Cookies from composite flour and starch (mocaf, breadfruit flour, orange sweet potato flour, breadfruit starch and orange sweet potato starch)

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Abstract. The physicochemical and sensory characteristics of cookies produced from mocaf, breadfruit flour, orange sweet potato flour, breadfruit starch and orange sweet potato starch, with several ratio were studied by us. Using non factorial completely randomized design with six controls (100% wheat flour, 100% mocaf (control 2); 100% breadfruit flour (control 3); 100% orange sweet potato flour (control 4); 100% breadfruit starch (control 5); and 100% orange sweet potato starch (control 6) and seven comparasions of mocaf (M): breadfruit flour (BF): orange sweet potato flour (OF): breadfruit starch (BS): orange sweet potato starch (OS). The results showed that cookies with the best quality was cookies from the mocaf ratio: breadfruit flour: orange sweet potato flour: breadfruit starch: orange sweet potato starch 70:10:10:5:5.

1. Introduction
Cookies (pastries) are snacks made from low protein flour. The process of making cookies is baked until hard but still crunchy to eat. Common ingredients used in making cookies include flour, milk powder, eggs, sugar, margarine, salt, and baking materials. Other Indonesia’s need for wheat flour consumption as a food ingredient continues to increase from year to year. The result is the high imports of wheat flour [1]. The production of flour from local ingredients also increases, such as jackfruit seeds as a food ingredient that increases the economic value and usefulness [2], saga that have high protein content [3], some manufacture of cassava as fried potatoes [4], and also durian seeds that been used as flour [5].

Mocaf is an edible cassava product. The use of mocaf has very potential as a substitute for flour which is more expensive, especially flour for noodles, bread, cakes, and pastries [6]. Powdered breadfruit has a relatively fixed nutritional value, and its use is not constrained by time. Many food products are made from breadfruit flour as the main ingredient, or additive. Starch is found on high-rise plants in the form of insoluble granules.

The yellow or orange colour in sweet potatoes is caused by the presence of beta-carotene compounds which function as provitamin A [7]. A number of studies on various types of sweet potato starch have been conducted [8]. The wheat flour commodity is increasing from year to year and continue to increase in line with growing consumption. Society started reduce the use of wheat
flour and re-use that flour processed and the raw materials come from within the country itself and as food innovation in making cookies in the hope of fulfilling nutritional needs with the use of a combination of non-wheat flour [9].

2. Materials and methods
Mocaf obtained from Bakery Innovations, orange sweet potato obtained from Pasaraya MMTC, and breadfruit obtained from Setia Budi, Medan. The process of making cookies was by mixing flour and starch according to several ratio. Other ingredients were prepared and weighed accurately as formulas, the ingredients were egg yolks 30 g, sugar 45 g, margarine 67,5g, salt 2,25g, and baking powder 0,75g. Margarine and sugar were stirred until 3 minutes, then added eggs, stirred again for 3 minutes, added baking powder, salt, flour, starch to the cream mixture, and stirred manually until thoroughly combined then roller until a thin dough with a thickness of ± 5 mm, cut the thin dough so that a same size is obtained, namely 50 mm. The cookie pieces baked at ± 180°C for 35 minutes. After finish removed from the pan, set aside, and packed in polyethylene plastic packaging. This research was using non factorial randomized design with six controls (100% wheat flour, 100% mocaf (control 2); 100% breadfruit flour (control 3); 100% orange sweet potato flour (control 4); 100% breadfruit starch (control 5); and 100% orange sweet potato starch (control 6) and seven comparations of mocaf (M): breadfruit flour (BF): orange sweet potato flour (OF): breadfruit starch (BS): orange sweet potato starch (OS) i.e

| Treatment | P1 | P2 | P3 | P4 | P5 | P6 | P7 |
|-----------|----|----|----|----|----|----|----|
| P1        | 100% wheat flour | 100% mocaf | 100% breadfruit flour | 100% orange sweet potato flour | 100% breadfruit starch | 100% orange sweet potato starch |
| P2        | 70 M: 10 BF: 10 OF: 5 BS: 5 OS |
| P3        | 60 M: 20 BF: 10 OF: 5 BS: 5 OS |
| P4        | 50 M: 30 BF: 10 OF: 5 BS: 5 OS |
| P5        | 40 M: 40 BF: 10 OF: 5 BS: 5 OS |
| P6        | 30 M: 50 BF: 10 OF: 5 BS: 5 OS |
| P7        | 20 M: 60 BF: 10 OF: 5 BS: 5 OS |
| P8        | 10 M: 70 BF: 10 OF: 5 BS: 5 OS |
| P9        | 100% mocaf |
| P10       | 100% breadfruit flour |
| P11       | 100% orange sweet potato flour |
| P12       | 100% breadfruit starch |
| P13       | 100% orange sweet potato starch |

Each treatment was made in 3 replications, so the total sample size was 39 samples. The Analysis of water content [10], ash content [11], fat content was done with boiling flask [10], protein content was done using KJeldahl [10], crude fibre content was done using the crude fibre method [12], sensory analysis in this study was using a hedonic rating test [13].

3. Results and discussion

3.1 Water content
Treatment P13 (100% orange sweet potato starch) at 2.95 was the highest and the lowest was treatment P3 (60%: 20%: 10%: 5%: 5%) at 2.27. Water content determines the resistance of a product because water can be a medium for bacterial growth. Food products that have a low water content will last longer than those that have a high water content. The cruder fibre content in the material, the more water is bound to the fibre so that the water content of the product will be lower [14].

![Figure 1](image-url)  
**Figure 1.** Correlation between composite flour formulations (mocaf, breadfruit flour, orange sweet potato flour, and breadfruit starch) with water content of cookies.
3.2 Ash content
Treatment P10 (100% breadfruit flour) at 1.48 was the higher and the lowest was P13 treatment (100% orange sweet potato starch) at 1.28. Ash content is one of the factors that determine the quality of a material. If the ash content is high, the mineral content is also high [14]. Starch is obtained from the extraction results and through repeated washing steps with water that cause the dissolution of minerals in the starch is lost with the waste.

![Figure 2](https://example.com/figure2.png)

**Figure 2.** Correlation between ash content and composite flour formulations (mocaf, breadfruit flour, orange sweet potato flour, orange sweet potato starch, and breadfruit starch) of cookies.

3.3 Fat content
The highest fat content was in treatment P9 (100% mocaf) at 23.55 and the lowest was treatment P8 (10%: 70%: 10%: 5%: 5%) at 21.8. The fat content of mocaf that has been tested on raw materials has the highest value so it affects the fat content of cookies and additional ingredients, namely butter and eggs too. In the dough, fat provides a shortening function and a texture function so that the cookies become softer [14].

![Figure 3](https://example.com/figure3.png)

**Figure 3.** Correlation between fat content and composite flour formulations (mocaf, breadfruit flour, orange sweet potato flour, orange sweet potato starch, and breadfruit starch) of cookies.

3.4 Protein content
The highest protein content was in treatment P1 (100% flour) valued at 10.32 and the lowest was treatment P13 (100% orange sweet potato starch) at 9.06. The high difference in protein content is influenced by the gluten content. Meanwhile, the composite flour that been used is non-gluten flour. The main protein in wheat flour was gluten (consisting gliadin (20-25%) and glutenin (35-40%)] [15]. Low levels the protein in starch caused by water soluble protein as a result of the starch extraction process and some protein is in the waste that is discarded.

![Figure 4](https://example.com/figure4.png)

**Figure 4.** Correlation between composite flour formulations (mocaf, breadfruit flour, orange sweet potato flour, orange sweet potato starch, and breadfruit starch) with protein content of cookies.
3.5 Carbohydrate content
The highest carbohydrate content was in treatment P8 (10%: 70%: 10%: 5%: 5%) at 65.03 and the lowest was treatment P11 (100% orange sweet potato flour) at 63.18. The other nutritional components can influence the carbohydrate content calculated by different. The heating process can cause a Maillard reaction between reducing sugars from carbohydrates and amino acids (primary amine groups) from proteins which results in the formation of a brownish yellow colour [16].

![Figure 5. Correlation between composite flour formulations (mocaf, breadfruit flour, orange sweet potato flour, orange sweet potato starch, and breadfruit starch) with carbohydrate content of cookies.](image)

3.6 Crude fibre content
In the data above, it was found that the highest fibre content was in treatment P1 (100% flour) at 2.21 and the lowest was treatment P8 (10%: 70%: 10%: 5%: 5%) at 1.02. The moisture content of cookies can be affected by the levels of carbohydrates and crude fibre contained in flour. Crude fibre contained in the material has the ability to bind water. The amount of crude fibre contained in a food ingredient causes a strong cell wall and as a result, food digestibility is low. Crude fibre digestibility is influenced by several factors, including fibre content in food, the composition of crude fibre, and the activity of microorganisms [17].

![Figure 6. Correlation between composite flour formulations (mocaf, breadfruit flour, orange sweet potato flour, orange sweet potato starch, and breadfruit starch) with crude fibre content of cookies.](image)

3.7 Colour (Hedonic value)
The highest colour hedonic value was P2 (70%: 10%: 10%: 5%: 5%) at 5.86 (like). The P2 has a colour that almost resembles the colour of the control cookies, namely with a slightly brownish cream colour. This is due to the dominant amount of mocaf flour, around 70% and 10% breadfruit flour, which has a colour that almost resembles the colour of wheat flour. Breadfruit flour has an added value so that it can be used as an ingredient in the manufacture of pastries, cakes, brownies and market snacks [18].

![Figure 7. Correlation between composite flour formulations (mocaf, breadfruit flour, orange sweet potato flour, orange sweet potato starch, and breadfruit starch) with colour hedonic value of cookies.](image)
3.8 Flavour (Hedonic value)
The highest hedonic value of flavour was P2 (70%: 10%: 10%: 5%: 5%) with a value of 5.66 (like). In P2 the number of mocaf is very dominant. The flavour of mocaf can not only cover the aroma of cassava which is the basic ingredient, but also cover the aroma of wheat flour or other flour [19]. The components in the cookie dough also cause a distinctive flavour, for example by mixing margarine and eggs which can give the panellists a preferred flavour.

![Figure 8](image-url) Correlation between composite flour formulations (mocaf, breadfruit flour, orange sweet potato flour, orange sweet potato starch, and breadfruit starch) with flavour hedonic value of cookies.

3.9 Taste (Hedonic value)
The highest hedonic value of taste was P2 (70%: 10%: 10%: 5%: 5%) with a value of 5.87 (like). This is because mocaf is the most dominant, while flour and other starches have a small proportion. The advantages of mocaf flour are that it is available as raw material, cheap price and its wide use, namely as a substitute for or replacing wheat flour [20].

![Figure 9](image-url) Correlation between composite flour formulations (mocaf, breadfruit flour, orange sweet potato flour, orange sweet potato starch, and breadfruit starch) with taste hedonic value of cookies.

3.10 Texture (Hedonic value)
The highest value of texture hedonic was P2 (70%: 10%: 10%: 5%: 5%) at 5.84 (like). In the P2 treatment, the ratio of the dominant amount of mocaf supports a good texture on cookies. The quantity of margarine added also determines the texture of the cookies [21]. Adding flour sugar will also produce a smooth texture and small porous cookies also related to its expansion, which is influenced by baking powder.

![Figure 10](image-url) Correlation between composite flour formulations (mocaf, breadfruit flour, orange sweet potato flour, orange sweet potato starch, and breadfruit starch) with texture hedonic value of cookies.

4. Conclusions
Based on the test results of cookies products from various parameters, the product (cookies P2 = 70% mocaf: 10% breadfruit flour: 10% orange sweet potato flour: 5% breadfruit starch: 5% orange sweet potato starch) was the best product.
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