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INCREASING THE NUTRITIONAL CONTENT OF COOKIES WITH PURPLE SWEET POTATO FLOUR: ORGANOLEPTIC TEST AND NUTRITIONAL ANALYSIS

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ABSTRACT

Functional foods containing additional ingredients that are beneficial for health have become an increasing research focus. Purple sweet potato flour is known to have a longer shelf life with proper pan processing. This research aims to test the acceptability and analysis of the nutritional content of cookies made from purple sweet potato flour as a potential healthy snack based on functional food. The research used an experimental design with two different formula comparisons: F1 with the addition of 50 grams of purple sweet potato flour and F2 with the addition of 100 grams of purple sweet potato flour. The organoleptic test was carried out by 30 panelists, while the nutritional content analysis used a proximate test. The results showed that there were significant differences in texture and taste between the two formulas ($p < 0.05$) while color and aroma did not show significant differences ($p > 0.05$). In addition, the nutritional content of cookies, especially energy, carbohydrates, protein, fat, iron, vitamin C, fiber and calcium, varies between the two formulas. Cookies based on purple sweet potato flour show potential to become a functional food-based snack option, especially for teenage girls. The recommendation is to use the F2 formula with the addition of 100 grams of purple sweet potato flour. Research supports further research by adding food ingredients high in iron to increase the nutritional value of iron in these cookies.

Keywords: Anemia; Cookies; Nutrient content; Purple Sweet Potato; Organoleptic Test

INTRODUCTION

Functional foods are food products with high nutritional value for individual growth and development, with a focus on nutritional content and consumption habits to improve overall health, well-being and well-being [1]. Functional foods aim to target specific functions in the body so as to provide physiological benefits and can reduce the risk of non-communicable diseases [2]. Functional foods contain additional ingredients that provide benefits for human health beyond the effects of conventional food products (not capsules, tablets or powders) made from natural substances that can and should be ingested as part of the daily diet [3].

Food innovation provides modern methods of preserving food. Processing food so that its supply is longer and more sustainable is a wise alternative [4]. Along with technological developments, sweet potatoes have been developed into flour to extend shelf life and are easily mixed with other ingredients to increase their nutritional content [5], [6].

In Indonesia, the plants that contain the most carbohydrates are rice, white bread, noodles, cassava and sweet potato, where sweet potato (*Ipomoea batatas* L) has many benefits compared to other tuber plants [7], [8]. Purple sweet potatoes have nutrients such as vitamin A, vitamin B6, vitamin C and vitamin E, fiber, low fat,

cholesterol, iron, potassium, calcium, zinc, sodium and magnesium [9] . Furthermore, polyphenols from purple sweet potato (UJU) exhibit diverse biological activities, including protective antioxidant, anti-inflammatory, anticancer, antidiabetic and hepatoprotective activity effects. Sweet potatoes have strong potential to contribute to better nutritional quality of our diets worldwide [10] . Various products can be obtained from sweet potatoes, such as cookies, biscuits, muffins, noodles and pies, with a longer shelf life and better characteristics [11] which are quite popular with the public and can be consumed daily by all age groups from children children to adults [12] . Therefore, this study aims to test the acceptability and analysis of the nutritional content of cookies made from purple sweet potato flour as a potential healthy snack based on functional food.

RESEARCH METHODS

2.1 Research Design and Location

This research used an experimental design with two formulation comparisons, namely formulation 1 (F1) with the addition of 50 gr purple sweet potato flour and formulation 2 (F2) with the addition of 100 gr purple sweet potato flour. The hedonic test was carried out at the Muhammadiyah University of Surakarta on 30 nutrition student panelists and the nutrient content analysis test was carried out in the chemistry laboratory of the Satya Wacana Christian University. Research ethics were obtained from the health research ethics committee of the Faculty of Medicine, Sebelas Maret University with No. 232/UN27.06.11/KEP/EC/2023.

2.2 Tools and Materials

The tools used in making cookies are a gas stove, frying pan, basin, plastic gloves, baking sheet, electric oven, scales, mixer, solet, bowl, spoon, cookie mold [13] . Purple sweet potato flour is produced by Primanaya Bogor Indonesia with P.IRT No. 2063271010282-19 and other ingredients such as wheat flour, powdered sugar,

cornstarch, margarine, egg yolks, vanilla and powdered milk from the supermarket.

Table 1 Composition of UJU Cookie Formula Ingredients

No	Material	Formula 1	Formula 2
1	Purple sweet potato flour	50 gr	100 gr
2	Flour	35 gr	35 gr
3	Fine	30 gr	30 gr
4	granulated	5 gr	5 gr
5	sugar	100 gr	100 gr
6	Cornstarch	1 btr	1 btr
7	Margarine	3 drops	3 drops
8	Egg yolk	20 gr	20 gr
	Vanilla		
	Milk powder		

2.3 Research Stages

Making cookies using 150 grams of margarine, 60 grams of powdered sugar, 1 egg yolk then mixed until soft for 5 minutes, then mix UJU flour, wheat flour, cornstarch, vanilla, powdered milk for 7-10 minutes, flatten the dough to a thickness of ± 0.5 cm, oven at 150°C for ± 20 minutes and packaged [13] .

The next stage is a hedonic test on two predetermined cookie formulations which include texture, taste, color and aroma on a scale of very dislike (1), dislike (2), somewhat like (3), like (4), like very much (5) (Suryono et al., 2018) then continued with the nutritional content test in the carbohydrate analysis test using the spectrophotometric method, the fat analysis test using the gravimetric method, the protein analysis test using the Kjeldahl method, the Fe analysis test using the HACH method, and the vitamin C analysis test using the titrimetric method [14] .

2.4 Data Analysis

In this study, Shapiro-Wilk was used because the sample was small, less than 100, so we used a parametric test with the Independent Sample T Test, but if the data was not normally distributed or homogeneous, we used a non-parametric test with the Mann Whitney test [15] . All

data was processed using Microsoft Excel and SPSS version 25.0 applications.

RESULTS AND DISCUSSION

3.1 Results

3.1.1 Organoleptic Test of Purple Sweet Potato Cookies

Table 2 presents the results of organoleptic tests on the two purple sweet potato cookie formulations. The organoleptic test has 5 scores for the level of liking for color, aroma, taste, texture. Based on the results of the Mann Whitney statistical test, the texture and taste have differences in the purple sweet potato cookie formula ($p < 0.05$). However, in terms of color and aroma, the results showed no difference to the purple sweet potato cookies formula ($p > 0.05$).

Table 2. Results Test Organoleptics of Sweet Potato Cookies Jalar Purple

Parameter	Product	Mean \pm SD	p value
Color	F1	3.90 \pm 0.712	0.792
	F2	3.83 \pm 0.791	
Aroma	F1	3.73 \pm 0.691	0.159
	F2	4.00 \pm 0.743	
Flavor	F1	3.07 \pm 0.944	0,000
	F2	4.03 \pm 0.890	
Texture	F1	3.60 \pm 1.003	0.027
	F2	4.17 \pm 0.747	

Note: SD = Standard Deviation

3.1.2 Nutrient Content of Purple Sweet Potato Cookies

These purple sweet potato cookies have potential nutritional content. Each purple sweet potato cookie formulation with a serving size of 100 grams and containing 50 gr (F1) and 100 gr (F2) purple sweet potato flour can be seen in table 3.

Table 3. Content Mark UJU Cookies Nutrition per 100 gr

Parameter	Unit	Test results	
		F1	F2
Energy	Kcal	494.33	446.29
Carbohydrate	Grams	34.31	40.37
Proteins	Grams	4.2	4.58
Fat	Grams	37.84	29.61
Fe	Milligrams	3.3	5.3
Vitamin C	Milligrams	0.29	0.68
Fiber	Grams	8	13.81
Calcium	Milligrams	32	36

From the results of the analysis of nutrient content based on formula variations, it was found that the highest energy was in F1, the carbohydrate content was found to be the highest in F2, the protein content was found to be the highest in F2, the fat content was found to be the highest in F1, the Fe content was found to be the highest in F2, the vitamin C content was found to be the highest in F2, the fiber content was found to be the highest in F2 and the calcium content was found to be the highest in F2.

Industrial development in food processing is driven by increasing consumer demand for high quality food products. In food processing through the cooking process where the process uses a temperature of 100° C or more with the aim of developing food alternatives that are delicious, nutritious, healthy, affordable, and easily accepted by consumers because of their organoleptic properties (eg appearance, taste, texture and aroma) [16] . However, the cooking process changes the composition and nutritional value [17] .

3.2 Discussion

3.2.1 Organoleptic Quality Analysis

Based on the results of organoleptic quality tests of two variations of the formula in terms of color, aroma, taste and texture. In table 2, the organoleptic test results show that the color of the purple sweet potato cookie formula is acceptable in the

somewhat favorable category, with an average value of 3.90 ± 0.712 and 3.83 ± 0.791 . Based on the results of the Mann-Whitney statistical test, the color of the formula variations was 0.792 ($p > 0.05$), which means that the formula variations had no influence on the color of the purple sweet potato cookies. Color is an important indicator in assessment, functioning as a visual indicator. It helps identify and evaluate food quality, ensuring consumer satisfaction with food products [12] .

The aroma in the formula with the most favorable acceptance of aroma parameters is F2 which has an average value of 4.00 ± 0.743 in the liking rating range, while F1 has an average value of 3.73 ± 0.691 in the somewhat liking rating range. Based on data analysis using the Mann-Whitney test, a value of 0.159 ($p > 0.05$) was obtained, meaning that there was no significant influence between formula variations on the acceptability of the aroma of purple sweet potato cookies. The subtle aroma increases consumer satisfaction, so it is important to consider food choices. In industry, flavor selection is very important because it quickly affects the quality of the product to attract consumers [18] .

The flavor in the formula with the most favorable acceptability regarding taste parameters is the F2 variation which has an average value of 4.03 ± 0.889 in the liking assessment while the F1 variation has a dislikeability with an average value of 3.07 ± 0.944 . The statistical results of the Mann-Whitney test show that with a significant value of 0.000 ($p < 0.05$), it can be interpreted that there is a significant influence between formula variations on the acceptability of the taste of purple sweet potato cookies. The taste of purple sweet potato cookies has a sweet taste, because by adding the same amount of sugar and chocolate to F1 and F2 this is also influenced by the sweet taste of purple sweet potato. Making cookies with a lot of purple sweet potato flour gives cookies a bitter and slightly unpleasant taste due to

the presence of compounds such as phenolics and alkaloids [19] .

The F2 texture is preferred by panelists with an average value of 4.17 ± 0.747 in the like rating category range and the F1 texture has an average value of 3.60 ± 1.003 in the somewhat like category range, however from both formulas the panelists prefer F2 over F1. Texture is a sensory experience that can be experienced in a variety of ways, such as touch, taste, smell, and taste. This is influenced by the appearance, taste and texture of the product. Softness and sharpness are important components of texture, which depend on the air quality of the product. High air quality can prevent crispiness and texture, while fat also affects texture quality [20] . The results of the Mann-Whitney statistical test show that the p-value is significant at 0.027 ($p < 0.05$), so it can be concluded that there is a difference between the formulations regarding the acceptability of the texture of purple sweet potato cookies.

3.2.2 Analysis of Nutrient Content

Results of nutritional content analysis of variations in purple sweet potato cookie formula. From table 3 it can be seen that purple sweet potato energy cookies have an energy content of 494.33 calories which is greater than F2 which is 446.29 calories. The nutritional value of cookies is 24% and 21% of the nutritional adequacy figure of 2100 kcal per adolescent girl per day [21] . Caloric value is measured in standard kilocalorie units, while macronutrients and total mass are measured in grams [22] . Globally there are three crops as food suppliers which provide around 40% of food energy such as rice, wheat and corn [23] . The energy density of a food is the amount of energy contained in a certain mass of food (kcal/gram). The contents of fat (9 kcal/g), protein (4 kcal/g), carbohydrates (4 kcal/g) and water (0 kcal/g) explain changes in the energy density of foods [24] .

Nutrient-rich carbohydrate foods, including fruits, vegetables, legumes, whole grains, nuts, seeds, starchy roots and tubers, are the basis of healthy diets worldwide [24], [25]. The term carbohydrate includes a variety of food ingredients that, by themselves and in food, can provide various health and physiological functions in dietary habits [26]. The results of the proximate analysis showed that the carbohydrate content of F2 was 40.37 grams, higher than that of F1 which was 34.31 grams. The nutritional value of cookies in F2 is 13% and F1 is 11% of daily carbohydrates from the nutritional adequacy figure of 300 grams per young woman per day [21].

Protein is a very important nutrient for the body, as well as fuel for building and regulating. Protein is a source of amino acids which contain the elements carbon, hydrogen, oxygen and nitrogen and are not available in fat or carbohydrates. As a building material, protein is the raw material for forming new tissue, and this happens all the time in the body. During growth, tissue formation occurs on a large scale [27]. Based on table 3, the nutritional value of purple sweet potato cookies in F1 is 6% or 4.2 grams and F2 is 7% or 4.58 grams from the nutritional adequacy figure of 70 grams per young woman per day [21]. The nutritional adequacy figure for adolescent girls is 70 grams per day [21].

The study of the composition of fatty acid samples is an important parameter to evaluate the quality, stability and physicochemical properties [28]. Fats provide savory taste, sensory qualities, mouthfeel, creaminess, palatability, satiety and other psychological benefits to consumers. As an energy-dense food nutrient, fat provides 9 cal/g of energy when consumed, twice as much as carbohydrates and protein [29]. Based on the results of the fat content analysis in the formulation, it was found that purple sweet potato cookies in F1 contained 37.84 grams of fat and in F2 29.61 grams. Various forms of fat are found

in various types of foods, such as salad dressings, dairy products, and potato chips [29]. Fat replacement products are substances that contain large amounts of fat in the diet without the same physiological effects as fat. These can be carbohydrates, proteins or lipids. Fat substitutes act as stabilizers, gels or lubricants, ensuring a smooth food texture [30].

Root crops are a source of energy and important nutrients in the form of fiber, carbohydrates, minerals (calcium, magnesium, potassium and zinc) and vitamins (C, B1, B2, E and A). Usually people's diets often lack minerals such as calcium (Ca) and iron (Fe) [11]. Based on the analysis results, the levels of Fe, vitamin C, fiber and calcium in F1 were respectively 5.3 mg/100gr, 0.68 mg/100gr, 12.81 gr/100gr and 36 mg/100gr compared to F2 which was 3.3 mg/100gr respectively, 0.29 mg/100gr, 8 gr/100gr and 32 mg/100gr.

Iron is a mineral needed for the formation of hemoglobin, or red blood cells, and plays a role in the body's defense system. Various studies conducted in Indonesia show that consumption of iron (Fe) together with vitamin C has an effect on increasing hemoglobin concentration [31]. Calcium is essential in the formation of strong bones and teeth, for blood clotting, growth, cell metabolism, and heart function [32]. Apart from that, in terms of diet, the recommended nutritional adequacy rate (AKG) for adolescent girls for iron, vitamin C, fiber and calcium is 9 mg, 75 mg, 29 grams and 1200 mg per day respectively [21].

CONCLUSION

In conclusion, purple sweet potato cookies with the addition of 100 grams of purple sweet potato flour (F2) showed a higher nutritional content compared to cookies with the addition of 50 grams of purple sweet potato flour (F1). F2 has more energy, carbohydrates and iron than F1. In organoleptic testing, F2 received a better assessment from the panelists in terms of

texture, taste and aroma compared to F1. With better nutritional value and good acceptance by panelists regarding taste and texture, F2 purple sweet potato cookies have the potential to be a healthy functional food-based snack option for young women, which can help overcome anemia and increase daily nutritional intake .

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