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Ratio Effect of Breadfruit Flour and Wheat Flour on Cookies Characteristics

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Abstract

Cookies are dried and sweet food products made from wheat flour, fat, and sugar baked with dried texture and less than 5% moisture content. The flour used in this study was substituted by breadfruit flour as an attempt to reduce the amount of wheat flour consumption also utilizes native crops. The purpose of the study was to determine the right ratio of breadfruit flour and wheat flour to get the best characteristics of cookies. The study was done at Food Processing Lab and Chemistry Lab of Ma'soem University which was conducted in 2022 on September to October. The method used in this study was Randomized Block Design (RBD) with 5 repetitions and 5 treatments. The criteria tested were organoleptic (color, aroma, texture, flavour), chemical properties (water content, carbohydrate content, calories value of cookies). The result indicated that ratio between breadfruit flour and wheat flour effected the water content, carbohydrate content, calories, aroma, texture, and flavor of cookies. The best characteristic of cookies made from treatment C (45:55) based on water content and carbohydrate content.

Keywords: Breadfruit Flour; Cookies; Ratio; Wheat Flour

1. Introduction

Breadfruit is a multipurpose tree crop that is primarily used for its nutritious, starchy fruit. It is the main staple crop in many areas of the Pacific and supplements other staple foods for home consumption elsewhere. It generally has little commercial use but is becoming an export crop in the Caribbean. In 100 g of breadfruit (approximately ½ cup) provides 25% of the RDA for fiber, and 5–10% of the RDA for protein, magnesium, potassium, phosphorus, thiamine (B1), and niacin (B3). Breadfruit also provides some carotenoids, such as β-carotene and lutein, which are not present in white rice or white potato (Ragone, 2014).

Breadfruit is one of the climacteric fruits which need a handling process to avoid rotten and quality deterioration. Breadfruit is a potential source of energy. Therefore, it is necessary to find a method to maximize breadfruit potency. In food technology, the method is the right process that change raw material onto intermediate product with long-term storage.

According to Ragone, (2014), another way to use breadfruit is to peel and core the raw fruit, shred or slice it into thin pieces, then dry and grind into a meal or flour. The coarse meal can substitute for panko or breadcrumbs. Since the flour is gluten free, it will not rise or have the elasticity of wheat flour, but can be used like other gluten-free flours.

Breadfruit has the potential to be used for a wide range of food applications for local use and export. It can be consumed boiled, baked, roasted, pickled, steamed or fried (Jones et al., 2011). However, it has short shelf-life as fruit ripens in 1 to 3 days followed by rapid starch deterioration after a week. Soft and over-ripened breadfruits are undesirable for consumption which leads to substantial loss. Cold storage can prolong shelf life and firmness for only a few more weeks (Worrell et. al., 2002).

Breadfruit is also processed to starch and flour. Breadfruit flour products continue to expand and complement existing and potential markets for the fresh or processed fruit. According to Nochera & Ragone, (2016), with the emerging health challenges, there is a need to develop more convenient, nutritious.

Flour production is one of the methods to lengthen the storage time of breadfruit. Breadfruit so far is only used for raw material in chip making, and cooked directly by frying or steaming at home. Therefore, making breadfruit onto flour is a way give an added value.

Cookies is one of products which use wheat flour as the main raw material. In Indonesia wheat flour is imported from other country. Wheat flour as raw material in food production so far is not able be replaced by another material.

However, wheat flour can be substituted by other flour such as breadfruit flour in order to reduce the dependency on wheat flour and to contribute the national diversification program. This program is an effort initiated by the government to increase the availability and consumption from various food based on local natural resources.

Based on this description before, the issue raised in this study is how to determine the right ratio of breadfruit flour and wheat flour in order to produce the best characteristic cookies base on moisture content, carbohydrate content, calories, aroma, texture, and flavor of cookies.

2. Literature Review

Breadfruit is a traditional staple crop from Pacific islands with the potential to improve worldwide food security and mitigate diabetes. Flour produced from breadfruit is a gluten-free, low glycemic index, nutrient dense and complete protein option for modern foods but basic scientific knowledge of health impacts of a breadfruit-based diet in animals and humans was lacking (Liu et al., 2020).

Breadfruit can be processed into several products, one of them is Breadfruit flour. The processing of breadfruit to become breadfruit flour is not only able to improve its economic value, but it can also increase the timespan of breadfruit consuming duration. Another benefit of breadfruit processing is it does not contain gluten, so, it can be consumed by autistics (Sukandar et al., 2021).

One of the main concerns in producing breadfruit flour is the drying procedure. The purpose of drying is inhibiting the fermentation process, the growth of bacteria and fungi. In addition, it also slows down the chemical changes in food (Gunasekaran et al., 2012).

3. Materials and Methods

3.1. Materials

This study was conducted at The Food Processing Laboratory and Chemistry Laboratory Faculty of Agriculture Ma'soem University in Sumedang from March to June 2022. The Randomized Block Design was applied in this study with 5 treatments and 5 repetitions. The treatments were ratio breadfruit and wheat flour 65:35 (A), 55:45 (B), 45:55 (C), 35:65 (D), and 25:75 (E).

Cookies Making Procedure

Wet stuff; granulated sugar (75g), palm sugar (30g), egg (55g), butter (110g) and vanilla paste (1,2g) were mixed and added by drying stuff; breadfruit flour and wheat flur (totally 200g) and baking soda (0,4g). Dough was formed each 16,5g and baked in electrical oven at 160^{o}C as long as 35 minutes.

3.2. Methods

3.2.1. Determination of Moisture Content

This procedure follows the National Standard of Indonesia (SNI); take a petri dish with its cover and put it into a drying oven (130^{o}C), heat for 1.0h. Cool in the desiccator for 0.5h before weighing (W_0). Take 2g of sample, put in on petri dish, cover it up, and weigh (W_1). Put sample in petri dish without its cover into oven and dry (130^{o}C) for 1.0h. Cover up petri dish while still in the oven, put it in desiccator, cool for 0.5h and weigh (W_2). Moisture content in the sample is calculated in accordance with formula:

$$X = \frac{W_1 - W_2}{W_1 - W_0}$$

Where X the moisture content in the sample, the unit is g/100g

3.2.2. Determination of Carbohydrate Content

This procedure based on the National Standard of Indonesia (SNI) and follows the Luff Schoorl Method; Put 5g of sample into erlenmeyer flask, add 200ml HCL 3%, refluxed for 3h with leibig condenser. The solution neutralized by NaOH 30%, add a little bit of CH3COOH 3% so that the solution is slightly acidic. The solution moved into 500ml volumetric flask, compressed, homogenized then filtered. Filtrate pipetted 10ml, put into erlenmeyer flask, add 25ml Luff Schoorl solution, some boiling stone and distilled water. Final solution heat on stable flame for 3 minutes, continue for the next 10 minutes. The solution cool with ice. Add 15ml KI 20% and 25ml H_2SO_4 25% slowly. The solution titrated by $Na_2S_2O_3$ 0,1N. Do also the blank.

1. Determine volume Na_2SO_3:
   $$V_{IOP}\ (ml) = V_{blank} - V_{titration} \times \frac{N_{IOP}}{0{,}1N}$$
2. Use the Luff Schoorl Table to find out mg of sugar for V_{IOP}.
3. Determine glucose content:

$$\text{Glucose content} = \frac{W_1 x\ df}{W} \times 100\%$$

4. Determine carbohydrate content
   Carbohydrate content (%) = 0,90 x glucose content
   Where:
   W = sample (mg)
   W_1 = glucose for ml of IOP used (mg)
   df = dilution factor
   IOP = Intraocular pressure (ml)

3.2.3. The amounts of calories

The amounts of calories measured manually based on table of Data of Indonesian Food Composition. Cookies energy calculation can be carried out as follow:

1. Carbohydrate, protein and fat summated (mg) according to the amount of material used in experiment.
2. Convert into kcal or cal. Every 1g of carbohydrate or protein multiplied by 4, while 1g of fat multiplied 9.
3. The formula is:

Total of energy (Cal) = total of carbohydrate + total of protein + total of fat

$$\text{Cookies energy per piece} = \frac{\text{Total of Energy}}{\text{Total piece of cookies}}$$

3.2.4. The organoleptic test

The organoleptic test involved aroma, texture, and flavor of cookies according hedonic scale rating (1=dislike extremely, 2=dislike, 3=neutral, 4=like, 5=extremely like) (Lawless & Heymann, 2010).

3.2.5. Statistical Analysis

Statistically data were analyzed by The Analysis of Variance (ANOVA) (Judd et al., 2017). The hypothesis is as follows.

If F statistic > F-value the H_1 is true, and the H_0 is rejected.

When the result showed significant effect, then will be analyzed by The Duncan's Multiple Range Test (DMRT) (Yu & Chung, 2021) with the formula:

$$LSR = SSR \times S_x$$

Where:
LSR = Least Significant Range
SSR = Studentized Significant Range
S_x = Standard Error

4. Results and Discussion

The result of the study showed that ratio of breadfruit flour and wheat flour effected the characteristics of cookies.

Table 1: The Effect of Breadfruit Flour and Wheat Flour Ratio on the Characteristics of Cookies

Parameters	Treatments (Breadfruit Flour : Wheat Flour)				
	A (65:35)	B (55:45)	C (45:55)	D (35:65)	E (25:75)
Moisture content (%)	2.63[a]	3.11[a]	3.97[b]	4.86[bc]	5,45[c]
Carbohydrate content (%)	76.03[e]	74.96[d]	71.30[c]	68.69[b]	63.05[a]
Color	3.42[a]	3.54[a]	3.56[a]	3.68[a]	3.68[a]
Aroma	2.38[a]	2.93[b]	3.35[bc]	3.88[cd]	4.12[d]
Texture	2.65[a]	2.96[a]	3.94[b]	3.85[b]	3.77[b]
Flavor	2.47[a]	3.02[b]	3.86[c]	4.08[cd]	4.41[d]
Calories (/pcs)	70.20	70.21	70.21	70.22	70.22

4.1. Moisture Content

Based on the statistical analysis, breadfruit flour and wheat flour ratio gave significant effect to moisture content. The A treatment produced the lowest moisture content (2.63%) while the E treatment produced the highest moisture content (5.45%). The moisture content followed the decrease of wheat flour ratio, because the protein content would be decrease too. In food protein bonds with H_2O, so if the protein lower then the water content will be lower too.

4.2. Carbohydrate Content

Based on the statistical analysis breadfruit flour and wheat flour ration gave real effect to carbohydrate content. According to SNI, cookies carbohydrate content that accordance with terms and quality is at least 70%. In the table 2 above, it can be seen that the highest carbohydrate content (76.03%) is obtained by treatment A, while the lowest (63.05%) is obtained by treatment E. Carbohydrate concentrate increases with the increase of the breadfruit flour ratio. The carbohydrate content in breadfruit flour 11.05% superior to the carbohydrate content of wheat flour.

4.3. Color

Color is the first sensory attribute that can be assessed directly by the panelists. Based on the statistical analysis in table 2, the ratio between breadfruit flour and wheat flour does not influence cookie's color. The color of the cookies is generated from the composition and processing technique. Breadfruit flour itself has a distinctive brownish color that is caused by contact between air and the polyphenol content in breadfruit during the process.

4.4. Aroma

Aroma is a sensation caused by chemical stimuli smelled by the olfactory nerves in the nasal cavity. Based on the statistical analysis, ratio between breadfruit flour and wheat flour gave different effects on the aroma of the cookies. In table 2 it can be seen that the lowest levels of preference (2.38) is obtained by treatment A while highest levels of preference (4.12) is obtained by treatment E. The higher breadfruit ratio decreases the level of preference. It is caused by the unpleasant aroma in breadfruit flour. Aroma is the difference between breadfruit flour and wheat flour. Furthermore, the breadfruit aroma can’t be erased.

4.5. Texture

The expected cookie’s texture is crunchy and crumbly. In the table 2 it can be seen that the lowest texture preference score (2.65) is obtained by treatment A while highest texture preference score (3.94) is obtained by treatment C. The higher breadfruit flour ratio, the harder and denser the cookie’s texture. Breadfruit flour ratio decrease makes the cookie’s texture softer and less liked by panelists.

4.6. Taste

Table 1 shows that panelists prefer treatment E with the highest average score (4.41) and treatment A received the lowest average score (2.47). The preference score for taste decreases as breadfruit flour ratio increases. It is because breadfruit flour gave a bitter taste as breadfruit ratio increases.

4.7. Calories

Based on the data and calculation, the ratio between breadfruit flour and wheat flour is not different in terms of total calories. Can be seen in table 2 that lowest total calories obtained by A treatment (70.20). It is because breadfruit flour has less protein and fat than wheat flour.

5. Conclussion

Based on the result the ratio between breadfruit flour and wheat flour has different effects on water content, carbohydrate content, aroma, texture, and breadfruit taste. Ratio of treatment C (45:55) produces the best characteristics of cookies, with the highest texture preference score, water content and carbohydrate content according to National Standard of Indonesia.

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