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Cookies of purple sweet potato and tempeh flour as functional foods: nutritional value and sensory acceptability

[1, *]Mushollini, F., [2]Salimo, H. and [3]Kartikasari, L.R.

[1]*Master Program in Nutrition, Universitas Sebelas Maret, Jl. Ir. Sutami No. 36A Surakarta 57126, Indonesia*
[2]*Faculty of Medicine, Universitas Sebelas Maret, Jl. Ir. Sutami No. 36A Surakarta 57126, Indonesia*
[3]*Department of Animal Science, Faculty of Animal Science, Universitas Sebelas Maret, Jl. Ir. Sutami No. 36A Surakarta 57126, Indonesia*

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Abstract

Purple sweet potato is a local food that entails health functions for the human body. The use of purple sweet potato in the production of cookies provides adequate and potential nutrition as a functional food. As a source of carbohydrates, purple sweet potato is enriched with vitamins and minerals such as calcium, iron, and antioxidants and displays a unique colour. The addition of protein source food ingredients, tempeh flour, for instance, is essential to complement the nutritional value of cookies' protein. This study aimed to analyse the nutritional value and sensory acceptability on cookies of purple sweet potato and tempeh flour. Cookies were tested proximately and for sensory acceptability (colour, flavour, texture, taste and overall parameters) with the ratios of purple sweet potato flour and tempeh flour, comprising 100:1 (FC01), 95:5 (FC02), 90:10 (FC03), 85:15 (FC04), and 80:20 (FC05). The results showed that cookies had moisture (2.05-4.28%), ash (1.05-4.18%), protein (8.06-22.31%), fat (4.19-7.61%), and carbohydrate (63.85-82.42%) content. The result of sensory acceptability showed that there was a significant difference on the aroma of the cookies by adding purple sweet potato flour and tempeh flour. Tempeh flour can increase the protein content of cookies. The most preferred cookies is group of cookies with treatment FC02, had 80% of purple sweet potato flour and 20% tempeh flour.

1. Introduction

Sweet potatoes and other tubers are among the plentiful local food ingredients found in Indonesia. The high carbohydrate content makes sweet potatoes an important source of calories. The high carbohydrate nutrition gives the sweet potato a sweet taste (Saeed *et al*., 2012). Moreover, the content of vitamins, minerals, and bioactive compounds is good for health. Sweet potatoes can give a natural taste and color to food products (Harahap *et al*., 2020). Sweet potatoes have varied colors, namely white, orange, yellow and purple (Flora *et al*., 2021). Purple sweet potato has a unique color and is rich in anthocyanins, which are strong antioxidants (Kurnianingsih *et al*., 2020; Alam *et al*., 2022). Purple sweet potatoes can be processed into flour so that it provides added value and can be used to make cakes as a substitute for wheat flour (Harahap *et al*, 2020). The nutritional content of purple sweet potato flour per 100 g contains energy of 354 kcal, protein 2.8 g, fat 0.6 g, carbohydrates 84.4 g, iron 3.9 mg, fiber 12.9 g, moisture content 9.4 g and ash content 2.8 g (Kemenkes RI, 2017). Meanwhile, the research Rodrigues *et al*. (2016) showed the results of the analysis of the chemical composition of purple sweet potato flour including energy 380 cal, protein 5.82 g, fat 0.39 g, carbohydrates 88.15 g, moisture content 6.91 g and ash content 3.07 g.

Purple sweet potato has a low protein nutritional content, so it is necessary to add other ingredients to complement the lack of protein nutrients. Tempeh as one of the most recognized food fermentation products in Indonesia, has a high nutritional content, is easy to produce and can be obtained at a low price. The high protein nutrient content in tempeh is equivalent to the protein content in meat. Tempeh can also be processed into flour so that it provides added value such as increasing shelf and providing many functions (Hernawan *et al*., 2021). Tempeh flour can be widely used as a food ingredient, as a source of protein, and

*Corresponding author.
Email: *Fitriamushollini14@gmail.com*

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increase the value of functionality (Puteri *et al*., 2020). The addition of tempeh flour to food products such as cookies can increase protein content, and affect the colour, aroma, taste and texture of cookies (Rauf *et al*., 2016). The nutritional content of tempeh flour in 100 g of dry weight contains have 50.18% of protein content, fat 25.02%, carbohydrates 22.88% and total isoflavone 53.08 mg (Astawan *et al*., 2016).

Cookies are nutrient-dense snacks and are most loved by all age groups in the world (Awobusuyi *et al*., 2020). In addition, cookies are also ready-to-eat food products with a longer shelf life. The main ingredients for making cookies are wheat flour, sugar, fat or oil and water and the addition of other ingredients to give a special taste (Saeed *et al*., 2012). The use of purple sweet potato as a local food with tempeh flour which has good quality nutritional content needs to be developed in food products such as cookies to produce functional local food.

Several studies have developed food products by utilizing local foods such as purple sweet potato and tempeh flour. Harahap *et al*. (2020) reported that sweet potato flour in previous studies can be used as a substitute for wheat flour in the development of food products such as noodles, cookies, bread and cakes. A previous study conducted by Yulianti *et al*. (2019) also reported that adding of tempeh flour to mixed flour (mocaf flour, corn-starch and rice flour) for pasta products, increased the protein content of the mixed flour. Given the good nutritional content in purple sweet potatoes and tempeh flour, the aims of this research to analyse the nutritional value and sensory acceptability on cookies of purple sweet potato and tempeh flour.

2. Materials and methods

2.1 Materials

The main materials used in this research are purple sweet potatoes and tempeh obtained from traditional markets. The purple sweet potatoes chosen for this study had smooth skin, a firm texture, and a dark purple skin and flesh. As for the tempeh used, tempeh is packaged with banana leaves. Purple sweet potatoes and tempeh were first processed into flour through an oven-drying process. Other ingredients in making cookies such as egg yolk, margarine, sugar, wheat flour, skim milk and corn-starch. While the tools used are knives, buckets, cutting boards, electric ovens, 80 mesh sieves, mixers, blenders, steamers, cookie moulds and bottles.

2.2 Producing purple sweet potato flour and tempeh flour

The process of making purple sweet potato flour and tempeh flour refers to the research of Sari *et al*. (2016) with some modifications. Purple sweet potatoes were peeled and washed, then sliced 0.5 cm thickness. Then, those potatoes were dried in an oven at 120^{o}C for 6 hrs. After that, it is blended until smooth and sieved through an 80-mesh sieve. Tempeh was thinly sliced and then steamed for 15 mins. After that, it is dried using an oven with a temperature of 120^{o}C for 6 hrs. Then blended until smooth and filtered using an 80-mesh sieve.

2.3 Producing cookies of purple sweet potato and tempeh flour

Margarine, egg yolk, refined sugar and vanilla were mixed at a moderate pace for 5 mins. Then, add wheat flour, skim milk and corn-starch. Purple sweet potato flour and tempeh flour were added to the formula in various concentrations (100:0, 95:5, 90:10, 85:15 and 80:20) as shown in Table 1, and then thoroughly mixed. The dough is piped and moulded using a mould, then heated for 3 hrs with a temperature of 80^{o}C in the oven. After that, it is removed and cooled at room temperature and stored in bottles.

Table 1. Ratio of purple sweet potato and tempeh flour on cookies.

Formulations	Ratio (%)	
	Purple sweet potato flour	Tempeh flour
FC01	100	0
FC02	95	5
FC03	90	10
FC04	85	15
FC05	80	20

2.4 Organoleptic and proximate tests of cookies

The organoleptic test aimed to evaluate the sensory acceptability on cookies of purple sweet potato and tempeh flour consisting of color, aroma, taste, texture and overall acceptability as in Figure 1. This organoleptic test involved 35 moderately trained panelists. The test used nine hedonic scales (9-point hedonic scale), 1 = dislike extremely, 2 = dislike very much, 3 = dislike moderately, 4 = dislike slightly, 5 = neither like nor dislike, 6 = like slightly, 7 = like moderately, 8 = like very much, 9 = like extremely. There were 5 kinds of cookie products that were tested by organoleptic with the formula. The results of the organoleptic test were analyzed by the Kruskal Walis test using the SPSS software application to determine the parameters that had the most influence on each cookie treatment with $p<0.05$.

Figure 1. Cookies of purple sweet potato and tempeh flour.

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Proximate testing which included moisture content, ash, fat, protein and carbohydrates was carried out at the Agricultural Product Technology laboratory, Universitas Eka Sakti Padang. The analysis of the nutritional value of energy in cookies was calculated manually based on the ingredients used in making cookies using the Indonesian food composition table.

3. Results and discussion

The proximate composition of cookies consisting of moisture content, ash, proteins, fats and carbohydrates is presented in Table 2. The moisture content in the cookie tends to decrease (2.05-4.28%) and the ash content increases (1.05-4.18%). The moisture content and ash content of purple sweet potato flour as reported by Rodrigues *et al*. (2016) were 6.91% and 3.07%, respectively. The moisture content and ash content of tempeh flour were 6.50% and 2.02%, respectively (Afifah and Ratnawati, 2017), while those by Huang *et al*. (2019) reported an ash content of 4.46%. Putri *et al*. (2020) reported that biscuits with a high ratio of purple sweet potato increased the moisture content of the biscuits. Another study found that the moisture content and ash content were higher without the addition of tempeh flour when compared to the addition of tempeh flour (Yulianti *et al*., 2019).

The macronutrient content in cookies includes protein, fat and carbohydrates. The results showed that tempeh flour in cookies increases the protein and fat content of cookies, but the carbohydrate content was higher in the cookies without tempeh flour. The increase in proteins and fat is proportional to the increase in energy. Protein content ranged from 8.06-22.31% increased with the increase in tempeh flour in cookies. This was due to the high protein content of tempeh flour. A study conducted by Astawan *et al*. (2016) found the protein content of tempeh flour was 50.18%. A related study by Puteri *et al*. (2018) showed that the protein content in water-soluble tempeh flour was 50% and Huang *et al*. (2019) reported a protein content of 43%. Related research by Yulianti *et al*. (2019) reported that the addition of tempeh flour to mixed flour (mocaf flour, corn-starch and rice flour) for pasta products increased the protein content of the mixed flour.

The fat content in the cookies increased from 4.19% to 7.61%. The highest fat content was found in cookies with a 20% tempeh flour formula. The increase in fat content was associated with a higher proportion of the tempeh flour ratio. This is because the fat content in tempeh flour is greater than in purple sweet potato flour. The fat content of tempeh flour was 25.02% (Astawan *et al*., 2016). Huang *et al*. (2019) reported that the fat content of tempeh flour was 26.6%, while purple sweet potato flour contains a low fat content of 0.39% (Rodrigues *et al*., 2016).

The carbohydrate content of cookies in each treatment ranged from 82.42 to 63.85%. Increasing the ratio of sweet potato flour used may raise the carbohydrate content of the cookies. This is due to the high carbohydrate content in purple sweet potato flour. In the Indonesian food composition table, the carbohydrate content was 84.4 g. Research by Rodrigues *et al*. (2016) reported the carbohydrate content in purple sweet potato flour of 88.15%.

The acceptability of purple sweet potato cookies and tempeh flour based on hedonic tests of color, aroma, taste, texture and overall acceptability is presented in Table 3. The organoleptic test's findings revealed no statistically significant differences based on parameters for color, taste, texture and overall acceptability, but did reveal a statistically significant difference based on aroma parameter. This study showed that there was a significant difference in the aroma parameters of the cookies. Based on panelists' score, the most preferred cookie aroma is achieved with a formula using an 80:20 ratio. The aroma of cookies came from a combination of the aroma of purple sweet potato and tempeh flour. Tempeh had a typical pleasant aroma such as yeast or tapai/alcohol aroma, of which might the unpleasant beany aroma (Kustyawati *et al*., 2017). Fathonah *et al*. (2020) reported that purple sweet potato flour substituted for onde-onde showed a different effect on the aroma of the dumplings. Meanwhile, a study conducted by Latifah *et al*. (2019) explained that there was no significant difference in biscuits with the substitution of tempeh flour because tempeh flour has a unique aroma and is influenced by the aroma of other ingredients in the manufacture of cookies.

The parameters of color, taste, texture and overall acceptability showed no significant effect on each

Table 2. The result of proximate test on cookies of sweet potato and tempeh flour.

Formulations	Moisture (%)	Ash (%)	Protein (%)	Fat (%)	Carbohydrate (%)	Energy (cal)
FC01	4.28	1.05	8.06	4.19	82.42	406.52
FC02	4.1	2.08	12.15	4.98	76.69	409.38
FC03	3.97	2.88	14.43	5.15	73.57	412.24
FC04	2.22	3.68	17.25	6.88	69.97	415.10
FC05	2.05	4.18	22.31	7.61	63.85	417.90

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Table 3. The result of organoleptic test on cookies of sweet potato and tempeh flour.

Parameter	Formulations				
	FC01	FC02	FC03	FC04	FC05
Color	6.69±1.491	6.31±1.231^{a}	6.49±1.502^{a}	6.00±1.799^{a}	6.94±1.305^{a}
Aroma	6.31±1.491^{abcd}	5.83±1.485^{a}	6.66±1.235^{bd}	6.09±1.634^{abc}	6.86±1.309^{d}
Taste	6.66±1.494	6.34±1.454^{a}	6.57±1.092^{a}	6.26±1.615^{a}	6.77±1.190^{a}
Texture	6.37±1.497	6.09±1.173^{a}	6.09±1.483^{a}	6.03±1.317^{a}	6.46±1.146^{a}
Overall acceptability	6.51±1.541	6.43±1.313^{a}	6.57±1.119^{a}	6.43±1.065^{a}	6.89±0.867^{a}

Values are presented as mean±SD. Values with different superscript within the same row are statistically significantly different ($p<0.05$).

treatment on cookies. This study proves that the acceptance of color in cookies produced with the ratios of purple sweet potato flour and tempeh flour of 80:20 was higher than the others. The greater the ratio of tempeh flour added to the cookies, the more the purple color fades. The results of a similar study by Hernawan *et al*. (2021) showed that the more tempeh flour was added, the darker the sweet bread was due to the light-yellow color of the tempeh. The taste parameters of the cookies did not show any significant difference. The cookies with the highest taste acceptance were the 80% purple sweet potato formula and 20% tempeh flour.

The results of the sensory test showed that that the score of the cookies obtained ranged from 6-7 which illustrates that the panelists assessed like slightly to like moderately in Figure 2. The average value of favourability on the colour parameters is 6.0-6.9 (like moderately), aroma 5.8 -6.9 (like slightly to like moderately), taste 6.3-6.8 (like moderately), texture 6.0-6.5 (like moderately) and overall acceptability 6.4-6.9 (like moderately). Overall, cookies with formulated with 80% purple sweet potato and 20% tempeh flour showed the highest value of sensory acceptability. Latifah *et al*. (2019) reported that arrowroot biscuits with the addition of 20% tempeh flour showed the highest overall acceptability.

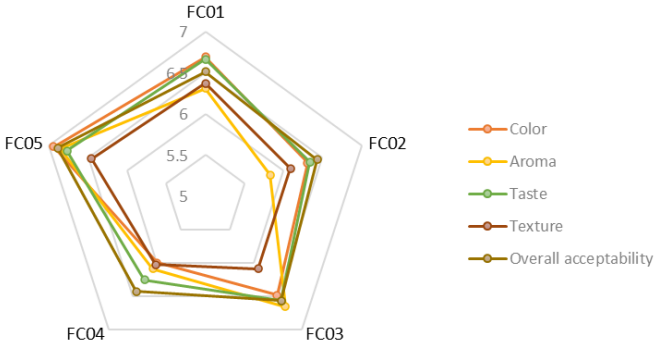

Figure 2. The result of organoleptic tests on cookies.

4. Conclusion

As functional foods, cookies of purple sweet potato cookies and tempeh flour have the potential to be nutrient-rich sources of dietary fat, protein and energy. Tempeh flour provides the potential to increase the protein content of cookies. In general, the acceptance of cookies by the panelists gave a score between like slightly to like moderately and the formula of purple sweet potato and tempeh 80:20 was the most preferred for the cookie.

Conflicts of interest

The authors declare no conflict of interest

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