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The effect of adding suji leaf flour on the physical characteristics of gluten-free cookies

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Abstract - Modern society is now increasingly paying attention to the food it consumes. Cookies, which are generally made from wheat, are now starting to be developed into non-gluten products from local flour which are considered healthier. This research aims to determine the effect of adding suji leaf flour on the physical characteristics of cookies. The method used in this research was a completely random plan with different concentrations of suji leaf powder, namely 0%, 2%, 4%, 6%, 8%. The physical parameters measured are texture (hardness and slice ability). The results of the research showed that the concentration of added suji leaf powder had a significant effect on the hardness and slicing power of the cookies produced. The higher the addition of suji leaf flour, the higher the measured hardness and slicing power values of the cookies. Control cookies without the addition of suji leaf flour had the lowest hardness and slicing power values (622.25 gf and 973.50 gs) and cookies with 8% addition of suji flour had the highest hardness and slicing power (1040.77 gf and 4807.67 gs). In conclusion, the addition of suji leaf flour to cake formulas provides new insights for developing healthier cakes from local ingredients.

Keywords: cookies, gluten free, healthy cookies, local ingredients, suji flour

1 Introduction

Cookies are one of the pastry snacks that are very popular with various groups of people in Indonesia [1]. The average consumption of pastries (including cookies) in Indonesia is in the high category, as in 2011-2015 it experienced a growth of around 24.22% [2]. Apart from that, many people are also trying to make cookies for personal consumption at home. The process of making cookies is quite easy, namely making the dough, molding, and baking [3]. In general, cookies are made from flour such as wheat flour, rice flour, tapioca flour, and others. Raw materials and equipment for making cookies are also very easy to find, such as wheat flour, sugar, eggs, leaving agents, spatulas, scales, and mixing tools [4].

Wheat flour, which is one of the raw materials for cookies, is the result of grinding wheat grains until they are fine and white [5]. Wheat flour is not only used as a raw material for cookies. The use of wheat flour as a food raw material in Indonesia is very diverse, such as to produce bread, cakes, noodles, and so on [6]. The Indonesian people responded very positively to this with the increasing consumption of wheat flour-based foods in Indonesia [7]. However, the use of wheat flour as a food raw material in Indonesia ultimately causes dependence on wheat flour [8]. In 2019, Indonesia

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imported 34,467 tons of wheat flour and 10.69 tons of wheat, which is the main ingredient for wheat flour [9]. Based on the opinion of [10], Indonesia can reduce dependence on flour imports by educating the public to reduce consumption of wheat flour and start using local flour. Therefore, local flours are needed that can replace wheat flour as a raw material for various foods in Indonesia, including as a raw material for cookies.

Several previous studies have revealed several local flours from leaves that can replace wheat flour as raw material for cookies, including the substitution of moringa leaf flour (*Moringa oleifera* L.) in cookies for physical properties, organoleptic properties, proximate levels, and Fe levels [11], the use of cassava leaf flour as a substitute for wheat flour in making cookies [12], the development of a cookie product as a substitute for *katuk* (*Sauropus androgynus* (L.) leaf flour and green beans for nutritional content and organoleptic testing as disaster emergency food for breastfeeding mothers [13], variations in mixing soursop leaf flour (*Annona muricata* Linn) in making cookies in terms of physical properties, organoleptic properties and fiber content [14]. The effect of substituting wheat flour with modified white sweet potato flour (*Ipomoea batatas* L.) and adding pandan flour (*Pandanus amaryllifolius*) on the quality of cookies using the creaming method [15]. Although there have been several studies regarding local flour from leaves which can replace wheat flour as a raw material for cookies, the options are still relatively few. Therefore, research on the physical testing of suji leaf cookies aims to add an alternative substitute for wheat flour as a raw material for making cookies.

2 Materials and methods

2.1 Materials

The ingredients used in making suji leaf cookies are suji leaf flour, rice flour, sago flour, cornstarch, butter, powdered sugar, granulated sugar, vanilla powder, and eggs.

2.2 Making Suji Cookies

The steps for making cookies start with weighing all the ingredients, mixing them into the dough, molding, and baking. Making cookie dough begins by mixing powdered sugar, granulated sugar and margarine using medium speed for 3 minutes using a Philips HR1559 mixer, then adding eggs and mixing for 10 minutes at high speed. The next step is to add the dry ingredients consisting of suji leaf flour, rice flour, sago flour, cornstarch, vanilla into the mixture, then stir at low to medium speed for 3 minutes until the mixture is evenly mixed. After the mixture is mixed evenly, the mixture is then molded using a cookie cutter and then baked at 170 ºC for 15 minutes using (Oven Toaster KWS1546ALQ-S1, China). The differences in suji flour concentrations are presented in Table 1.

Table 1. Formula design for suji leaf flour cookies with various treatments.

Ingredients	Material weight (g)				
	F1 (0%)	F2 (2%)	F3 (4%)	F4 (6%)	F5 (8%)
Suji leaf flour	0	8	16	24	32
Rice flour	270	270	270	270	270
Sago flour	80	80	80	80	80
Cornstarch	50	50	50	50	50
Vanilla	2	2	2	2	2
Fine granulated sugar	150	150	150	150	150

Ingredients	Material weight (g)				
	F1 (0%)	F2 (2%)	F3 (4%)	F4 (6%)	F5 (8%)
Butter	200	200	200	200	200
Egg	52	52	52	52	52
Food Coloring	1	1	1	1	1

Note: F1= substitution of 0% suji flour as control, F2= substitution of 2% suji flour, F3= substitution of 4% suji flour, F4= substitution of 6% suji flour, and F5= substitution of 8% suji flour.

2.3 Texture Analysis

The hardness of the suji cake was evaluated using a texture profile analyzer. A total of five different treatments within 24 hours after baking suji cakes of the same size were analyzed. The cookie texture method refers to the analysis method of Li et al., (2020) which uses (TA-TX2i Texture Analyzer, Stable Micro System Ltd., Godalming, Surrey, UK).

2.4 Experimental Design and Data Analysis

This research used a completely randomized design (CRD) with the addition of suji leaf flour (0%, 2%, 4%, 6% and 8%). The research was repeated 2 times. The measurement results were then analyzed using one-way analysis of variance (ONE-WAY ANOVA) at a 95% confidence level. If the ANOVA results showed a real effect, then Duncan multiple range comparison test as a further test is carried out to see the differences between treatments using SPSS Statistics version 21.0 for windows (IBM Corp., Armonk, NY, USA).

3 Results and discussion

3.1 Hardness

The texture characteristic that is related to human perception is hardness [16]. The hardness results of suji cookies at different concentration levels are presented in Table 2. Based on the ANOVA results, the addition of suji flour with different concentrations showed a significant effect on the hardness of the cookies ($p<0.05$). The higher the concentration of suji flour added to the cookie formula, the higher the hardness value of the cookies produced. Based on Table 2, the minimum hardness value is found in cookies with the addition of 0% suji flour (control) (622.25 gf), while the maximum hardness value is found in 8% suji cookies (1040.77 gf).

Table 2. Results of texture analysis of suji cookies at various concentration levels.

Formula	Parameter	
	Hardnesss (gf)	Slice ability (gs)
F1	$622,25\pm30,43^{e}$	$973,50\pm53,50^{e}$
F2	$746,95\pm9,89^{d}$	$1737,67\pm35,21^{d}$
F3	$832,17\pm5,50^{c}$	$2225,33\pm35,21^{c}$
F4	$946,62\pm10,06^{b}$	$3493,25\pm42,31^{b}$
F5	$1040,77\pm36,33^{a}$	$4807,67\pm86,96^{a}$

Note: Numbers in the same column and followed by different letters indicate significant differences ($p<0.05$); F1= substitution of 0% suji flour as control, F2= substitution of 2% suji flour, F3= substitution of 4% suji flour, F4= substitution of 6% suji flour, and F5= substitution of 8% suji flour.

The increase in hardness in suji cookies is caused by an increase in the concentration of added suji flour which is related to its high fiber component. Based on Rismaya et al. [17], dietary fiber components can increase mechanical resistance during compression. Dietary fiber can reduce the

dough's ability to expand during baking, thereby making the texture more compact and increasing the hardness value. These results are in line with research by Viani et al. [18] which states that the hardness value of cupcakes is increased by the presence of dietary fiber content in moringa leaf flour. Dietary fiber has a high ability to bind water, so that the water that should be used for the dough rising process is reduced. This condition causes a decrease in expansion volume and produces a hard texture.

3.2 Slice ability

Slice ability or compactness is one of the product quality parameters that can be analyzed using texture profile analysis (TPA). The value of this parameter can be determined through the maximum force required to cut the sample [19]. The ANOVA results showed that the substitution of suji leaf flour significantly affected the slicability value of the cookies produced. The higher the concentration of suji leaf flour substitute, the higher the slicing power value. Based on Table 2, the slicing power shows that cookies with the addition of 0% suji had the lowest slicing power value (973.50 gs), while the highest slicing power value was found in cookies with the addition of 8% suji leaf flour (4807.67 gs).

The presence of a fairly high dietary fiber component in suji leaf flour is thought to be the main cause of the increase in the slice ability and hardness of the cookies produced. Food fiber has a high water binding ability which can cause the starch gelatinization process during the cookie baking process to be disrupted [20]. This condition causes the dough development process during baking to be disrupted, so that the hardness value of the resulting cookies becomes high. The results of this research are in line with Anggraeni et al. [21] who stated that food ingredients that have low slicing power show a soft texture. The addition of compounds high in dietary fiber such as carrageenan can increase gel strength and have a higher level of hardness [19].

4 Conclusion

Based on the research that has been carried out, it can be concluded that the substitution of suji leaf flour has a significant effect on the texture of cookies. The higher the level of suji leaf flour substitution added, the higher the hardness and slicability of the cookies produced. The measurable change in cookie texture was influenced by the addition of suji leaf flour which is known to have a high dietary fiber content. Although the addition of suji leaf flour can affect the texture of the cookies, it is hoped that it can increase the functional value of the product.

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