyzed through the use of the ANOVA and Duncan's Analysis method, with 95% significance level.

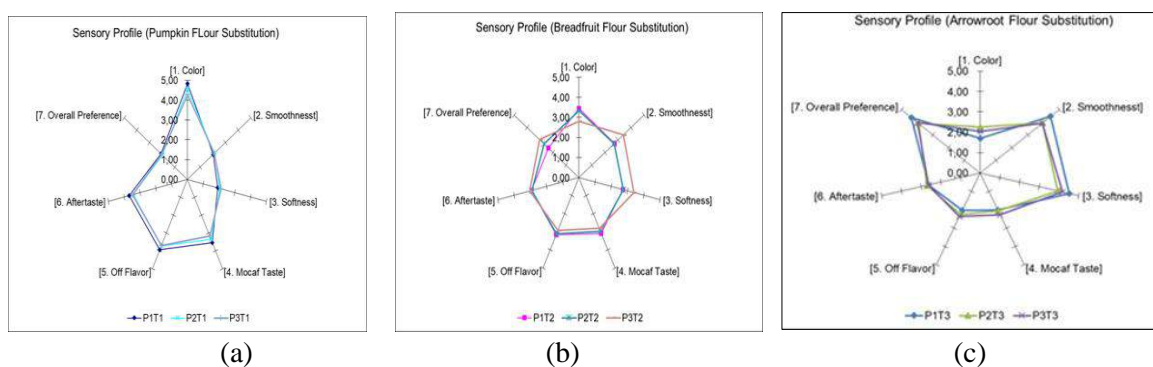
## 3. Results and Discussion

### 3.1. Sensory Profile

The sensory analysis was carried out by 15 panelists, through the use of a scoring test method [15], i.e., they were told to give a score of 1 - 5 on the sensual attributes, which had already been determined. The data obtained was the mean value of each sensory parameter assessed.

The sensory profile of Mocaf sponge cake with pumpkin flour was similar to that of the relationship of other types. The star-chart diagram (Figure 1a) indicated a coincide pattern in the three flour ratios. The sponge cake made of composite flours from Mocaf and pumpkin flour was brown, and had the highest score (a score of 5), due to a considerably high  $\beta$ -carotene in the vegetable fruit (pumpkin) which was about 9-19.9 mg/100 g [16]. However, this sponge cake had a low preference level at a score of 2 (less preferable), and a fairly strong aftertaste from the pumpkin flour.

Furthermore, the colour of the cake was greatly affected by that of the flour used. The cake made from substitute pumpkin flour attained a very high colour score (brown), due to a high beta carotene content, which was 7.29 mg/100 g in the vegetable fruit [16]. Raysita et al [17], argued that the higher the proportion of Mocaf flour, the more brownish-yellow the chiffon cake becomes. Moreover, with pumpkin very specific in taste and flavour, it influences the off-flavour and aftertaste in sponge cake. The panelists' preference level of Mocaf sponge cake with pumpkin flour was low, indicating that the product was rather preferred at a powdery ratio of 40:60, and undesirable at 50:50. The low preference level was likely due to the strong off-flavour and aftertaste generated by the pumpkin flour. However, the percentage of substitute pumpkin flour in this research was probably too high. Pongjanta et al.[16] clarified that the optimum substitution of pumpkin flour in a butter and chiffon cake was 20%. At this percentage, pumpkin flour had significantly elevated the beta carotene content in bakery products. Also, the substitution of pumpkin flour by 20% for that of wheat in several bakery products, enhances vitamin A 1.88 content by 12.92% per 20-40 baked commodities consumed.



**Figure 1.** Sensory Profile of sponge cake with pumpkin flour substitution (a), breadfruit flour substitution (b), and arrowroot flour substitution (c)

Furthermore, the sensory profile of Mocaf sponge cake with breadfruit flour presented in Figure 1b, showed that the powder ratio of 60:40 generated a different sensory attribute from those produced through the use of the other three proportions. Also, sponge cakes produced from composite flours of Mocaf and breadfruit (with a flour ratio of 60:40) have the highest softness and smoothness score. The higher the breadfruit flour proportion, the more brownish the sponge cake becomes. This was probably caused by the number of carotenoids in the breadfruit pulp. Apart from the presence of carotenoids, the carbohydrate content of breadfruit was also quite high at 27.12% with 1.07% of protein [18], which causes a browning reaction with other ingredients, during the process of preparing the sponge cake. Breadfruit also has a total phenolic and flavonoid contents of 277 mg / g GAE and 777.23 mg / 100 g, respectively [19], which plays a role in the formation of yellow to brownish colours in the product.

Figure 3 represents the sensory profile of sponge cake made from the composite flours of Mocaf and arrowroot. It also had the highest score of the overall preference. Also, Mocaf sponge cake substituted with arrowroot flour had a higher smoothness and softness score than those of breadfruit and pumpkin flours. This result was likely influenced by the fine particle size of the arrowroot flour, and its composition of amylose-amylopectin. The amylose and amylopectin levels of arrowroot flour were respectively 24.64% and 75.36% [8], and according to Hakim, Rosyidi, and Widati, [20] were within the range of 20-25% and 75 - 80%. Also, the high amylopectin content causes the ability to bind water to a high level, in order to produce a moist, soft, and smooth texture.

### 3.2. Chemical Properties

Table 1 below, presents the results of the statistical analysis, based on the mean of each factors, i.e., the ratio and type of flours. Also, the effects of the factors were observed by the statistical notation on each average.

**Table 1.** Result of Statistical Analysis by Each Factor (Flour Ratio and Type of Flour)

<b>Flour Ratio</b>	<b>40:60</b>	<b>50:50</b>	<b>60:40</b>
Moisture Content	22.01 ± 2.19 <sup>q</sup>	26.04 ± 2.95 <sup>r</sup>	17.94 ± 3.95 <sup>p</sup>
Ash Content	1.35 ± 0.48 <sup>q</sup>	1.29 ± 0.40 <sup>pq</sup>	1.21 ± 0.28 <sup>q</sup>
Protein Content	5.28 ± 0.25 <sup>p</sup>	5.34 ± 1.17 <sup>p</sup>	7.22 ± 0.76 <sup>q</sup>
Fat Content	8.75 ± 2.09 <sup>p</sup>	8.35 ± 1.62 <sup>p</sup>	10.31 ± 1.62 <sup>q</sup>
Carbohydrate by Difference	62.74 ± 2.54 <sup>q</sup>	58.97 ± 3.48 <sup>p</sup>	63.16 ± 6.57 <sup>q</sup>
<b>Type of Flour</b>	<b>Pumpkin</b>	<b>Breadfruit</b>	<b>Arrowroot</b>
Moisture Content	21.40 ± 4.26 <sup>x</sup>	20.20 ± 5.04 <sup>x</sup>	24.41 ± 3.68 <sup>y</sup>
Ash Content	1.77 ± 0.21 <sup>z</sup>	1.14 ± 0.28 <sup>y</sup>	0.94 ± 0.34 <sup>x</sup>
Protein Content	6.06 ± 0.95 <sup>z</sup>	5.93 ± 0.94 <sup>y</sup>	5.85 ± 1.09 <sup>x</sup>
Fat Content	7.74 ± 0.42 <sup>x</sup>	8.34 ± 0.66 <sup>x</sup>	11.33 ± 1.96 <sup>y</sup>
Carbohydrate by Difference	63.04 ± 2.65 <sup>b</sup>	64.38 ± 4.57 <sup>b</sup>	57.46 ± 1.96 <sup>a</sup>

Means with different letter within columns are significantly different ( $P < 0.05$ )

#### 3.2.1. Moisture Content

The statistical notation in Table 1 showed that the flour ratio had a significant effect on the moisture content of the sponge cakes. The more the Mocaf used, the lower the moisture content of the cakes. The arrowroot flour also had a significant effect on the moisture content of sponge cake. The sponge cake produced from the composite flours of Mocaf and arrowroot, had higher moisture content than those generated from the relationship of powdered modified cassava with breadfruit and pumpkin. The arrowroot flour had a relatively higher water content than other types of substitutes.

Moreover, the water content in the cakes closely pertained to the holding capacity (WHC) of the type of flours being used. The water holding capacity (WHC) of flour was influenced by multiple factors, such as the ratio/weight of amylose and amylopectin molecules, molecular weight distribution, degree of branching, and the outermost length of the amylopectin branch, which contributes to the collection of bonds. Therefore, a high amylopectin content in flour creates an increment in the water holding capacity.

### 3.2.2. Ash Content

The statistical notation on Table 1 showed the type of substitute flour having a significant effect on the ash content of the sponge cake. The sponge cake with the lowest to highest ash content was that, which was made from the composite flours of Mocaf and pumpkin, accompanied by the breadfruit, and the arrowroot. Also, the pumpkin flour separately analyzed, had a ash content higher than that of the breadfruit and arrowroot. Therefore, the ash content in pumpkin, breadfruit, and arrowroot were 7.47% [23], 2.0 % [7], and 0.31% [10], respectively.

### 3.2.3. Protein Content

Table 1 also showed the type of substitute flour having a significant effect on the protein content of the sponge cake. The highest protein content was identified in the sponge cake produced from the composite flours of Mocaf and pumpkin, with the lowest in that of the arrowroot composition. Using a ratio of 60:40 (Mocaf to substitute flour) engenders a sponge cake with a protein content significantly higher, compared to the proportion of 50:50 and 40:60. Therefore, with arrowroot flour not possessing a proteinous contribution to the sponge cake products, the pumpkin and breadfruit composition, had a protein content of 4.28% [24] and 0.23% [25], respectively.

### 3.2.4. Fat Content

The fat content of sponge cake in arrowroot flour substitution was significantly different from other substituents, as it seemed higher. Based on the ratio of flour, the sponge cake with the highest fat content was discovered in the proportion of the Mocaf at 60%. However, the fat content of Mocaf was high, compared to all types of substituted flour, which was within the range of 1.5-2.14% [22]. Also, the fat content of substitution in pumpkin, breadfruit, and arrowroot flours were 4.87% [23], 0.8% [7], and 0.32% [18], respectively. Therefore, the relatively high fat content in Mocaf, was probably the most influencing factor in that of the sponge cake.

### 3.2.5. Carbohydrate Content

Flour type and ratio had no significant effect on the carbohydrate content of the sponge cakes. The higher the proportion of the Mocaf, the more incremental the cake's carbohydrate content. Based on the type of substituted flour, the breadfruit, pumpkin, and arrowroot substitution respectively ranked from the highest to the lowest, in terms of the carbohydrate content in the cakes.

## 4. Conclusion

The most preferred sponge cake selected by the panelists was that, which was made from a flour ratio of 40:60, while using arrowroot flour as a substitute. The sponge cake had a bright yellow colour (colour score 1.7), very soft (score 4.46), smooth (score 4.52), slight Mocaf taste (score 2.01), with partially pronounced off-flavour and aftertaste (scores 2.05 and 2.63). Moreover, the most preferred chemical composition of sponge cake was 21.79% water content, 0.93% ash, 5.07% protein, 10.12% fat, and 62.74% carbohydrates.

## Acknowledgement

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# mokaf

*by* Artikel Mba Yani

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The process of sponge cake involves mixing the ingredients of eggs (200 g), sugar (130 g), and cake emulsifier (15 g) together, by using a mixer for 10 mins until the mixture becomes thick and stiff. After the mixture process, place the composite flour according to the treatment (total weight 100 g), and shake at low speed for 3 mins until blended. Furthermore, the melted margarine (50 g) is to be placed into the dough, and beaten with a mixer for 1 min, until evenly distributed. The mixed dough is to be poured into the pan, and baked in the oven, at 180°C for 30 mins.

#### 2.4.3. Analysis of Chemical, Physical, and Sensory Characteristics of Cake

The analysis included the measurement of protein, fat, carbohydrate, and crude fiber contents, through the use of Micro-Kjehdal, Soxhlet, Carbohydrates, and Acid-Base methods, respectively [14]. Further analysis involved several sensory tests of color, Mocaf taste, soft and smooth texture, and overall acceptability, using the level of preference measurement with that of scoring [15].

#### 2.4.4. Data Analysis

Data were analyzed through the use of the ANOVA and Duncan's Analysis method, with 95% significance level.

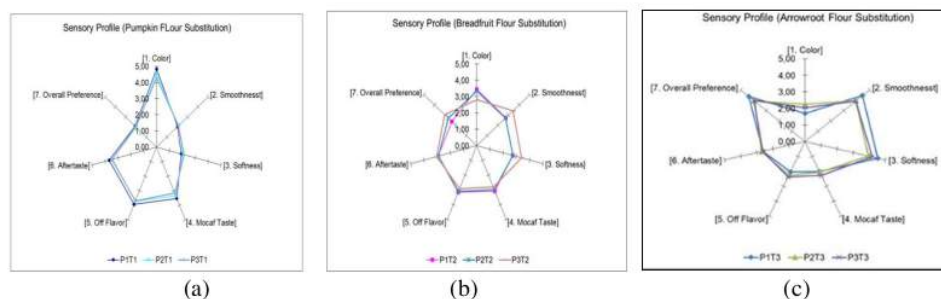
### 3. Results and Discussion

#### 3.1. Sensory Profile

The sensory analysis was carried out by 15 panelists, through the use of a scoring test method [15], i.e., they were told to give a score of 1 - 5 on the sensual attributes, which had already been determined. The data obtained was the mean value of each sensory parameter assessed.

The sensory profile of Mocaf sponge cake with pumpkin flour was similar to that of the relationship of other types. The star-chart diagram (Figure 1a) indicated a coincide pattern in the three flour ratios. The sponge cake made of composite flours from Mocaf and pumpkin flour was brown, and had the highest score (a score of 5), due to a considerably high  $\beta$ -carotene in the vegetable fruit (pumpkin) which was about 9-19.9 mg/100 g [16]. However, this sponge cake had a low preference level at a score of 2 (less preferable), and a fairly strong aftertaste from the pumpkin flour.

Furthermore, the colour of the cake was greatly affected by that of the flour used. The cake made from substitute pumpkin flour attained a very high colour score (brown), due to a high beta carotene content, which was 7.29 mg/100 g in the vegetable fruit [16]. Raysita et al [17], argued that the higher the proportion of Mocaf flour, the more brownish-yellow the chiffon cake becomes. Moreover, with pumpkin very specific in taste and flavour, it influences the off-flavour and aftertaste in sponge cake. The panelists' preference level of Mocaf sponge cake with pumpkin flour was low, indicating that the product was rather preferred at a powdery ratio of 40:60, and undesirable at 50:50. The low preference level was likely due to the strong off-flavour and aftertaste generated by the pumpkin flour. However, the percentage of substitute pumpkin flour in this research was probably too high. Pongjanta et al. [16] clarified that the optimum substitution of pumpkin flour in a butter and chiffon cake was 20%. At this percentage, pumpkin flour had significantly elevated the beta carotene content in bakery products. Also, the substitution of pumpkin flour by 20% for that of wheat in several bakery products, enhances vitamin A 1.88 content by 12.92% per 20-40 baked commodities consumed.



**Figure 1.** Sensory Profile of sponge cake with pumpkin flour substitution (a), breadfruit flour substitution (b), and arrowroot flour substitution (c)

Furthermore, the sensory profile of Mocaf sponge cake with breadfruit flour presented in Figure 1b, showed that the powder ratio of 60:40 generated a different sensory attribute from those produced through the use of the other three proportions. Also, sponge cakes produced from composite flours of Mocaf and breadfruit (with a flour ratio of 60:40) have the highest softness and smoothness score.

The higher the breadfruit flour proportion, the more brownish the sponge cake becomes. This was probably caused by the number of carotenoids in the breadfruit pulp. Apart from the presence of carotenoids, the carbohydrate content of breadfruit was also quite high at 27.12% with 1.07% of protein [18], which causes a browning reaction with other ingredients, during the process of preparing the sponge cake. Breadfruit also has a total phenolic and flavonoid contents of 277 mg / g GAE and 777.23 mg / 100 g, respectively [19], which plays a role in the formation of yellow to brownish colours in the product.

Figure 3 represents the sensory profile of sponge cake made from the composite flours of Mocaf and arrowroot. It also had the highest score of the overall preference. Also, Mocaf sponge cake substituted with arrowroot flour had a higher smoothness and softness score than those of breadfruit and pumpkin flours. This result was likely influenced by the fine particle size of the arrowroot flour, and its composition of amylose-amylopectin. The amylose and amylopectin levels of arrowroot flour were respectively 24.64% and 75.36% [8], and according to Hakim, Rosyidi, and Widati, [20] were within the range of 20-25% and 75 - 80%. Also, the high amylopectin content causes the ability to bind water to a high level, in order to produce a moist, soft, and smooth texture.

### 3.2. Chemical Properties

Table 1 below, presents the results of the statistical analysis, based on the mean of each factors, i.e., the ratio and type of flours. Also, the effects of the factors were observed by the statistical notation on each average.

**Table 1.** Result of Statistical Analysis by Each Factor (Flour Ratio and Type of Flour)

Flour Ratio	40:60	50:50	60:40
Moisture Content	22.01 ± 2.19 <sup>q</sup>	26.04 ± 2.95 <sup>r</sup>	17.94 ± 3.95 <sup>p</sup>
Ash Content	1.35 ± 0.48 <sup>q</sup>	1.29 ± 0.40 <sup>pq</sup>	1.21 ± 0.28 <sup>q</sup>
Protein Content	5.28 ± 0.25 <sup>p</sup>	5.34 ± 1.17 <sup>p</sup>	7.22 ± 0.76 <sup>q</sup>
Fat Content	8.75 ± 2.09 <sup>p</sup>	8.35 ± 1.62 <sup>p</sup>	10.31 ± 1.62 <sup>q</sup>
Carbohydrate by Difference	62.74 ± 2.54 <sup>q</sup>	58.97 ± 3.48 <sup>p</sup>	63.16 ± 6.57 <sup>q</sup>
Type of Flour	Pumpkin	Breadfruit	Arrowroot
Moisture Content	21.40 ± 4.26 <sup>x</sup>	20.20 ± 5.04 <sup>x</sup>	24.41 ± 3.68 <sup>y</sup>
Ash Content	1.77 ± 0.21 <sup>z</sup>	1.14 ± 0.28 <sup>y</sup>	0.94 ± 0.34 <sup>x</sup>
Protein Content	6.06 ± 0.95 <sup>z</sup>	5.93 ± 0.94 <sup>y</sup>	5.85 ± 1.09 <sup>x</sup>
Fat Content	7.74 ± 0.42 <sup>x</sup>	8.34 ± 0.66 <sup>x</sup>	11.33 ± 1.96 <sup>y</sup>
Carbohydrate by Difference	63.04 ± 2.65 <sup>b</sup>	64.38 ± 4.57 <sup>b</sup>	57.46 ± 1.96 <sup>a</sup>

Means with different letter within columns are significantly different (P < 0.05)

#### 3.2.1. Moisture Content

The statistical notation in Table 1 showed that the flour ratio had a significant effect on the moisture content of the sponge cake. The more the Mocaf used, the lower the moisture content of the cakes. The arrowroot flour also had a significant effect on the moisture content of sponge cake. The sponge cake produced from the composite flours of Mocaf and arrowroot, had higher moisture content than those generated from the relationship of powdered modified cassava with breadfruit and pumpkin. The arrowroot flour had a relatively higher water content than other types of substitutes.

Moreover, the water content in the cakes closely pertained to the holding capacity (WHC) of the type of flours being used. The water holding capacity (WHC) of flour was influenced by multiple factors, such as the ratio/weight of amylose and amylopectin molecules, molecular weight distribution, degree of branching, and the outermost length of the amylopectin branch, which contributes to the collection of bonds. Therefore, a high amylopectin content in flour creates an increment in the water holding capacity.

### 3.2.2. Ash Content

The statistical notation on Table 1 showed the type of substitute flour having a significant effect on the ash content of the sponge cake. The sponge cake with the lowest to highest ash content was that, which was made from the composite flours of Mocaf and pumpkin, accompanied by the breadfruit, and the arrowroot. Also, the pumpkin flour separately analyzed, had a ash content higher than that of the breadfruit and arrowroot. Therefore, the ash content in pumpkin, breadfruit, and arrowroot were 7.47% [23], 2.0 % [7], and 0.31% [10], respectively.

### 3.2.3. Protein Content

Table 1 also showed the type of substitute flour having a significant effect on the protein content of the sponge cake. The highest protein content was identified in the sponge cake produced from the composite flours of Mocaf and pumpkin, with the lowest in that of the arrowroot composition. Using a ratio of 60:40 (Mocaf to substitute flour) engenders a sponge cake with a protein content significantly higher, compared to the proportion of 50:50 and 40:60. Therefore, with arrowroot flour not possessing a proteinous contribution to the sponge cake products, the pumpkin and breadfruit composition, had a protein content of 4.28% [24] and 0.23% [25], respectively.

### 3.2.4. Fat Content

The fat content of sponge cake in arrowroot flour substitution was significantly different from other substituents, as it seemed higher. Based on the ratio of flour, the sponge cake with the highest fat content was discovered in the proportion of the Mocaf at 60%. However, the fat content of Mocaf was high, compared to all types of substituted flour, which was within the range of 1.5-2.14% [22]. Also, the fat content of substitution in pumpkin, breadfruit, and arrowroot flours were 4.87% [23], 0.8% [7], and 0.32% [18], respectively. Therefore, the relatively high fat content in Mocaf, was probably the most influencing factor in that of the sponge cake.

### 3.2.5. Carbohydrate Content

Flour type and ratio had no significant effect on the carbohydrate content of the sponge cakes. The higher the proportion of the Mocaf, the more incremental the cake's carbohydrate content. Based on the type of substituted flour, the breadfruit, pumpkin, and arrowroot substitution respectively ranked from the highest to the lowest, in terms of the carbohydrate content in the cakes.

## 4. Conclusion

The most preferred sponge cake selected by the panelists was that, which was made from a flour ratio of 40:60, while using arrowroot flour as a substitute. The sponge cake had a bright yellow colour (colour score 1.7), very soft (score 4.46), smooth (score 4.52), slight Mocaf taste (score 2.01), with partially pronounced off-flavour and aftertaste (scores 2.05 and 2.63). Moreover, the most preferred chemical composition of sponge cake was 21.79% water content, 0.93% ash, 5.07% protein, 10.12% fat, and 62.74% carbohydrates.

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