

Original Paper

The Effect of Substitution of Seed Flour of Jackfruit (*Artocarpus heterophyllus* Lam.) on the Physicochemical and Organoleptic Characteristics of Macrons

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Received: 5 February 2021; Accepted: 3 April 2021

DOI: <https://doi.org/10.46676/ij-fanres.v2i1.25>

Abstract — Jackfruit seeds are rich in carbohydrates, so they can be processed into food products such as macrons. Macron is a typical food of Ternate city which is usually made using wheat flour as the base ingredient. The purpose of this study was to determine the best ratio of substitution of jackfruit seed flour in macron manufacturing and to determine the physicochemical and organoleptic characteristics of macrons produced from different substitutions of jackfruit seed flour. This research investigated the substitution of jackfruit seed flour and wheat flour with formulation (P0 = 0%: 100%, P1 = 25%: 75%, P2 = 50%: 50%, P3 = 75%: 25% and P4 = 100. %: 0%), using a completely randomized design (CRD) consisting of five treatments with three replications to obtain 5 x 3 = 15 experimental units. The best treatment results showed the formulation of 25% jackfruit seed flour and 75% wheat flour (P1) in macrons with physical characteristics in the form of texture (fracture power) 12.25 N, color L * 56.42, a * 9.77, b * 25.44. The chemical properties are 18.313% protein, 11.846% fat, 63.693% carbohydrate, 0.916% ash, and 3.5% moisture. The organoleptic properties include aroma 4.12 (preference), taste 3.30 (neutral), color 4.14 (preference) and texture 4.05 (preference). Macron, with the addition of jackfruit seed flour, has a significant effect on physicochemical properties, including texture, color, moisture content, ash content, and protein, as well as organoleptic characteristics such as taste, aroma, color, and texture. Meanwhile, the addition of jackfruit seed flour to macrons has no effect on fat and carbohydrate levels.

Keywords— *Macron, Jackfruit Seed, Texture, Proximate, Organoleptic*

I. INTRODUCTION

Food is the most important basic need for humans to survive [23]. Food as a source of nutrition such as carbohydrates, fats, proteins, vitamins, minerals, and water is the main resource for humans to achieve health and well-being [18].

Food diversification is very important to avoid dependence on a type of food source. This diversification can take advantage of plant and animal products [19]. Through

food diversification, a wide variety of foods can be obtained according to agricultural products and can also meet human nutritional needs (Soenardi, 2002). Food diversification is useful for reducing dependence on foodstuffs such as wheat flour [7].

Wheat flour is consumed in various forms of food, such as cakes and various other types of food preparations. The increasing consumption of wheat flour as an alternative to increasing calories apart from rice has caused wheat flour to be frequently used in a variety of household food menus, restaurants and street vendors so that the demand for wheat flour becomes fairly high [2]. To overcome this issue, the government is trying to meet the demand for wheat flour by importing wheat flour from abroad. This proves that there is a government dependence on imports of wheat flour. One of the efforts to overcome this is by developing the use of local food ingredients. One of the local food ingredients that have the potential to be processed into flour is jackfruit seeds because of its nutritional and health benefits [13]. Jackfruit seeds can be used as a raw material to replace wheat flour because jackfruit seeds contain low molecular carbohydrates and have antioxidant activity [10].

The utilization of jackfruit seeds in society is still very limited. To date, people only boil or roast jackfruit seeds, meaning that this resource has not been used optimally. Jackfruit seeds contain high carbohydrates and have the potential to be processed into food products [22][15].

Jackfruit seeds contain high nutritional value so they can be used as a substitute for wheat flour. Every 100 grams of jackfruit seeds contain 165 calories of energy, 36.7 g carbohydrates, 0.1 g fat, 4.2 g protein, 1 mg iron, 200 mg phosphorus, 33 mg calcium, 0.2 mg thiamine, and 57.7 g water. Wheat flour contains 414.77 calories of energy, 87.84 g carbohydrates, 1.47 g fat, 10.11 g protein, 1.36 mg iron, 120.45 mg phosphorus, 16 mg calcium, and 0.125 mg vitamin B1 (Directorate of Nutrition, 1994). Calcium and phosphorus play an important role in the formation of bones and teeth in humans [24]. Various studies on ingredients of jackfruit seed

flour have been carried out such as making cat tongue cookies [16], dry pia cakes [14] and noodles [8].

Walnut macrons are a type of cookie made with hard dough, through ripening process. The macron shape of walnuts is very different from the flattened biscuits. The walnut macron is a bit thick, dense, and crunchy, and the taste is slightly sweet. The basic ingredient for making walnut macrons is wheat flour. Wheat flour is the basic ingredient in most cakes, which are relatively expensive. To reduce the use of wheat flour, it is necessary to combine it with other ingredients. One of the ingredients that can reduce wheat flour is jackfruit seeds. However, efforts to diversify processed products with the basic ingredients of jackfruit seed flour need to consider public acceptance and the nutritional value of these products. Based on the above background, it is necessary to conduct research on the effect of substitution of jackfruit seed flour (*Artocarpus heterophyllus*) and wheat flour on the physicochemical and organoleptic characteristics of macrons.

II. MATERIALS AND METHOD

A. Time and Place

This research was conducted from October to November 2020 at the Laboratory of Agricultural Product Technology Study Program, Faculty of Agriculture, Khairun University, Ternate, North Maluku, Indonesia.

B. Ingredient and Equipment

The ingredients used in the manufacture of flour were dried jackfruit seeds (ripe jackfruit waste). The ingredients for making macrons were jackfruit seed flour, walnut grits, wheat flour, butter, sugar, vanilla powder, and eggs. Chemicals were used for proximate analysis.

The tools used in the manufacture of jackfruit seed flour were cabinet drying temperature of 48o C, slicer, knife, basin, spoon, digital scale, flour tool, and 100 mesh sieve. The tools used in making macrons were mixers, ovens, molds, digital scales. The other tools for physical analysis were a color reader, Force Gauge PCE FM200, and proximate analysis tools, and organoleptic tests.

C. Research Procedure

The Production of Jackfruit Seed Flour

The process of making jackfruit seed flour [16], begins with sorting the jackfruit seeds, which were waste from ripe jackfruit. Afterward, the jackfruit seeds were washed and cleaned, followed with blanching the seeds at 80o C for \pm 10 minutes. The husk was removed, and the seeds were sliced with a thickness of 2 mm. These seeds were then dried in a cabinet drying at a temperature of 48o C for \pm 24 hours. The seeds were then refined using flour and then sieved with a size of 100 mesh.

The Production of Jackfruit Seed Macrons

The process of making jackfruit seed macrons began by preparing macron dough as the main ingredient, which

denoted the treatment in this study. The substitution of jackfruit seed flour and wheat flour with was differentiated into the following percentages (P0 = 0%: 100%, P1 = 25%: 75%, P2 = 50%: 50%, P3 = 75%: 25% and P4 = 100%: 0%). The mixing process was performed using a mixer at medium speed, during which other ingredients in the form of sugar, butter, eggs, crushed walnuts, and vanilla were added. Furthermore, the dough was left to stand for \pm 20 minutes. The ready-made walnut macron dough was then printed with a thickness of 2 cm with a diameter of 3 mm. Macron biscuits mold on a baking sheet were then baked in an oven at 135o C for \pm 20 minutes. The macron biscuit products were followed by observations of physicochemical and organoleptic properties.

D. Observation

Research parameters included analysis of physicochemical and organoleptic properties. The physical analysis included texture (fracture), color (L^* , a^* , b^*). Chemical properties included moisture content, ash content, protein content, fat content, and carbohydrates. The organoleptic properties consisted of aroma, taste, color, and texture using. Both properties were tested in hedonic test method (like, somewhat like, neutral, somewhat dislike, and dislike).

E. Data Analysis

This study used a Completely Randomized Design (CRD) model with 5 treatments and 3 replications in order to obtain 15 experimental units. The data were processed using SPSS 24 software. The data obtained were analyzed using analysis of variance. Once there was a difference identified between treatments, LSD test was carried out with α 5%.

III. RESULTS AND DISCUSSION

A. Physical Characteristics of Macron

Table 1. Physical Characteristics, Texture, and Color of Macron Jackfruit Seed Flour

Treatment (T) Jackfruit Seed Flour: Wheat Flour	Texture (Fracture Strength) (N)	Color		
		L^*	a^*	b^*
P0 = 0% : 100%	21,55 \pm 0.16A	75,92 \pm 0.15A	8,83 \pm 0.17B	32,61 \pm 0.14A
P1 = 25% : 75%	12,25 \pm 0.07B	56,42 \pm 0.21B	9,77 \pm 0.19B	25,44 \pm 0.22A
P2 = 50% : 50%	10,20 \pm 0.10C	55,11 \pm 0.18B	9,67 \pm 0.24B	22,68 \pm 0.25B
P3 = 75% : 25%	9,26 \pm 0.09C	53,74 \pm 0.25B	10,12 \pm 0.20A	21,86 \pm 0.23B
P4 = 100% : 0%	14,61 \pm 0.11B	52,21 \pm 0.09B	11,54 \pm 0.12A	19,52 \pm 0.08B

The values followed by the same letter were not significantly different from each other (α = 0.05).

Texture (Fracture Strength)

Analysis of average texture (fracture strength) of jackfruit seeds with different treatments is presented in Table 1. The

results of the analysis of texture variability (fracture strength) show that, in each treatment, the addition of different jackfruit seed flour has a very significant effect on the hardness value of macron. This shows that the addition of jackfruit seed flour has a significant effect on macron hardness. The gelatinization process is thought to have contributed to the hardness of the jackfruit seed walnut macrons. The roasting process causes moisture and air trapped in the dough to evaporate and produce a porous structure so that it becomes drier and has a crunchy texture [24].

Color (L^* , a^* , b^*)

The analysis of the average macron color of the jackfruit seed flour with different treatments is presented in Table 1. The results of the analysis of variance showed that the different treatments of adding jackfruit seed flour in making macrons had a significant effect on the resulting macron colors from yellow to brown. The yellow and brown color of the jackfruit seed walnut macrons was thought to be influenced by the maillard and caramelization processes that occur during the roasting process. Maillard reaction is a reaction that occurs between carbohydrates, especially reducing sugars with amino groups. The result of this reaction produced a brown color on the macrons of jackfruit seeds. Caramelization is a sucrose solution that is evaporated, and then the concentration and boiling point in the solution will evaporate and reach the melting point at a temperature of 160° C. However, heating is continued until it exceeds the melting point to allow caramelization to occur [24].

The results of a^* color variance on the macron of jackfruit seeds showed that the addition of jackfruit seed flour had a significantly different effect. According to [5], the color dimension with the symbol a^* demonstrates that the more positive the value of a^* , the redder the color will be. Likewise, the more negative the value of a^* , the greener the color will be. The results of b^* color variance on the macron of jackfruit seeds showed that the addition of different jackfruit seed flour in making macrons gave significantly different effects. The color dimension with the symbol b^* demonstrates that the more positive the value of b^* , the yellower the color will be. The more negative the b^* value, the bluer the color will be [5].

B. The Chemical Characteristics of Macron

Protein Content

The analysis of the average protein content of macron associated with jackfruit seed flour is presented in Figure 1.

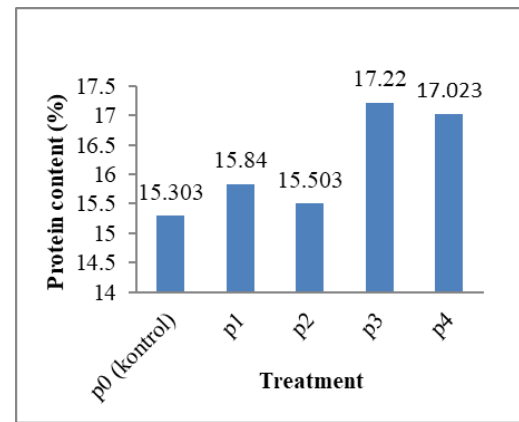


Figure 1. Protein Content of Different Proportions of Jackfruit Seed Flour and wheat flour

In Figure 1, it can be seen from the results of different levels of protein in the macron of jackfruit seeds pose a significant effect on the levels of macron protein. This shows that the addition of different jackfruit seed flour has a significant effect on the value of macron protein content. According to [1], the protein content of jackfruit seed flour is higher than that of wheat flour, in that the protein content of jackfruit seed flour is 12.19 g and wheat flour is 9 g.

Fat Content

The analysis of average fat content in jackfruit seed flour macron is presented in Figure 2.

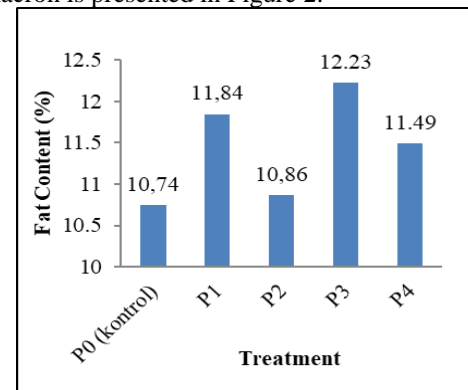


Figure 2. Fat Content of Different Proportions of Jackfruit Seed Flour Macron and Wheat Flour

In Figure 2, the results of the variety of fat content in the macron of jackfruit seeds show that the different treatment of adding jackfruit seed flour has no significant effect on macron fat content. This shows that the addition of jackfruit seed flour has no significant effect on macron fat content. Macron fat content is affected by the additional ingredients used, such as walnuts and butter. According to [11], ripe walnuts contain 70% fat.

Water Content

The analysis of the water content of jackfruit seed flour macron is shown in Figure 3.

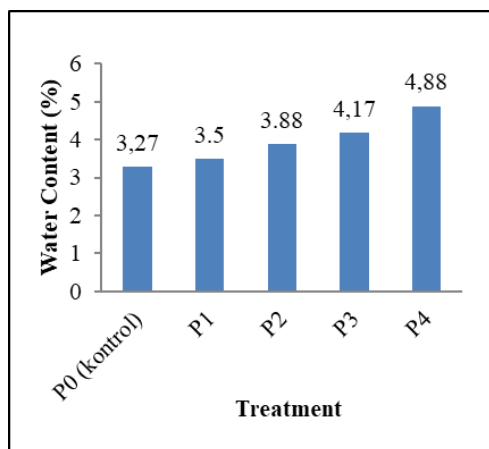


Figure 3. Water Content of Different Proportions of Jackfruit Seed Flour Macron and Wheat Flour

In Figure 3, the different moisture content is found in the macron of jackfruit seed flour. This result indicates that the addition of different jackfruit seed flour has a significant effect on macron water content. This shows that the addition of jackfruit seed flour has a significant effect on macron moisture content. The more jackfruit seed flour is added, the higher the moisture content emerges. The water content in each different treatment is presumed to result from the influence of the water content of the main raw material. In addition, the temperature and roasting time affect the moisture content of the resulting product. [17] states that the greater the amylose content, the drier the starch will be, making it difficult to absorb water. On the other hand, if the amylopectin content is high, the starch will be bigger and therefore absorb less water. The amylose and amylopectin content in jackfruit seed flour is 16.72% amylose and 83.28% amylopectin, while wheat flour contains 10.23% amylose and 89.77% amylopectin (Imanningsih, 2012).

Ash Content

The analysis of ash content of jackfruit seed flour macron is shown in Figure 4.

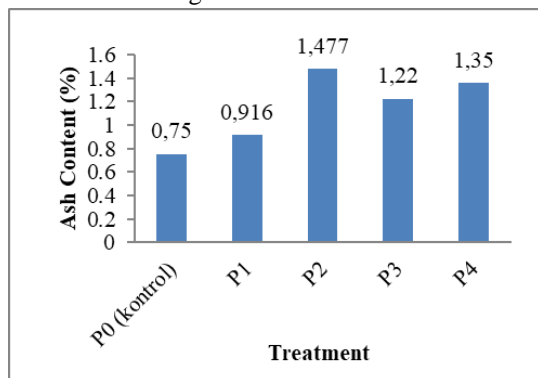


Figure 4. Ash Content of Different Proportions of Jackfruit Seed Flour Macron and Wheat Flour

Carbohydrate Content

The analysis of carbohydrate content of jackfruit seed flour macron is shown in Figure 5.

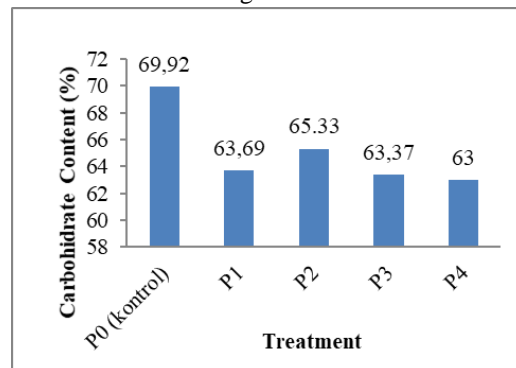


Figure 5. Carbohydrate Content of Different Proportions of Jackfruit Seed Flour Macron and Wheat Flour

In Figure 5, different carbohydrate contents in the macron of jackfruit seeds show that the treatment of adding jackfruit seed flour to making macrons poses no significant effect. This is because the addition of jackfruit seed flour to macrons has no significant effect on macron carbohydrate levels. According to Andriyani and Hidayati, the carbohydrate content of jackfruit seeds is 56.1 g, and that of wheat flour is 77.2 g. This shows that the carbohydrate content of wheat flour is higher than that of jackfruit seed flour. The results show that the macron carbohydrate content of the jackfruit seed does not satisfy SNI quality standard. This is because the macron carbohydrate content of jackfruit seed walnuts has not met the required quality standard. According to (SNI 01-2937-1992) the carbohydrate content in cookies needs to reach 70%, at least.

C. Characteristics of Macron Organoleptic Properties

Table 2. Characteristics of Macron Organoleptic Properties of Jackfruit Seed Flour

Treatment (T) Jackfruit Seed Flour: Wheat Flour	Organoleptic Characteristics			
	Aroma	Taste	Color	Texture
P0 = 0% : 100%,	3.97±0.12B	4.66±0.14A	3.92±0.10B	3.42±0.15B
P1 = 25% : 75%,	4.11±0.23A	3.20±0.21B	4.17±0.24A	4.04±0.20A
P2 = 50% : 50%,	3.13±0.14B	2.48±0.16C	2.86±0.20C	3.51±0.18B
P3 = 75% : 25%	3.09±0.20B	2.21±0.19C	2.88±0.22C	3.11±0.19B
P4 = 100% : 0%	3.09±0.13B	2.06±0.11C	3.2±0.09C	3.17±0.15B

The values followed by the same letter were not significantly different from each other ($\alpha = 0.05$).

Aroma

The organoleptic test results of the macron aroma of jackfruit seeds with different treatments are presented in

Table 2. The variant results show that the addition of jackfruit seed flour to macron generates a significant effect on the aroma. This is because the addition of jackfruit seed flour has a significant effect on the panelists' preference for macron aroma. According to [21], the aroma caused by macrons with the substitution of jackfruit seed flour is thought to originate from jackfruit seed flour which contains aroma-forming volatile components, including aromatics and esters. The volatile compounds in the material will evaporate during the roasting process. As a corollary, a distinctive aroma will emerge in the material [12]. The aroma of macrons is also influenced by the addition of other ingredients, such as vanilla, butter and eggs.

Taste

The organoleptic test results of the macron taste of jackfruit seeds with different treatments are presented in Table 2. The variant results show that the addition of jackfruit seed flour to macron generates a significant effect on the macron taste. This shows that the addition of jackfruit seed flour to macrons has a significant effect on the taste. In the organoleptic taste test, the panelists on average disliked macrons with the addition of jackfruit seed flour. Greater amount of jackfruit seed flour resulted in an unfavourable taste of the macron. This is because the addition of jackfruit seed flour gives the macron a slightly bitter taste. According to [3], jackfruit seeds positively contain chemical compounds in the form of saponins, which are associated with a bitter taste.

Color

The organoleptic test results for the macron color of the jackfruit seed walnuts with different treatments are presented in Table 2. The variant results show that the addition of jackfruit seed flour to macron generates a significant effect on the macron color. This shows that the addition of jackfruit seed flour has a significant effect on panelists' acceptance of the macron color. The addition of jackfruit seed flour to the macrons gives the macrons a brownish color. The higher amount of jackfruit seed flour generates browner macrons.

Texture

The organoleptic test results of the macron texture of the jackfruit seed walnuts with different treatments are presented in Table 2. The variant results show that the addition of jackfruit seed flour to macron generates a significant effect on the macron texture. This shows that the addition of jackfruit seed flour has a significant effect on panelists acceptance of the macron texture. Panelists on average preferred the macron texture under P1 treatment, with the formulation of 75% wheat flour and 25% jackfruit seed flour.

D. The Best Treatment of Jackfruit Seed Macron

Selection of the best treatment was done by ranking of the characteristics of the physicochemical and organoleptic properties of jackfruit seeds macron. The best ranking was seen from the smallest number of rankings. Based on the smallest number of rankings, the best macron of jackfruit seeds is treatment P1. Ranking was determined by adding up the superscript numbers for each treatment. The best criteria of the physical properties of water content, texture and ash content are seen from those that have the smallest value. The best criteria involving fat, protein and organoleptic levels are associated with the treatment found to have the highest value. The physicochemical and organoleptic characteristics of the best treatment macrons based on the ranking are presented in Table 3 below.

Table 3. Ranking of Physicochemical and Organoleptic Characteristics of Jackfruit Seeds with Different Treatments

Characteristics	Treatment				
	P0	P1	P2	P3	P4
Fracture Strength	21,55 ⁵	12,25 ³	10,2 ²	9,26 ¹	14,61 ⁴
Protein	15,303 ⁵	15,84 ³	15,5 ⁴	17,22 ²	17,023 ¹
Color L*	75,92 ¹	56,42 ²	55,11 ³	53,746 ⁴	52,21 ⁵
Color a*	8,83 ⁵	9,77 ⁴	9,67 ³	10,12 ²	11,54 ¹
Color b*	32,61 ¹	25,44 ²	22,68 ³	21,86 ⁴	19,52 ⁵
Ash	0,75 ¹	0,91 ²	1,47 ⁵	1,22 ³	1,35 ⁴
Water					
Organoleptics	3,27 ¹	3,5 ²	3,88 ³	4,17 ⁴	4,88 ⁵
Aroma	3,09 ⁵	4,11 ¹	3,13 ³	3,12 ⁴	3,97 ²
Taste	4,65 ¹	3,29 ²	2,47 ³	2,19 ⁴	2,05 ⁵
Color	3,9 ²	4,14 ¹	2,85 ⁵	2,87 ⁴	3,27 ³
Texture	3,42 ³	4,055 ¹	3,51 ²	3,06 ⁵	3,16 ⁴
Σ Ranging	30	23	33	37	39

Description: P0 (Control). Ranks are indicated by the superscript numbers for each treatment.

IV. CONCLUSION

Based on the research results, the best macron of jackfruit seeds is in P1 treatment with the formulation of 25% jackfruit seed flour and 75% wheat flour. Macron with the addition of jackfruit seed flour has a significant effect on physicochemical properties, including texture (fracture), color (L*, a*, b*), moisture content, ash content, protein. Likewise, organoleptic properties involving taste, aroma, color, and texture are also found satisfactory concerning the quality standard operative. However, the addition of jackfruit seed flour to macrons does not affect fat and carbohydrate levels.

ACKNOWLEDGMENT

The authors would like to express their massive gratitude to the Agricultural Product Technology Laboratory, Faculty of Agriculture, Khairun Ternate University for providing laboratory facilities, without which the entire research procedure will be impossible to be accomplished.

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