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The Effect of Substituting Wheat Flour with Pumpkin Flour (*Cucurbita Moschata*) on the Characteristics of Ladyfinger

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ABSCTRACT

This study aims to determine the effect of substituting wheat flour with pumpkin flour on the characteristics of ladyfinger. This experimental study used a randomized block design (RBD) with 5 treatments and 3 replicates. The results of the study indicate that substituting wheat flour with yellow pumpkin flour has a significant effect on organoleptic quality, including color (3.79–4.23, liked), aroma (3.81–4.29, liked), texture (3.66–4.16, liked), taste 3.58 (somewhat like) – 4.26 (like), overall acceptance 3.79–4.26 (like) with color quality 1.78 (yellow) – 2.82 (yellowish-brown) and texture quality 2.28 (slightly crispy) – 2.81 (crispy). The treatment also had a significant effect on crude fiber content (0.365%–0.467%) but had no significant effect on beta-carotene content (7.61–8.40 mg/100g). The best treatment in this study was P3 (80% wheat flour : 20% pumpkin flour) with preferred organoleptic quality, including color 4.23 (liked), aroma 4.29 (liked), texture 4.16 (liked), taste 4.20 (liked), overall acceptance 4.26 (liked), color quality 2.82 (yellowish-brown) and texture quality 2.81 (crispy) with crude fiber content 0.398%, beta-carotene content 8.32 mg/100g, protein content 3.89%, fat 30.45%, carbohydrate content 56.57%, ash content 1.598%, and moisture content 3.28%.

Keywords: Ladyfinger, Pumkin Flour, Organoleptic Quality

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INTRODUCTION

Ladyfinger is a cookie with an elongated, thin and light shape resembling a cat's tongue(Oktaviana et al., 2023). Ladyfinger are generally made from a mixture of wheat flour, egg whites, caster sugar, and margarine. Wheat flour is the main component in making ladyfinger. This flour is the basic ingredient in various foods such as bread, cakes, and noodles. Wheat flour is produced by grinding wheat(Rahmawati et al., 2023). Considering that Indonesia does not produce wheat grains for wheat flour production, it is necessary to increase imports to meet wheat flour needs(Lestari et al., 2023). Indonesia consumes 2,750 kg of wheat flour per capita per year. But, the raw materials needed for wheat flour production in Indonesia still have to be imported. Meanwhile, wheat imports to meet wheat availability in Indonesia reach 7,259 tons per year(Pusat Data dan Sistem Informasi Pertanian, 2022).

One strategy to reduce Indonesia's dependence on wheat flour is to utilize locally grown ingredients, such as pumpkin. In Indonesia, pumpkin is a commodity with a relatively large harvest(Laila et al., 2023). In 2018, the average pumpkin harvest reached around 55.74 tons per hectare. But, pumpkin consumption in Indonesia is still low, at less than 5 kilograms per capita per year(Ghifarie & Rahmawati, 2022).

The process of processing pumpkin into flour can facilitate the packaging and distribution process, as well as providing a longer shelf life and being more practical for further processing(Rismaya et al., 2018). Chemical composition analysis of pumpkin flour shows a water content of 3.29%, ash 6.23%, fat 2.17%, protein 7.82%, carbohydrates 80.49%, crude fiber 6.55%, and beta-carotene 25,835.73 µg/100 g(Putri et al., 2019). Based on the 2017 Indonesian Food Composition Table, the nutritional composition of 100 grams of wheat flour is 11.8 g of water, 9 g of protein, 1 g of fat, 77.2 g of carbohydrates, 1 g of ash, and 0 g of beta-carotene (TKPI, 2018). Meanwhile, the crude fiber content in wheat flour is 1.1%(Witono et al., 2012).

Based on the results of a study entitled "Beta-carotene content and acceptability of Garut cookies with pumpkin flour substitution," the lowest beta-carotene content was found in cookies with 0% pumpkin flour substitution, at 1.32 mg/100 grams, while cookies with 25% pumpkin flour substitution had the highest beta-carotene content at 8.67 mg/100 grams(Noviati & Purwani, 2017). Based on preliminary research, substitution of pumpkin flour up to 30% in

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making ladyfinger still forms ladyfinger, but substitution of pumpkin flour above 30% does not meet the expected shape criteria for the characteristics of ladyfinger.

METHOD

This study used an experimental research type with a Randomized Block Design (RBD) design. This study was conducted using 5 treatments and 3 replicates, resulting in 15 experimental units. The treatments carried out in this study were P1 (90% wheat flour substitution treatment, 10% pumpkin flour), P2 (85% wheat flour substitution treatment, 15% pumpkin flour), P3 (80% wheat flour substitution treatment, 20% pumpkin flour), P4 (75% wheat flour substitution treatment, 25% pumpkin flour), and P5 (70% wheat flour substitution treatment, 30% pumpkin flour). Product manufacturing was carried out at the Food Processing Laboratory of the Nutrition Department of the Denpasar Health Polytechnic. Organoleptic quality testing was conducted by 30 panelists at the Organoleptic Laboratory of the Nutrition Departemen, Poltekkes Denpasar with the completion of a questionnaire using a hedonic scale. The objective test was conducted at the Basic Science Laboratory, Faculty of Agriculture, Warmadewa University. This research was conducted from November 2024 - May 2025. The data obtained was then analyzed using computer applications such as Microsoft Excel and SPSS.

RESULTS

Based on the assessment of organoleptic quality characteristics which include preferences for taste, texture, aroma, color, and overall acceptance, as shown in Table 1.

Tabel 1. Average Organoleptic Quality Score for Ladyfinger

Treatment	Average Organoleptic Quality Score				
	Color	Aroma	Texture	Taste	Overall
P1	4,09ab	3,97b	4,10a	4,01ab	4,07ab
P2	4,20a	4,18a	4,09a	4,04ab	4,12a
P3	4,23a	4,29a	4,16a	4,20a	4,26a
P4	3,79c	3,91b	3,98a	3,87b	3,89bc
P5	3,92bc	3,81b	3,66b	3,58c	3,79c

Note: Differences in letters after the mean in the same column indicate significant differences based on Duncan's test at the 5% level (P<0.05).

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Based on the results of the variance analysis, there were differences between treatments in terms of color, aroma, texture, taste, and overall acceptance of the characteristics of ladyfinger that used wheat flour and pumpkin flour substitutes.

Based on the assessment of hedonic quality characteristics, which include color quality and texture quality, as shown in Table 2.

Tabel 2. Average Hedonic Quality Test for Ladyfinger

Treatment	Average Hedonic Quality Test	
	Color	Texture
P1	1,78c	2,57b
P2	1,98b	2,28c
P3	2,82a	2,81a
P4	2,80a	2,54b
P5	2,81a	2,53b

Note: Differences in letters after the mean in the same column indicate significant differences based on Duncan's test at the 5% level (P<0.05).

Based on the results of variance analysis on the color and texture quality of ladyfinger using different substitutions of wheat flour and pumpkin flour, it was found that there was a significant effect of different substitutions of wheat flour and pumpkin flour on the color and texture quality of ladyfinger.

An objective analysis was conducted to determine the crude fiber and beta-carotene content in ladyfinger with wheat flour substituted with pumpkin flour. The results of the crude fiber and beta-carotene content analysis in ladyfinger as show in Table 3.

Tabel 3. Average Objective Test for Ladyfinger

Treatment	Average Objective Test	
	Crude Fiber(%)	Beta-Carotene (mg/100 g)
P1	0,365b	7,91a
P2	0,388ab	7,77a
P3	0,398ab	8,32a
P4	0,423ab	8,40a
P5	0,467a	7,61a

Note: Differences in letters after the mean in the same column indicate significant differences based on Duncan's test at the 5% level (P<0.05).

Based on the results of variance analysis of crude fiber content in ladyfinger using the substitution of wheat flour and different pumpkin flours, it was found that F count (7.736) > F table 5% (3.83). which means that there is an effect of substitution of wheat flour and pumpkin

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flour on the crude fiber content of ladyfinger, with the average crude fiber content contained in ladyfinger ranging between 0.365% up to 0.467%.

The best treatment value for ladyfinger with wheat flour and pumpkin flour substitution was obtained by P3, which received the highest score notation a of 8 points. These results indicate that P3 (80% wheat flour: 20% pumpkin flour) was the best treatment of the five. After P3 was identified as the best treatment, objective analysis was conducted on the protein, fat, carbohydrate, ash, and water content of the third treatment of Ladyfinger.

The values of protein, fat, carbohydrate, ash content and water content in ladyfinger with wheat flour substitution with pumpkin flour in the best treatment were obtained that cat's tongue cake with wheat flour substitution with pumpkin flour in the best treatment (P3) can be seen in Table 4.

Tabel 4. Nutritional Value of Ladyfinger Best treatment

Treatment	Protein (%)	Fat (%)	Carbohydrate (%)	Ash (%)	Water (%)
P3	3,887	30,44	56,569	1,598	3,279

The protein, fat, carbohydrate, ash, and water content values in ladyfinger made with substituted wheat flour with pumpkin flour in the best treatment showed that ladyfinger made with substituted wheat flour with pumpkin flour in the best treatment (P3) had a protein content of 3.887%, fat content of 30.448%, carbohydrate content of 56.569%, ash content of 1.598%, and water content of 3.279%.

DISCUSSION

Color is another factor that influences consumer perception of a food. The external appearance of a food product is often used to determine consumer preferences(Tutuhatunewa, 2020).

From the average results of the color preference test for cat's tongue cookies, the lowest average value was obtained in P4, which was 3.79 (Like) and the highest average value was obtained in P3, which was 4.23 (Like). In the color quality test for ladyfinger, the lowest average value of the color quality test was found in ladyfinger in P1, which was 1.78 (Yellow) and the highest value was obtained in P3, which was 2.82 (Brownish Yellow). Based on the

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average value, it was found that the higher the substitution of wheat flour with pumpkin flour, the browner the ladyfinger. The brownish color is caused by the baking process, which causes the Maillard reaction and caramelization. The Maillard reaction is a non-enzymatic browning process that occurs when proteins and carbohydrates, especially reducing sugars, react with the amine groups in food ingredients. High temperatures catalyze this reaction, resulting in a brown color(Mufida et al., 2023).

The results of this study are in line with research conducted by Rasyid et al. (2020), which states that there is an effect of substituting pumpkin flour on the level of cookie color preference with the resulting pumpkin flour substitution. When pumpkin flour is added, the final color of the cookies is usually yellowish brown. If more pumpkin flour is added, the color of the cookies will be more yellowish brown (Rasyid et al., 2020).

The aroma of food can be evaluated using the sense of smell by detecting the aroma it emits. Aroma plays an important role in influencing the overall taste and quality of food, as it directly affects consumers' first impressions. In the food industry, aroma is important to test because it can be an indicator of production quality. In addition, aroma plays a role that is just as important as color, because these two attributes together influence the level of consumer acceptance of the food products produced(Khalisa et al., 2021).

Based on the average value of ladyfinger aroma preference test, the lowest average value was obtained at P5, which was 3.81 (Like) and the highest average value was at P3, which was 4.29 (Like). Based on several panelists' opinions, the decrease in the panelists' level of preference for the treatment with the highest pumpkin flour ratio was caused by the unpleasant smell of ladyfinger. This is caused by the presence of volatile compounds in pumpkin which play a role in producing this distinctive aroma(Salsabila et al., 2024).

This is consistent with research by Noviati and Purwani (2017), which found that cookies substituted with pumpkin flour had a strong pumpkin aroma, making them less popular among panelists. This is due to volatile compounds remaining during processing, resulting in cookies with a distinctive pumpkin aroma(Noviati & Purwani, 2017).

Texture is more often used as a standard for assessing food quality than color and aroma, which are usually used as markers of food safety(Oktaviana et al., 2023). Based on the average value of the preference test for the texture of ladyfinger, the lowest average value was obtained

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at P5, which was 3.66 (liked) and the highest average value was obtained at P3, which was 4.16 (liked). In the texture quality test for ladyfinger, the lowest average value was obtained at P2, which was 2.28 (slightly crunchy) and the highest average value was obtained at P3, which was 2.81 (crunchy). The crunchy texture of ladyfinger is caused by the presence of gluten. Gluten is a protein commonly found in wheat flour and plays an important role in providing elasticity and firmness to the resulting product, thus affecting its texture. The higher the gluten content, the resulting product tends to be crispier. Conversely, a low gluten content can reduce the elasticity of the dough, resulting in a harder cake texture after the baking (Ambarwati, 2020).

The results of this study align with those of Agus et al. (2020), which showed that increasing the amount of pumpkin flour used resulted in a decrease in breakability. Conversely, increasing the amount of wheat flour used resulted in a higher breakability, indicating that the biscuits were more difficult to break. This is due to the glutenin and gliadin content in wheat flour, which combine to form gluten. Gluten forms a compact protein-starch matrix, resulting in a harder and firmer biscuit texture(Agus et al., 2023).

Taste is a component that requires the interaction of several senses, especially the sense of taste (tongue). Consumer preferences for food are largely determined by taste, as it allows consumers to judge whether a food is delicious or not. Choosing the right basic ingredients is very important for creating foods that consumers enjoy, because the ingredients used greatly affect the taste of a food product. Based on the average taste rating for ladyfinger, the lowest average rating was found in P5, which was 3.58 (somewhat liked), and the highest average rating was in P3, which was 4.20 (liked). The higher the ratio of pumpkin flour, the lower the panelists' level of liking.

The results of this study align with those of Maulidya et al. (2023), which showed that pumpkin flour substitution significantly affected the taste of pumpkin cookies. Higher levels of pumpkin flour substitution tended to decrease panelists' preference for the taste of pumpkin cookies (Maulidya et al., 2023).

The assessment of color, taste, aroma, and texture are aspects that are included in assessing overall acceptance by the panelists. The highest average score for overall acceptance was found in P3, which was 4.26 (like), and the lowest average score was found in P5, which

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was 3.79 (like). The third treatment was preferred by the panelists because it had the color, aroma, texture, and taste that the panelists liked.

Crude fiber refers to the part of food that is resistant to damage by chemicals, such as sodium hydroxide and sulfuric acid, which are commonly used in fiber content analysis (Hardiyanti & Nisah, 2021). Based on the results of the study, the crude fiber content had an average value of between 0.365% until 0.467%. The lowest average value in P1 was 0.365% and the highest average value in P5 was 0.467%. The difference in crude fiber content in ladyfinger occurs due to differences in the ratio of wheat flour and pumpkin flour. The higher the substitution of pumpkin flour, the higher the crude fiber content of ladyfinger. This is because pumpkin flour has a higher crude fiber content than wheat flour.

The results of this study are in line with Maulidya et al. (2023). The substitution of pumpkin flour has a very significant effect on the crude fiber content of cookies. In addition, the crude fiber content in the resulting product is due to the high crude fiber content in the ingredients used (Maulidya et al., 2023).

Pumpkin contains beta-carotene, a pigment that can be used as an anti-cancer agent by preventing damage caused by free radicals. It is this compound, called carotenoid, that gives pumpkin flesh its golden color(Saeroji et al., 2023). Based on the results of the study, it was found that the beta-carotene content in ladyfinger increased by 7.61 mg/100 g to 8.40 mg/100 mg, but decreased slightly in P5. The increase in beta-carotene content in this study is in line with the results of a study Panjaitan & Rosida (2021) which explains that F1 (addition of 27.5% pumpkin flour with 2.5% moringa leaf flour) had the highest beta-carotene content of 0.214% compared to F1 (addition of 22.5% pumpkin flour with 2.5% moringa leaf flour), which was only 0.193% (Panjaitan & Rosida, 2021).

Beta-carotene found in pumpkin is a pigment rich in pro-vitamin A, which can be converted into vitamin A by the body. Therefore, pumpkin can be used as an alternative source of vitamin A to prevent vitamin A deficiency (Halimah & Rahmawati, 2021).

This study produced 25 ladyfinger weighing 6 gram. Proximate analysis showed that ladyfinger in P3 contained 3.887% protein, 30.448% fat, 56.569% carbohydrates, 3.279% water, and 1.598% ash. The ladyfinger in P3, which were rated as the best by the panelists, had a water content of 3.279%. Based on the SNI (2011) quality requirements, the maximum

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moisture content limit is 5%, so the water content of the ladyfinger met the quality requirements (SNI 2973:2011, 2011).

Beta-carotene found in pumpkin is a pigment rich in pro-vitamin A that can be converted into Vitamin A by the body. Vitamin A activity in food can be expressed in retinol equivalent (RE) units, where 1 RE of Vitamin A is equivalent to 6 µg of beta-carotene(Inosenshia et al., 2024). In P3, it contains 8.32 mg of beta-carotene/100 g of beta-carotene, which is the same as Vitamin A of 1,386.67 RE/100 g.

Ladyfinger are generally consumed as a snack, with one serving of snacks amounting to 10% of the daily requirement. The nutritional content of ladyfinger in one portion (30 grams) under optimal conditions is 154.76 kcal of energy, 1.17 g of protein, 9.13 g of fat, and 166.97 g of carbohydrates, 0.12 g of crude fiber, and 416.1 RE of vitamin A. According to the AKG (2019), adults aged 19-29 need an average of 2450 kcal of energy, 62.5 g of protein, 70 g of fat, and 395 g of carbohydrates, 69 g of crude fiber and 1250 RE of Vitamin A (AKG, 2019). Consuming 1 portion of cat's tongue cake with wheat flour and pumpkin flour substitution can fulfill 6.32% of energy, 1.87% of protein, 13.04% of fat, 4.30% of carbohydrates, 0.17% of crude fiber and 33.29% of vitamin A in the daily snack requirement.

CONCLUSION(S)

Based on the results of the research, data analysis, and discussion described above, it can be concluded that: The organoleptic quality results for ladyfinger with substitution of wheat flour with pumpkin flour produced a color level of 3.79–4.23 (like), aroma 3.91–4.29 (like), texture 3.66–4.16 (like), taste 3.58–4.20 (like), overall acceptance 3.79–4.26 (like), color quality 1.78 (yellow) – 2.82 (brownish yellow), texture quality 2.53 (slightly crispy) – 2.81 (crispy). The results of crude fiber content in ladyfinger showed a significant difference, with crude fiber content ranges between 0.365% and 0.467%, while the results of beta-carotene content in ladyfinger showed no significant difference, with beta-carotene content ranges between 7.612 and 8.403 mg/100g. Ladyfinger with different substitution of wheat flour and pumpkin flour had a significant effect on the organoleptic test, including color, aroma, texture, taste, overall acceptance, color quality test, and texture quality test. Based on the best acceptance results for ladyfinger with wheat flour substitution with pumpkin flour, P3 had the

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best results with 80% wheat flour substitution: 20% pumpkin flour with characteristics of color, aroma, texture, taste, and overall acceptance preferred by panelists with a crude fiber content of 0.398% and a beta-carotene content of 8.32 mg/100g. Based on the results of protein, fat, carbohydrate, ash, and water content in ladyfinger with wheat flour substitution with pumpkin flour at the best acceptance, namely P3 (wheat flour substitution 80% : yellow pumpkin flour (20%) had a protein content of 3.887%, fat content of 30.448%, carbohydrate content of 56.569%, ash content of 1.598%, and water content of 3.279%.

The production of ladyfinger with substitution of wheat flour and pumpkin flour is recommended to use a ratio of 80% wheat flour to 20% pumpkin flour, as this is acceptable in terms of overall organoleptic quality, including color, aroma, texture, taste, color quality, and texture quality. It is also recommended that when making ladyfinger with substitution of wheat flour and pumpkin flour, food ingredients that can increase the protein and beta-carotene content of ladyfinger be added.

Conflict of Interest

We all authors declare that there is no conflict of interest from this research activity

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