Proximate Analysis and Organoleptic Properties of Purple Sweet Potato (*Ipomoea batatas* l.) Cookies

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Abstract. Substitution of wheat flour with other ingredients in food processing is currently being considered for developing healthy food products. Purple Sweet Potato flour is one option that can be used as a substitute for wheat flour. In this study, cookies were made with purple sweet potato flour as a substitute. This study aims to determine the best formulation and analyze the proximate and hedonic characteristics to determine consumer acceptance of purple sweet potato cookies through sensory tests. This research is a completely randomized design experiment. treatment is the ratio of the amount of wheat flour and purple sweet potato flour in the processing of pastries. The parameters tested were moisture content, ash, protein, fat, crude fiber, carbohydrates, and organoleptic (taste, aroma, color, and texture). The results of the proximate analysis illustrate that, compared with control cookies, cookies substituted with purple sweet potato had higher carbohydrate, ash, fiber, and water content, while the fat and protein content became lower. Purple sweet potato flour can substitute up to 100% wheat flour, but based on research results, most of the panelists didn't like the taste. Most of the panelists liked the taste, aroma, and texture of cookies with a concentration of 25% purple sweet potato flour substitution compared to wheat flour. Based on the color parameters, most of the panelists liked cookies with a purple sweet potato flour substitution concentration of 50%.

1 Introduction

Purple sweet potato has gained the attention of today's food researchers, it is considered to provide health benefits for its consumption [1]. Purple sweet potato contains nutrients and bioactives needed by the body to metabolize and regenerate, in Indonesia it is common to process purple sweet potatoes by boiling or steaming then consumed directly [2]. The types of food processed from purple sweet potatoes are still very limited, therefore there is a need

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to diversify food products made from purple sweet potatoes. In this study, the product made in the form of cookies "Snow White" or "snow white cookies". Cookies are one of the bake products that are widely produced by bakers, besides that it is also one of the bake products that are favored by consumers [3]. Cookies are a type of food made from the basic ingredients of butter or margarine, sugar, eggs, wheat flour [4], in this study cookies were made with substitutions of purple sweet potato flour, hoping to get the best quality product. Proximate testing is carried out to determine the nutritional content of cookies [5]. Proximate analysis is needed to ensure the nutritional content of a food, so that consumers can find out the nutritional content of a food by reading the food label on the packaging. Consumers have the right to know what and how much nutrition is in the food they consume [6]. After lab testing to determine the truth and the amount of proximate content in cookies, the next step is to conduct an organoleptic test. In Malang there is a purple sweet potato producing area, so tourists who come to Malang also buy purple sweet potatoes as souvenir food that they bring home. This research is expected to provide food souvenir options in the form of processed foods from purple sweet potatoes.

2 Materials and Methods

2.1 Materials

The ingredients used in this research are ingredients for making "Putri Salju" cookies or "Snow White Cookies", including butter, margarine, icing sugar, egg yolk, cornstarch, milk powder, cheddar cheese, wheat flour, and substitute ingredients, namely purple sweet potato flour. The tools used in making cookie products are scales, mixing bowls, mixers, strainers, spatulas, baking sheets and ovens. There are other materials and tools used in this research, namely tools and materials used in proximate testing in the chemistry lab and organoleptic tests.

2.2 Methods

This research is an experimental study with 2 treatments, tests carried out include proximate tests (carbohydrates, ash, water content, protein, fat and fiber), and organoleptic properties tests (aroma, taste, color and texture) [7]. The collected data form proximate analysis and organoleptic properties analysis were analysed using SPSS version 26. Following an examination of the data using analysis of variance (ANOVA) at a significance threshold of ≤ 0.05, the Duncan post hoc test was used to determine whether the results were statistically different.

In this study, the creaming process was utilized for the production of cookies [3], First combine butter and margarine, powdered sugar, and egg yolks in a bowl, then beat using a mixer on medium speed until all ingredients are well mixed and creamy, then turn off the mixer, set aside. The second step dry ingredients include flour, maizena, milk powder mixed in a bowl then sifted. Step three, take the cream mixture and mix it with the dry ingredients, stir well using a spatula. Step four divide and weigh the dough weighing 7g then round and arrange on a baking sheet, then bake at 150^{o}C for 25-30 minutes. After the cookies are cooked, then please serve the cookies directly or pack them as needed. The product formula for this research sample can be seen in Table 1.

Table 1. Formula of Purple Sweet Potato Snow White Cookies

Ingredients	Formula A 0% (Control)	Formula B 25%	Formula C 50%	Formula D 75%	Formula E 100%
Wheat Flour	134g	33.5g	67g	100.5g	0g
Purple Sweet Potato flour	0g	100.5g	67g	33.5g	134g
Butter	67g	67g	67g	67g	67g
Margarine	34g	34g	34g	34g	34g
Icing sugar	40g	40g	40g	40g	40g
Egg yolk	20g	20g	20g	20g	20g
Maizena	34g	34g	34g	34g	34g
Milk powder	13g	13g	13g	13g	13g
Cheddar cheese	27g	27g	27g	27g	27g

The organoleptic test was conducted to determine the level of consumer liking for cookies[8], the organoleptic test panelists in this study were bake shop consumers in Malang, this is because another goal of this research product development is to provide a variant of healthy food souvenirs from Malang [9].

3 Results and Discussion

3.1 Proximate Analysis of Purple Sweet Potato Snow Ball Cookies

Based on the analysis results as can be seen in Table 2 below, it can be explained that the results of the ANOVA test were significantly different, so further tests were carried out using Duncan.

Table 2. Proximate Content of Purple Sweet Potato Snowball Cookies

Samples	Parameters					
	Carbohydrate(%)	Ash(%)	Water(%)	Protein(%)	Fat(%)	Fibers(%)
Formula A 0%	75.48 ± 0.13^{a}	0.72 ± 0.04^{a}	1.90 ± 0.01^{b}	8.35 ± 0.02^{d}	13.55 ± 0.12^{d}	0.50 ± 0.00^{a}
Formula B 25%	76.59 ± 0.13^{b}	0.88 ± 0.04^{b}	1.75 ± 0.07^{a}	8.15 ± 0.03^{c}	12.64 ± 0.21^{c}	0.58 ± 0.035^{b}
Formula C 50%	$76.77\pm0.15^{b,c}$	1.10 ± 0.00^{c}	1.94 ± 0.01^{b}	7.93 ± 0.09^{c}	12.27 ± 0.06^{b}	0.75 ± 0.00^{c}
Formula D 75%	$77.01\pm0.04^{c,d}$	1.12 ± 0.35^{d}	2.07 ± 0.04^{c}	7.85 ± 0.02^{b}	11.85 ± 0.05^{a}	0.88 ± 0.035^{d}
Formula E 100%	77.18 ± 0.16^{d}	1.35 ± 0.00^{e}	2.15 ± 0.01^{c}	7.67 ± 0.04^{a}	11.67 ± 0.12^{a}	0.97 ± 0.029^{e}

Note: Comparison in Formula box is Wheat Flour Vs Purple Sweet Potato Flour , %=g/100 g EP
^{a,b} = Letter notations represent differences or no differences in the results of Duncan's post hoc test.

3.2 Carbohydrate

Based on the analysis there is a significant difference ($p<0.05$) in the carbohydrate content of cookies with the substitution of purple sweet potato flour, the more wheat flour is replaced with purple sweet potato flour, the greater the carbohydrate content in the cookies. This is evidenced according to the results that can be seen in Table 2 formula A (control) known carbohydrate content as much as 75.48%, the amount of content gradually increases according to the level of the addition of purple sweet potato flour until the results are known that the most carbohydrate content worth 77.18% is contained in Formula E which is 100% wheat flour replaced by purple sweet potato flour. Carbohydrates are energy-building substances needed by humans, based on the range of quality requirements for cookies according to SNI 01- 2973-2011 [10], which is a minimum of 70% carbohydrates. The 5

types of cookies have carbohydrate levels> 70%, meaning that they have met the requirements. Apart from being a source of energy, foods containing carbohydrates will change color to brown when heated, this is because carbohydrates have a reducing sugar content that plays a role in non-enzymatic browning reactions (Maillard) when reacting with compounds that have amino groups such as proteins [11]. In this study, it is known that cookies that contain more purple sweet potato flour become darker brownish in color.

3.3 Ash

Based on the analysis of ash content in cookies, it will increase the more wheat flour is replaced with purple sweet potato flour, it can be seen when comparing the ash content of Formula A (Control) (0.72%) with the ash content of Formula E (1.35%) where there is a replacement of wheat flour with 100% purple sweet potato flour, the difference is almost doubled. When viewed as a whole, there is a significant difference ($p<0.05$) and an increase in ash content in cookies made with more purple sweet potato flour. According [12] Ash content analysis is important as the first step in analyzing proximate minerals, ash content refers to the minerals or inorganic residues left over from acid-facilitated oxidation of organic matter in foods. The more ash content indicates the amount of mineral element content that is beneficial to the body [13]. The role of minerals in the body is as a regulator and builder of metabolic processes, Some of the minerals contained in purple sweet potatoes include sodium, phosphorus, calcium, magnesium, and iron [14]. There are things to note if the ash content in food is high simultaneously the water content is also high, this can increase the risk of food spoilage, therefore special handling is needed so that the shelf life of food is longer [15]. Based on the range of quality requirements for cookies according to SNI 01-2973-2011 [10], which is a minimum less than 3.5g/100g, the 5 types of cookies have ash levels less than 3.5g/100g, meaning that they have met the requirements.

3.4 Water

Water content in food is one of the quality indicators that affect shelf life[13], besides that water content also affects the appearance, texture and taste of food ingredients. The moisture content of cookies is in the range of quality requirements for cookies according to SNI 01-2973-2011[10], which is a maximum of 5%. Moisture content in cookies of various flour substitutions is below 5%. If a food contains high water content, it can be an ideal medium for bacteria, yeast, and mold to develop so that food is at risk of being damaged due to biological contamination [16]. Based on the results of the analysis test which can be seen in Table 2, it shows that the different formulations of purple sweet potato flour substitution compared to wheat flour have a significant effect ($p<0.05$). The average results of cookie water content show that the more the amount of purple sweet potato flour used as a substitute, the higher the cookie water content. As can be seen at Table 2, Formula B has the lowest water content, this causes the texture of Formula B cookies to be crisper than other formulas. Based on the organoleptic properties test which can be seen in Table 3, the texture of Formula B is the most preferred texture by panelists. According [16] water content affects the crispness of food, thus affecting consumer acceptance of the product. Agreed with this statement based on the results of research people tend to like crispy textured foods, including food souvenirs [9].

3.5 Protein

Based on the analysis results as can be seen in Table 2, there is a significant difference ($p<0.05$) in the protein content of cookies with the substitution of purple sweet potato flour.

The protein content in cookies with known substitutions decreases with the increasing percentage of the amount of purple sweet potato flour substitution used. The cause of the decrease in protein content in food is due to exposure to heat in the cooking process, resulting in protein denaturation [17]. The highest amount of protein content in cookies with purple sweet potato flour substitution is Formula B (8.15%), while the lowest is found in Formula E. (7.67%). According to SNI 01- 2973-2011[10], the amount of protein content is at least 9%, based on the results of the analysis of the protein content of cookies this study is in the range of 8.15-7.67%, meaning that it does not meet the criteria, so it is necessary to fortify the protein in cookies to comply with SNI provisions. According [18] food ingredients that can be added to enrich the protein content of cookies are soybeans, cottonseed, peanut flour or corn seed flour, but of these options the best is soy flour.

3.6 Fat

Based on the analysis there is a significant difference ($p<0.05$) in the fat content of cookies with the substitution of purple sweet potato flour, the fat content decreased as the number of purple sweet potato flour substitutes for wheat flour increased. When compared to Formula A (Control), the fat content of cookies with purple sweet potato substitution gradually becomes lower simultaneously with the percentage of purple sweet potato flour substitution, the results can be seen that Formula E contains the least fat (11.67%). According to [17] the decrease in the amount of fat in food could be due to the temperature and length of the cooking process, fat is not heat resistant, it will melt and evaporate into flavor. At the time of cooking cookies made with a higher substitution requires additional time, the more the percentage of substitution the more additional time required in the baking process, this is because the water content of the cookies becomes higher, and it turns out that it ultimately also affects the fat content. According to SNI 01- 2973-2011 [10] the fat content in cookies should not be less than 9.5%, it can be seen in Table 2 that the fat content of cookies with purple sweet potato substitution is in the range of 11.67%-12.64%, which means that the fat content of cookies in this study is in accordance with the standard.

3.7 Fibers

Based on the analysis there was a significant increase ($p<0.05$) in fiber content, fiber content increases with the increasing amount of substitution of purple sweet potato flour for wheat flour in making cookies, the highest fiber content is in Formula E (0.97%) compared to Formula A, the amount of fiber increases almost 2 times. Fiber is an insoluble part of food, several types of fiber found in purple sweet potatoes include hemicellulose, cellulose, and pectin. [14]. According [19] cookies with high fiber content can be an alternative food source of fiber that can provide health benefits for consumers. According to SNI 01- 2973-2011 [10] The maximum amount of fiber content is 0.5%, in this research cookies the amount of fiber is in the range of 0.58-0.97%, of the four cookie formulas with purple sweet potato substitution only Formula B whose fiber content is in accordance with SNI standards. Foods with high fiber content are good for digestion, can reduce cholesterol levels, but babies and children are not advised to consume too much fiber because it can actually cause problems with digestive health [7], this is because their digestive metabolic system is still not perfect. So it can be suggested that the research product cookies made with Formula C, D, E are not suitable for infants and toddlers because of their high fiber content.

3.8 Organoleptic Properties

Organoleptic properties testing on new experimental products is important to carry out, this is to determine consumer acceptance of the product. Several parameters that are commonly tested include aroma, taste, color and texture [20], [21]. As seen in Table 3, the substitution of purple sweet potato flour for wheat flour, compared to Formula A (Control), all organoleptic properties parameters decreased. Of the four formulations containing substitutions, based on the results of organoleptic testing, Formula B (25%) was most favored by panelists, this was indicated by test result data in all parameters higher than Formula C (50%), D (75%), E (100%). Formula E (100%) is the product with the lowest test results, meaning that this product is least preferred compared to products made with other formulas. Based on the results of the ANOVA test, there is one parameter whose results are not significantly different so that post hoc Duncan testing is not needed, namely the Colour parameter, which means that according to the panelists there is no noticeable color difference shown by Formula B, C, D, E products. From the results of the study, it can be interpreted that the acceptance of the control product is better than the product with purple sweet potato flour substitution, so in the future there needs to be a formula development that is better than the control formula. Based on the results of the analysis of comments given by panelists, Formula B is more delicious than the others and deserves to be produced and sold as a variant of typical Malang food souvenirs. This is because the cookies have a distinctive taste obtained from the substitution of purple sweet potato, in order to become a variant of healthy food souvenirs they suggest that it be developed into low call and diabetic friendly cookies. Of the four formulas with purple sweet potato flour substitution, based on the color parameter the panelists liked the most was the color of Formula C cookies. The most disliked cookies were those made with Formula E, based on the results of the comments the reason for dislike was the color that did not attractive and there was a sour aftertaste after consuming it, besides that there was a dry sensation in the throat after eating this is suspeccted because fiber content binds water[22]. Some panelists also stated that there was a burnt taste even though the appearance was not burnt, this is suspected to be the influence of the maillard reaction considering that the carbohydrate content of Formula E is higher than the other formulas.

Table 3. Organoleptic Properties of Purple Sweet Potato Snow Ball Cookies

Samples	Parameters			
	Aroma	Taste	Colour	Texture
Formula A 0%	4.27 ± 0.87^{b}	4.20 ± 0.81^{c}	4.13 ± 1.01	$4.27\pm1.11b$
Formula B 25%	4.03 ± 0.94^{ab}	4.07 ± 0.88^{bc}	3.59 ± 1.01	3.97 ± 1.01^{ab}
Formula C 50%	3.76 ± 1.06^{ab}	3.66 ± 1.08^{ab}	3.76 ± 1.06	3.48 ± 1.12^{a}
Formula D 75%	3.48 ± 1.02^{a}	3.24 ± 0.91^{a}	3.66 ± 1.01	3.52 ± 1.21^{a}
Formula E 100%	3.69 ± 1.23^{ab}	3.17 ± 1.20^{a}	3.62 ± 1.32	3.52 ± 1.35^{a}

Note: The percentage in the formula represents the number of substitutions for purple sweet potato flour for wheat flour Rating of favorability on a scale of 1-5, 1=dislike very much, 2=dislike, 3=quite like, 4=like, 5=like very much

4 Conclusion

The result shows that more purple sweet potato flour than wheat flour in the dough increases the value of carbohydrates, ash content, water, and fiber. otherwise, lower levels of fat, and protein. Due to the high fiber content in cookies made with formulas C, D, E, it is not recommended for consumption by infants and toddlers. Based on the experiment of making snow princess cookies with purple sweet potato substitution, the results of purple sweet potato flour can substitute wheat flour up to 100% but based on the results of the organoleptic

properties test compared to the control formulation, cookies made with purple sweet potato substitution decreased in acceptance value. Of the four formulations B, C, D, E containing purple sweet potato flour, cookies Formula E was least liked by panelists because of its taste. Most panelists liked the taste aroma texture of cookies made from Formula B, other findings on the color side most panelists liked cookies made from Formula C.

Thank you to the State University of Malang for providing support and funding for this research through an internal fund competitive grant in 2023 **(**5.4.843/UN32.20.1/LT/2023**).**

References

1. A. Sittisak, N. Fuengkajornfung, T. Sanprom, & J. Weenuttranon, the Quality of Cracker From Purple Sweet Potato Flour. *International Academic Research Conference in Amsterdam*, (2019) 145–150.
2. N. El Husna, M. Novita, & S. Rohaya, Anthocyanins Content and Antioxidant Activity of Fresh Purple Fleshed Sweet Potato and Selected Products. *Agritech*, **33** (2013) 296–302.
3. N. A. Sunaryo, M. Devi, A. M. J. Saputri, & A. R. Cahyani, Proximate analysis of pumpkin and carrot cookies. *AIP Conference Proceedings*, **2353** (2021). https://doi.org/10.1063/5.0052617.
4. A. R. Mustika & W. D. Kartika, Formulation of yellow pumpkin cookies with mocaf (modified cassava flour) flour. *Food Research*, **4** (2020) 109–113. https://doi.org/10.26656/fr.2017.4(S3).S02 Abstract.
5. W. T. Eden & C. O. Rumambarsari, Proximate analysis of soybean and red beans cookies according to the Indonesian National Standard. *Journal of Physics: Conference Series*, **1567** (2020) 6–11. https://doi.org/10.1088/1742-6596/1567/2/022033.
6. BPOM RI, *Label Pangan Olahan* (2020).
7. T. Laelago, A. Haile, & T. Fekadu, Production and quality evaluation of cookies enriched with β-carotene by blending orange-fleshed sweetpotato and wheat flours for alleviation of nutritional insecurity. *International Journal of Food Science and Nutrition Engineering*, **5** (2015) 209–217. https://doi.org/10.5923/j.food.20150505.05.
8. E. Moskvicheva, I. Timoshenkova, D. Chernikova, E. Fedinishina, & M. Bernavskaya, Technology of biscuit semi-finished products using recycled pumpkin seeds. *IOP Conference Series: Earth and Environmental Science*, **337** (2019) 0–6. https://doi.org/10.1088/1755-1315/337/1/012036.
9. N. A. Sunaryo, I. N. D. Putra, & M. H. U. Dewi, Food Souvenirs Preferences by Domestic Tourists-Indonesia. **406** (2020) 46–50. https://doi.org/10.2991/assehr.k.200218.008.
10. BSN (Badan Standarisasi Nasional), *Biskuit* (2011).
11. W. K. Dwi & A. Wulandari, Analisa Proksimat Cookies Dengan Substitusi Tepung Lokal. *Agrointek : Jurnal Teknologi Industri Pertanian*, **16** (2022) 96–103. https://doi.org/10.21107/agrointek.v16i1.12562.
12. G. K. Harris & M. R. Marshall, Ash Analysis. (2017) 287–297. https://doi.org/10.1007/978-3-319-45776-5_16.
13. B. Nb, A. Sa, G. Ja, G. Dm, & M. Mg, Chemical and organoleptic properties of Chinchin produced from flour blends of wheat , defatted peanut and orange peels. *journal of Nutritional Health &Food Engineering*, **13** (2023). https://doi.org/10.15406/jnhfe.2023.07.00367.

14. A. A. J. Setyadi & R. Ninsix, PENGARUH SUBSTITUSI TEPUNG UBI JALAR UNGU (Ipomoe batatas var. Ayamurasaki) TERHADAP KARAKTERISTIK BOLU YANG DIHASILKAN. *Jurnal Teknologi Pertanian*, **8** (2019) 107–111. https://doi.org/10.32520/jtp.v8i2.942.
15. C. A. Darmawan, D. Rosyidi, & H. Evanuarini, Analysis of Quality Rawon in Malang City Based on Ash Content, Texture and Sensory Evaluation with Spices Addition. *International Research Journal of Advanced Engineering and Science*, **5** (2020) 208–211.
16. H. Y. Firmansyah, E. Pratiwi, & A. S. Putri, STUDY OF ADDITIONAL PURPLE FLOUR ON PHYSICOCHEMICAL PROPERTIES OF PURPLE SWEET COOKIES (Ipomoea batatas L). *Jurnal Mahasiswa USM*, (2022) 1–20.
17. A. N. F. Rahman, M. Bilang, & L. N. Ikawati, Physical and proximate analysis of green banana cake premix flour. *IOP Conference Series: Earth and Environmental Science*, **486** (2020). https://doi.org/10.1088/1755-1315/486/1/012051.
18. A. A. Kulthe, V. D. Pawar, P. M. Kotecha, U. D. Chavan, & V. V. Bansode, Development of high protein and low calorie cookies. *Journal of Food Science and Technology*, **51** (2014) 153–157. https://doi.org/10.1007/s13197-011-0465-2.
19. I. C. Devi, P. Ardiningsih, & N. Idiawati, Kandungan Gizi Dan Organoleptik cookies Tersubtitusi Tepung Kulit Pisang Kepok (Musa paradisiaca Linn). *Jurnal Kimia Khatulistiwa*, **8** (2019) 71–77.
20. A. Renzo, F. Tedjakusuma, & R. Surya, Cookies Product Development with the Addition of Turmeric Extract. *IOP Conference Series: Earth and Environmental Science*, **1169** (2023). https://doi.org/10.1088/1755-1315/1169/1/012087.
21. P. T. Ina, G. A. K. D. Puspawati, G. A. Ekawati, & G. P. G. Putra, Pemanfaatan Ekstrak Ubi Ungu sebagai Pewarna Merah pada Soft Candy dan Stabilitasnya. *agriTECH*, **39** (2019) 20. https://doi.org/10.22146/agritech.32195.
22. S. Debnath, S. Jawahar, H. Muntaj, V. Purushotham, G. Sharmila, K. Sireesha, & M. N. Babu, A Review on Dietary Fiber and its Application. *Research Journal of Pharmacognosy and Phytochemistry*, **11** (2019) 109. https://doi.org/10.5958/0975-4385.2019.00019.0.