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Physicochemical and Sensory Characteristics of Flakes Made of Proportion of Breadfruit Flour *(Artocarpus altilis)* and Mocaf *(Modified Cassava Flour)* and Concentration of Sodium Bicarbonate

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A B S T R A C T

Flakes are a thin, sheet-shaped food with a brownish-yellow color and are usually consumed with milk as a breakfast menu. In this research, we will make flakes using a combination of breadfruit flour and Mocaf flour. The purpose of this research was to determine the effect of the proportion of breadfruit flour and mocaf flour and the concentration of sodium bicarbonate on the physicochemical and organoleptic characteristics of the quality of the flakes produced. This research used a completely randomized design (CRD) factorial pattern with two factors and two replications. Factor I is the proportion of breadfruit flour and mocaf flour consisting of 10:90, 20:80, and 30:70. Factor II is the concentration of sodium bicarbonate, namely 0.3%, 0.4%, and 0.5%. If there is a significant difference, it will be continued with the DMRT 5% further test. The best treatment results were obtained in the treatment of the proportion of breadfruit flour (20%) and mocaf flour (80%) and sodium bicarbonate concentration of 0.4%, namely water content 3.48%, ash content 2.63%, fat content 1.67%, protein content 3.81%, carbohydrate content 87.22%, starch content 78.58%, rehydration power 125.32% and organoleptic values, which include color 3.72 (Slightly brownish yellow), aroma 3.48 (Slightly languorous), taste 3.92 (Slightly savory), and crunchiness 3.92 (slightly crunchy).

Contribution to Sustainable Development Goals (SDGs):
SDG 2: Zero Hunger
SDG 3: Good Health and Well-Being
SDG 9: Industry, Innovation, and Infrastructure
SDG 13: Climate Action

1. INTRODUCTION

1.1. Research Background

Consuming food is a daily necessity that fulfills basic human nutritional needs. Food consumption habits shape consumption behavior. Society's fast-paced thinking pattern, supported by technological advances, causes people to want everything instantly[1].

One food favored by the public for breakfast is cereal. Flakes are a ready-to-eat breakfast product that takes less than three minutes to prepare and fulfills a person's calorie needs because they contain high carbohydrate content. Flakes are thin, sheet-shaped, brownish-yellow foods that are usually consumed with milk as part of a breakfast meal [2].

Flakes requires ingredients with high starch content, Using starch-containing ingredients when manufacturing flakes can facilitate the gelatinization process, resulting in expanded flakes that are easier to make into dough [3]. One of the important physical properties of flakes is crispness. Different amylose and amylopectin content in starch can affect the crispness value of the product. The mixing matrix between starch, protein, and fiber, can form a compact structure and cause the texture of flakes to be hard [4]. The hard Flakes and too compact can be conditioned to be porous, by adding $NaHCO_3$, which can produce gas (CO_2) during the heating process, so as to increase the product's expandability and crispness [5].

Flakes are food products made from food ingredients cereals, such as rice, wheat, and corn, as well as tubers, such as potatoes, cassava, and sweet potatoes. They are ready to eat and come in various types and shapes. They can be served with added milk. The milk temperature used is 29°C. Initially, flakes were made from whole corn kernels, such as corn flakes. The flakes commonly found in stores are made from wheat flour [6].

The basic principle of making flake-shaped instant breakfast cereal is the drying of gelatinized starch. The dried starch can still absorb a large amount of water. Once the water is absorbed into the starch, the starch/cereal can be consumed immediately. During the process stages, cereals change such as: (1) The starch is gelatinized and partially hydrolyzed, (2) The particles undergo a browning reaction due to the interaction of proteins and sugars, (3) The enzymatic reaction stops, indicating a more stable end product, (4) The dextrination and caramelization of sugars occurs as a result of the high temperature in the baking oven and (5) The flakes become crispy due to the reduction of moisture content to a very low level [7].

Flakes' products on the market contain high carbohydrates. Therefore, it is necessary to select raw materials in the manufacture of flakes that contain a complete source of nutrients. In general, flakes are made from grains in the form of flour, and their development can also be made from other carbohydrate sources such as tubers or beans [8]. In this research, breadfruit flour and mocaf were used. The processing of breadfruit and mocaf is still not maximally utilized, therefore, it is necessary to process breadfruit seeds modified into flour products to increase added value and increase product diversification.

Mocaf *(modified cassava flour)* has good development prospects because the raw materials are abundant, so there is very little chance of scarcity. Mocaf has a higher starch content than wheat flour, which ranges from 85-87 percent. This high starch content is directly proportional to the carbohydrate content, meaning mocaf also has a high carbohydrate content [9].

Crunchiness is an important physical property of flakes. The difference in amylose and amylopectin content in starch affects the crunchiness value of a product. To overcome the formation of flakes with hard texture and too compact, the flakes must be conditioned to be porous first by adding $NaHCO_3$ which can produce gas (CO_2) during the heating process so as to increase the growth and crispness of the product [3]. During the combustion process, the volume of gas along with the air and water vapor will be trapped into the dough, thus obtaining a porous structure and making the product crispy. The speed of releasing CO_2 will affect the texture of the product [10]. Starch also functions as a component that can bind and retain CO_2 produced in the form of dough [11].

1.2. Research Objective

The purpose of this research was to determine the effect of the treatment of the proportion of breadfruit flour and mocaf and sodium bicarbonate concentration on the physicochemical and organoleptic characteristics of the flakes produced and to determine the best treatment combination of the proportion of breadfruit flour and mocaf and sodium bicarbonate concentration on the quality of the flakes produced.

2. MATERIALS AND METHODS

2.1 Materials and Tools

The main ingredients used in this research are breadfruit, mocaf *(modified cassava flour)*, water, margarine, sugar, and salt from traditional markets in Sidoarjo, East Java. The chemical materials used for analysis flakes were petroleum ether, H_2SO_4 (*sulfuric acid*), H_2BO_3 *(boric acid)*, NaOH *(sodium hydroxide)*, HCl (*hydrochloric acid*, 0.02 N, 95% alcohol, K_2SO_4, *petroleum benzene*, *bromontesol green methyl*, and *distilled water*.

The tools used in this research include tools for processing and tools for analysis. Tools for processing include an oven, an 80 mesh sieve, a baking sheet, and disk mill. Tools for analysis include analytical balance, measuring flask, cabinet dryer, beaker glass, erlenmeyer, stirrer, measuring cup, funnel, petri dish, spray bottle, magnetic stirrer, filter paper, thermometer. The tools used in making flakes are scales, basins, stoves, pans, baking sheets, ovens, knives, weighing bottles, Soxhlet, ash cups, and kjedahl flasks.

2.2 Methodology

This research used a completely randomized design (CRD) factorial pattern with two factors and two replications. Factor I is the proportion of breadfruit flour and mocaf consisting of 10:90, 20:80, 30:70. Factor II is the concentration of sodium bicarbonate, namely 0.3%, 0.4%, 0.5%. If there is a significant difference, it will be continued with the DMRT 5% further test.

The samples in this study from the treatment of the proportion of breadfruit flour and mocaf and the addition of sodium bicarbonate concentration, obtained 9 samples from the combination of the two treatments :

A1B1 = Proportion of Breadfruit Flour and Mocaf 10 : 90 with Concentration of Sodium Bicarbonate ($NaHCO_3$) 0.3%
A1B2 = Proportion of Breadfruit Flour and Mocaf 10 : 90 with Concentration of Sodium Bicarbonate ($NaHCO_3$) 0.4%
A1B3 = Proportion of Breadfruit Flour and Mocaf 10 : 90 with Concentration of Sodium Bicarbonate ($NaHCO_3$) 0.5%
A2B1 = Proportion of Breadfruit Flour and Mocaf 20 : 80 with Concentration of Sodium Bicarbonate ($NaHCO_3$) 0.3%
A2B2 = Proportion of Breadfruit Flour and Mocaf 20 : 80 with Concentration of Sodium Bicarbonate ($NaHCO_3$) 0.4%
A2B3 = Proportion of Breadfruit Flour and Mocaf 20 : 80 with Concentration of Sodium Bicarbonate ($NaHCO_3$) 0.5%
A3B1 = Proportion of Breadfruit Flour and Mocaf 30 : 70 with Concentration of Sodium Bicarbonate ($NaHCO_3$) 0.3%

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A3B2 = Proportion of Breadfruit Flour and Mocaf 30 : 70 with Concentration of Sodium Bicarbonate ($NaHCO_3$) 0.4%
A3B3 = Proportion of Breadfruit Flour and Mocaf 30 : 70 with Concentration of Sodium Bicarbonate ($NaHCO_{35}$) 0.3%

The data obtained were processed using Analysis of Variance (ANOVA) and continued with Duncan's Multiple Range Test (DMRT) to determine the differences between treatments. The results of all tests were analyzed using the De Garmo method to determine the product with the best treatment results.

2.3 Flakes Making

Prepare raw materials that have been weighed in the proportion of breadfruit flour and mocaf (10:90; 20; 80; 30:70) and other supporting ingredients, namely margarine 5% (w/b), sugar 15% (w/b), salt 3% (w/b), water 40% (v/b), and sodium bicarbonate (0.3%; 0.4%; 0.5% (v/b)). Then mix all the dough and knead until homogeneous for 15 minutes. Flatten the dough with a thickness of 1mm and cut it into a size of 3x2cm^2 then lay it out on a baking sheet. The flakes dough was then baked using an oven at 135°C for 25 minutes.

2.4 Research Analysis

2.4.1. Raw Material Evaluation

The raw material analyzed was breadfruit flour and mocaf. The analysis included moisture, ash, fat, protein, carbohydrate, and starch (AOAC 1995).

2.4.2. Physicochemical Evalution of Flakes

Parameters analyzed include moisture, ash, fat, protein carbohydrate, starch, and rehydration power (AOAC 1995)..

2.4.3 *Evaluation Sensory of Flakes*

The sensory characteristics selected to evaluate the quality of flakes include aroma, taste, color, and crunchiness. Data analysis included the use of the scoring test. A total of 25 panelists were assigned to rate the acceptability of the product using a 5-point scale.

3. RESULT AND DISCUSSION

3.1 Raw Material Analysis

Analysis of raw materials in this research was carried out on on breadfruit flour and mocaf. The results of raw material analysis can be seen in **Table 1.**

Table 1. Chemical Composition of breadfruit flour and mocaf

Analysis	Breadfruit Flour (%)	Literatur (%)	Mocaf (%)	Literatur (%)
Moisture	9.83	12.36	8.52	9.84
Ash	3.39	4.54	0.38	0.4
Fat	1.64	1.77	0.50	0.4-0.8
Protein	4.85	3.50	2.79	1.93
Carbohydrate	80.61	76.05	88.67	84.12
Starch	77.98	77.48	81.07	78.27-85.63

Based on **Table 1,** it is known that breadfruit flour has a moisture content of 9.83%, ash of 3.39%, fat of 1.64%, protein of 4.85%, carbohydrate of 80.61%, and starch of 77.98%. However, based on the results of this research, there are some discrepancies with previous literature. In the analysis of mocaf, it was found that the flour in this research had a moisture content of 8.52%, ash content 0.38%, fat content 0.50%, protein content 2.79%, carbohydrate content 88.67%, and starch content 81.07%. Differences in the results of the analyses compared to those in the literature can be caused by several factors, such as differences in harvest age, shelf life, and the location and soil conditions where the breadfruit and cassava used as raw materials for making the flours grow

3.2 Physicochemical Analysis of Flakes

3.2.1. Moisture Content

The average total moisture content of flakes ranged from 3.35-3.84%. The highest moisture content of flakes was 3.84% in the treatment of the proportion of breadfruit flour and mocaf (30:70) and 0.5% sodium bicarbonate concentration, while the lowest moisture content was obtained at 3.35% in the treatment of the proportion of breadfruit flour and mocaf (10:90) and 0.3% sodium bicarbonate concentration. Differences in moisture content can be caused by the use of different types of flour. Breadfruit flour has a higher initial moisture content (9.83%) than mocaf (8.42%). The water content of breadfruit flour according to the results of research by [12] is 12.36%, while the water content of mocaf, according to the results of research by [13] is 9.04%. In this research, it has met the Indonesian National Standard, namely the moisture content in flakes is a maximum of 4%, so all treatments in this research fulfill the Indonesian National Standart.

3.2.2. Ash Content

Based on the results, the average total ash content of flakes ranged from 2.51-2.77% (Table 2). The highest ash content of flakes was 2.77% in the treatment of the proportion of breadfruit flour and mocaf (30:70) and 0.5% sodium bicarbonate concentration, while the lowest ash content was obtained at 2.51% in the treatment of the proportion of breadfruit flour and mocaf (10:90) and 0.3% sodium bicarbonate concentration. The ash content of breadfruit flour was higher than that of mocaf. This is due to breadfruit flour, which has a higher ash content than mocaf. The ash content of breadfruit flour, according to Ref. [14], was found to be 4.54%. The high content is closely related to the mineral content. [15] reported that breadfruit flour contains several minerals such as calcium (58.8 mg/100g), phosphorus (165.2 mg/100g), and iron (1.1 mg/100 g). In this research, it has met the Indonesian National Standard, namely the ash content in flakes is a maximum of 4%, so all treatments in this research fulfill the Indonesian National Standard.

Table 2. Physicochemical Characteristics of Flakes

Samples	Moisture (%)	Ash (%)	Fat (%)	Protein (%)	Carbohydrate (%)	Starch (%)	Rehydration Power (%)
A1B1	$3.35^{a}\pm0.000$	$2.51^{a}\pm0.078$	$1.48^{a}\pm0.014$	$2.74^{a}\pm0.021$	$88.66^{g}\pm0.035$	$80.05^{e}\pm0.226$	$119.10^{c}\pm0.191$
A1B2	$3.41^{a}\pm0.007$	$2.54^{a}\pm0.028$	$1.50^{a}\pm0.014$	$2.92^{b}\pm0.049$	$87.98^{f}\pm0.177$	$79.89^{e}\pm0.339$	$125.89^{e}\pm0.042$
A1B3	$3.42^{b}\pm0.014$	$2.55^{a}\pm0.028$	$1.55^{b}\pm0.014$	$2.93^{b}\pm0.035$	$87.93^{f}\pm0.403$	$79.39^{d}\pm0.233$	$128.96^{g}\pm0.042$
A2B1	$3.46^{b}\pm0.028$	$2.60^{a}\pm0.007$	$1.62^{c}\pm0.007$	$3.52^{c}\pm0.071$	$87.70^{e}\pm0.028$	$78.30^{c}\pm0.071$	$117.52^{b}\pm0.693$
A2B2	$3.48^{c}\pm0.057$	$2.63^{b}\pm0.014$	$1.67^{d}\pm0.014$	$3.81^{d}\pm0.085$	$87.22^{d}\pm0.431$	$78.58^{c}\pm0.049$	$125.32^{e}\pm0.608$
A2B3	$3.61^{d}\pm0.007$	$2.68^{c}\pm0.071$	$1.68^{d}\pm0.014$	$3.97^{e}\pm0.021$	$86.12^{a}\pm0.247$	$78.42^{c}\pm0.014$	$128.19^{f}\pm0.438$
A3B1	$3.67^{e}\pm0.014$	$2.66^{c}\pm0.014$	$1.72^{e}\pm0.014$	$4.30^{f}\pm0.071$	$86.72^{c}\pm0.057$	$77.70^{b}\pm0.071$	$112.53^{a}\pm0.735$
A3B2	$3.71^{e}\pm0.028$	$2.66^{c}\pm0.042$	$1.81^{f}\pm0.007$	$4.64^{g}\pm0.064$	$86.59^{b}\pm0.064$	$76.49^{a}\pm0.028$	$123.79^{d}\pm0.049$
A3B3	$3.84^{f}\pm0.007$	$2.77^{d}\pm0.021$	$1.82^{f}\pm0.014$	$5.41^{h}\pm0.014$	$85.91^{a}\pm0.057$	$76.34^{a}\pm0.021$	$127.33^{f}\pm0.304$

3.2.3. Fat Content

Based on the results, flakes' average total fat content ranged from 1.48-1.82%. The highest fat content of flakes was 1.82% in the treatment of the proportion of breadfruit flour and mocaf (30:70) and 0.5% sodium bicarbonate concentration. In comparison, the lowest fat content was 1.48% in treating the proportion of breadfruit flour and mocaf (10:90) and 0.5% sodium bicarbonate concentration. The high-fat content influences this in breadfruit flour; the higher the addition of breadfruit flour, the higher the fat content contained in the flakes. However, this range is considered low, which can be caused by the low-fat content in the ingredients that make up the flakes. According to [12], the fat content of breadfruit flour is 1.77%.

Meanwhile, in mocaf, according to Ref. [16], the fat content of mocaf was 0.4-0.8%. The fat value of flakes does not comply with the Indonesian National Standard, which is at least 7%. The low-fat content of the flakes can be improved by brewing them with milk rich in fat when consumed.

3.2.4. Protein Content

Based on the research, flakes' average total protein content ranged from 2.74-5.41%. The highest protein content of flakes was 5.41% in the treatment of the proportion of breadfruit flour and mocaf (30:70) and 0.5% sodium bicarbonate concentration, while the lowest protein content was obtained at 2.74% in the treatment of the proportion of breadfruit flour and mocaf (10:90) and 0.3% sodium bicarbonate concentration. Based on the results of protein content analysis, it is known that the protein content of breadfruit flour is higher than mocaf flour. The average protein content of breadfruit flour was 4.85% and that of mocaf was 2.79%. This result is not much different from the results of research by [17], that the protein content of breadfruit flour is 3.50%. Meanwhile, in mocaf flour, according to the results of research by [18], which states that the protein content of mocaf is 1.93%. Based on the Indonesian National Standard, the quality requirement for protein content in flakes is at least 5%, so the treatment of the proportion of breadfruit flour and mocaf (30:70) and 0.5% sodium bicarbonate concentration, namely 5.41%, has met the Indonesian National Standard.

3.2.5. Carbohydrate Content

Based on research, the average total carbohydrate content of flakes ranged from 85.91-88.66%. The highest carbohydrate content of flakes was 88.66% in treating the proportion of breadfruit flour and mocaf (10:90) and 0.3% sodium bicarbonate concentration. In comparison, the lowest carbohydrate content was 85.91% in treating the proportion of breadfruit flour and mocaf (30:70) and 0.5% sodium bicarbonate concentration. The use of different types of flour can cause a difference in levels. Breadfruit flour has a lower initial carbohydrate content (80.61%) than mocaf (88.67%). The carbohydrate content of breadfruit flour obtained from the research was 76.05%. Meanwhile, in Mocaf, according to [13], the carbohydrate content of mocaf is 84.12%. Based on the Indonesian National Standard, the quality requirement for flake carbohydrate content is at least 60%, so all treatments of the proportion of breadfruit flour and mocaf flour and the concentration of sodium bicarbonate have met the Indonesian National standards.

3.2.6. Starch Content

Based on research, the average total starch content of flakes ranged from 76.34-80.05%. The highest starch content of flakes was 80.05% in the treatment of the proportion of breadfruit flour and mocaf (10:90) and 0.3% sodium bicarbonate concentration, while the lowest carbohydrate content was 85.91% in the treatment of the proportion of breadfruit flour and mocaf (30:70) and 0.5% sodium bicarbonate concentration. The processing process causes starch degradation. Starch, which consists of amylose and amylopectin, will affect the high and low levels of starch produced. Starch, especially amylopectin content, stimulates the development process (puffin), so flakes derived from starch with high amylopectin content will be crisp and crunchy. High amylopectin can give high crispness and low hardness to products compared to high amylose content [19].

3.2.7. Rehydration Power

Based on research, the average total rehydration power of flakes ranged from 112.53-128.96%. The highest rehydration power in flakes was 128.96% in the treatment of the proportion of breadfruit flour and mocaf (10:90) and 0.5% sodium bicarbonate concentration, while the lowest rehydration power was obtained at 112.53% in the treatment

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of the proportion of breadfruit flour and mocaf (30:70) and 0.3% sodium bicarbonate concentration. Rehydration power is the absorption of water. The high and low rehydration power is influenced by starch content, one of which is amylose and amylopectin and with the concentration of sodium bicarbonate, it will cause the opening of pores in the flakes so that water will enter more easily, this causes high rehydration power. Rehydration capacity is influenced by several things, including water content, amylose content in starch, and material components. Rehydration capacity is the ability to bind water through hydrogen bonds expressed as the ratio of noodle weight before and after rehydration [20]. The higher the starch content in the ingredients, the faster the starch gelatinization and water absorption. Rehydration power increases with the increasing number of hydroxyl groups in starch.

3.3. Sensory Analysis Flake

3.3.1. Color

The average scoring value of descriptive panellist assessment of flakes color parameters is between 3.36-4.00. The scoring value states that the flakes product has a slightly yellow to yellow color appearance. The highest scoring average value of flakes was shown in the treatment of the proportion of breadfruit flour and mocaf (20:80) and sodium bicarbonate concentration (0.5%), namely 4.00 (brownish yellow). In comparison, the lowest scoring average value was shown in the treatment of the proportion of breadfruit flour and mocaf (30:70) and sodium bicarbonate concentration (0.5%), namely 3.36 (slightly brownish yellow) (Table 3). The comparison of the concentration of breadfruit flour and mocaf used in making flakes does not affect the color of the flakes. The color of the flakes produced is slightly brownish because the flour influences the amount of flour added and the cooking process. This is supported by research [10], the brownish color formed on the flakes can be caused by the Maillard reaction during baking in the oven. The Maillard reaction is browning because reducing sugars react with compounds containing NH2 in hot conditions, which is also caused by the caramelization process.

Table 3. Sensory test result of Flakes

Samples	Colour	Aroma	Taste	Crunchiness
A1B1	3.76^a±0.879	3.20^a±0.645	3.44^a±0.879	3.68^a±0.945
A1B2	3.84^b±0.898	3.44^a±0.583	3.68^a±0.898	3.76^b±0.970
A1B3	3.60^a±0.957	3.80^c±0.500	3.80^b±0.957	4.16^c±0.746
A2B1	3.48^a±0.936	3.40^a±0.577	3.76^b±0.936	3.80^b±0.957
A2B2	3.72^b±0.936	3.48^a±0.510	3.92^c±0.936	3.92^b±0.997
A2B3	4.00^c±0.957	3.64^b±0.638	4.24^c±0.957	3.72^b±0.980
A3B1	3.76^b±0.831	3.52^b±0.653	3.56^b±0.831	3.24^a±0.926
A3B2	3.80^b±0.866	3.60^b±0.500	3.68^b±0.866	3.64^a±0.907
A3B3	3.36^a±0.952	3.48^a±0.510	3.24^a±0.952	3.52^a±0.963

3.3.2. Aroma

The average scoring value of descriptive panelist assessment of flakes aroma parameter was between 3.20-3.80. The scoring value states that the flakes product has a mild aroma. The highest scoring average value of flakes aroma was shown in the treatment of the proportion of breadfruit flour and mocaf (10:90) and the concentration of sodium bicarbonate (0.5%), which was 3.80 (mild), while the lowest scoring average value was shown in the treatment of the proportion of breadfruit flour and mocaf (10:90) and the concentration of sodium bicarbonate (0.3%), which was 3.20 (mild). This is supported by research [21], aroma is one of the sensory measurement tools that is often used to determine the quality of food products, whether it is good taste, fragrance, or rancidity, because aroma also determines consumer acceptance of food

3.3.3. Taste

The average scoring value of descriptive panelist assessment of flakes taste parameter was between 3,24-4,24. The scoring value states that the flakes product has a mildly savory to savory taste. The highest average scoring value of flakes was shown in the treatment of the proportion of breadfruit flour and mocaf (20:80) and sodium bicarbonate concentration (0.5%), namely 4.24 (savory), while the lowest average scoring value was shown in the treatment of the proportion of breadfruit flour and mocaf (30:70) and sodium bicarbonate concentration (0.5%), namely 3.36 (mildly savory). Based on the results of the organoleptic test on the taste of flakes, it shows that the treatment of making flakes in the proportion of breadfruit flour and mocaf and the concentration of sodium bicarbonate has a significant effect on the taste of the product. This is supported by research [22], due to the nature of starch granules that undergo hydrolysis, which will produce monosaccharides as raw materials to produce organic acids that will mix with flour, which, if processed into products will create a flavor that covers cassava.

3.3.4. Crunchiness

The average scoring value of descriptive panellist assessment of flakes' crunchiness parameter was between 3.24-4.16. The scoring value states that the flakes product has a crispy crunch. The highest scoring average value of flakes crispness was shown in the treatment of the proportion of breadfruit flour and mocaf (10:90) and the concentration of sodium bicarbonate (0.5%), namely 4.16 (crunchy). In comparison, the lowest scoring average value was shown in the treatment of the proportion of breadfruit flour and mocaf (30:70) and the concentration of sodium bicarbonate (0.3%), namely 3.24 (slightly crunchy). This is because sodium bicarbonate can produce gas (CO_2) during the heating process to increase the product's growth and crispness. This is also supported by the research [3]. The CO_2 gas produced will fill the cavities formed from the bond between starch and water, so that it expands more, thus the flakes produced are crunchy. The cavities formed in food products will affect the fracture power formed.

4. CONCLUSION

The best treatment is the proportion of breadfruit flour and mocaf (20:80) and the concentration of sodium bicarbonate 0.4%, namely with a moisture content of 3.48%, ash content 2.63%, fat content 1.67%, protein content 3.81%, carbohydrate content 87.22%, starch content 78.58%, rehydration power 125.32% and organoleptic value which includes color 3.72 (Slightly yellow), aroma 3.48 (Slightly languish), taste 3.92 (Slightly savory) and crispness 3.92 (Slightly crunchy).

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REFERENCE

[1] Dennisa Alfora, Erika Saori, Lutfiah Nur Fajriah. 2023. Pengaruh Konsumsi Makanan Cepat Saji Terhadap gizi Remaja. Jurnal Ilmiah Kesehatan.. Vol 2 No. 1.

[2] Aprilia Nurhidayanti, Sari Astina Dewi dan Narsih. 2017. Pembuatan Flakes Dengan Variasi Tepung Gandum dan Tepung Kelapa Dalam Upaya Peningkatan Mutu Flakes. Jurnal Teknologi Pangan Vol 8 (2): 163-170.

[3] Purnamasari, I. W., dan Putri, W. D. R. 2015. Pengaruh Penambahan Tepung Labu Kuning dan Natrium Bikarbonat Terhadap Karakteristik Flakes Talas. Jurnal Pangan dan Agroindustri. 3 (4): 1375-1385

[4] Chassagne-Berces, S., Leitner, M., Melado, A., Barreiro, P., Correa, E.C., Blank, I., Gumy, J., Chanvrier, H. 2011. Procedia Food Science 1 (2011) 17 – 23. DOI: 10.1016/j.tifs.2012.06.008.

[5] Agustia, F.C., Rukmini, H.S., Naufalin, R. 2016a. Utilization of pregerminated jackbean and soybean for increasing the protein content of instant tiwul. Proceeding. 162-169. ISBN : 978- 602-61032-1-5. Page 163-169

[6] Febrianty,K., Widyaningsin T.D., Wijayanti, S.D., Nugrahini N.I.P., Maligan J.M. 2015. Pengaruh proporsi tepung (ubi jalar terfermentasi : kecambah kacang tunggak) dan lama perkecambahan terhadap kualitas fisik dan kimia flake. Jurnal Pangan dan Agroindustri Vol. 3 No 3p.824-834.

[7] Matz, A. Samuel. 2005. The Chemistry and Technology of Cereal As Food and Feed, Second Edition, Van Nostrand Reinhold, New York.

[8] Mishartina, Ansarullah, Nur Asyik. 2018. Pengaruh Formulasi Breakfast Flakes Berbahan Baku Ubi Jalar Putih *(Ipomoea batatas L)* dan Kacang Merah *(Phaseolus vulgaris L)* Terhadap Penilaian Organoleptik dan Fisikokimia. Jurnal Sains dan Teknologi Pangan. Vol. 3, No.2, P. 1221-1236

[9] Widasari, M dan Handayani. 2014. Pengaruh proporsi terigu-mocaf (modified cassava flour) dan penambahan tepung tepung formula tempe terhadap hasil jadi flake. E-journal Boga, Volume 3. Nomor 3. Periode Oktober 2014, hal 222-228.

[10] Winarno, F. G. 2008. Ilmu Pangan dan Gizi. Jakarta : Gramedia Pustaka Utama

[11] Hadi, S.R., Juswono, U.P., dan Widodo, C.S. 2013. Pengaruh Bengkuang *(Pachyrhizus erosus L. Urban)* dan Lidah Buaya *(Aloe vera)* Terhadap Kandungan Radikal Bebas Pada Daging Ayam yang Diradiasi dengan Sinar Ultraviolet. Malang: Universitas Brawijaya

[12] Wa Rasyita, La Karimuna, R. F. F. 2024. Karakteristik fisikokimia tepung sukun *(Artocarpus altilis L.)* asal Buton dan aplikasi terhadap cake. 49(2), 2131–2147

[13] Delvi Sembiring, Ni Wayan Wisaniyasa, Anak Agung Istri Sri Wiadnyani. 2023. Pengaruh Perbandingan Mocaf *(Modified Cassava Flour)* Dan Tepung Kecambah Kacang Merah *(Phaseolus vulgaris L.)* Terhadap Karakteristik Flakes. Jurnal Ilmu dan Teknologi Pangan. Itepa 12 (3) 2023 693-706. ISSN : 2527-8010

[14] Ketut Ayurina Singarsari Diasaputri, Ni Nyoman Puspawati, Putu Suparthana. 2023. Pengaruh Proporsi Terigu dan Tepung Sukun *(Artocarpus altilis)* terhadap Karakteristik Brownis Panggang. Jurnal Ilmu dan Teknologi Pangan. Itepa 12 (4) 2023 1114-1124. ISSN : 2527-8010

[15] Hasan, L., Nikmawatisusanti, Y., dan Luman, M. 2014. Pengaruh Penambahan *Kappaphycus alvarezii* terhadap Karakteristik Organoleptik dan Kimiawi Kue Tradisional Semprong. Jurnal Ilmiah Perikanan dan Kelautan [online], 2 (3): 107-114.

[16] Sunarsi, S., A. M. Sugeng., S. Wahyuni., dan W. Ratnaningsih. 2011. Memanfaatkan singkong menjadi tepung mocaf untuk pmberdayaan masyarakat sumberejo. Prosiding. 5(3): 306-310.

[17] Ronald Surachman, I Nengah Kencana Putra, A. A. Istri Sri Wiadnyani. 2022. Pengaruh Perbandingan Terigu dan Tepung Sukun *(Artocarpus altilis)* Terhadap Sifat Fisiko-Kimia dan Sensoris Bolu Kukus. Jurnal Ilmu dan Teknologi Pangan. Itepa 11 (2). ISSN : 2527-8010

[18] Ika Gusriani. Hidayat Koto. Yusril Dany. 2021. Aplikasi Pemanfaatan Tepung Mocaf *(Modified Cassava Flour)* Pada Beberapa Produk Pangan Di Madrasah Aliyah Mambaul Ulum Kabupaten Bengkulu Tengah. Jurnal Inovasi Pengabdian Masyarakat Pendidikan. Volume 2, Nomor 1. P-ISSN: 2774-6194

[19] Supriyadi, D. 2012. Studi Pengaruh Rasio Amilosa-Amilopektin dan Kadar Air Terhadap Kerenyahan dan Kekerasan Model Produk Gorengan. Skripsi. Fakultas Teknologi Pertanian. Institut Pertaniaan Bogor. Bogor

[20] Pradana, Adita, A. 2014. Pembuatan Mie Kering dengan Substitusi Tepung Daun Mangga (Kajian Penambahan Telur Terhadap Kualitas Mie Kering). Skripsi Universitas Pembangunan Nasional "Veteran" Jawa Timur.

[21] Dewayanthi, 1997 dalam Irma Susantia, Enny Hawani Lubisa dan Shilvi Meilidayani, 2017. Flakes Sarapan Pagi Berbasis Mocaf dan Tepung Jagung. Journal of Agro-based Industry Vol.34 (No.1) 07 2017: 44-52

[22] Khasanah, Anggriani. 2010. Formulasi karakteristik fisiko-kimia dan organoleptik produk makanan sarapan ubi jalar *(Sweet potato flakes)*. Skripsi. Fateta-IPB. Bogor.