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Organoleptic Test of Boba Flour Substitution of Pumpkin Seeds High in Fiber and Protein

Maurizka Sabrina Septia[1], Septa Katmawanti[1], Supriyadi[1]
[1] Public Health Department, Universitas Negeri Malang, Indonesia

Abstract

In 2013, the obesity rate in Indonesia for people over the age of 18 was 14.8 percent; by 2018, the obesity rate had risen to 21.8%. The significant number of fat people in Indonesia is caused by high sugar consumption and low fiber consumption regularly. 100 grams of pumpkin seeds contain 6 grams of fiber, 30.23 grams of protein, 7.2 mg/100 zinc, polyunsaturated fatty acids, and phytosterols. The purpose of this study is to identify the panelists' level of preference for four formulations of pumpkin seed flour boba using assessment factors such as taste, color, texture, and aroma. The procedural model was used in this research and development. This development study utilizes an opinion-based process, which is then modified based on research needs. Organoleptic testing on boba products without added milk drinks on untrained panelists revealed a significant difference in color and texture parameters. There was no significant difference in panelist acceptability of aroma and taste characteristics. The findings of the untrained panelist's appraisal of boba added to a milk companion drink were then presented, revealing significant changes in the color and texture parameters. Furthermore, there were no statistically significant changes in the aroma and taste indices.

Keywords: *Boba, Pumpkin Seed Flour, Obesity*

INTRODUCTION

In 2013, the obesity rate in Indonesia for people over the age of 18 was 14.8 percent; by 2018, the obesity rate had risen to 21.8% [1]. Obesity sufferers in East Java province in 2013-2018 with the age of more than 18 years experienced a significant increase. The significant number of fat people in Indonesia is due to high sugar consumption and low fiber consumption on a regular basis. In 2018, Indonesians used 11.47 kg of sugar per person per year, or 32 grams per person per day [2]. The young adult age group (>19 years) consumes the highest extra sugar by age, accounting for more than 13 percent of the population [3].

Obesity is induced not just by excessive sugar consumption, but also by a lack of fiber consumption, such as vegetables and fruit. According to a 2013 study conducted by Kumboyono et al., 62% of Malang schoolchildren dislike vegetables [4]. The daily fiber consumption of Malang City teenagers is 3.19 g/day, which is much less than the recommended daily fiber consumption of 25 g/day [8]. According to the SKMI analysis, fruit and vegetable consumption in Indonesia remains low at 9.71%, with the adolescent age group dominating this figure [5].

Cucurbita moschata seeds, also known as pumpkin seeds, are a good source of protein and fiber in Indonesia. According to Central Bureau of Statistics data, pumpkin production in Indonesia reached 942,928 kg in 2015, while it fell slightly to 805,173 kg in 2016 [6]. *C. moschata* seeds, sometimes known as pumpkin seeds, are abundant in fiber, protein, minerals, and antioxidants.

Corresponding author
Maurizka Sabrina Septia, maurizkasabrina@gmail.com
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Pumpkin seeds contain 6 grams of fiber and 30.23 grams of protein per 100 grams, as well as 7,2 mg of zinc per 100 grams, double unsaturated fatty acids, and phytosterols. Amino acids, Mg (magnesium), vitamin E (tocopherol), carotenoids, cryptoxanthin, monocyclic sesquiterpenoids, and trypsin inhibitors that can inhibit peroxides that turn into free radicals and oxidize unsaturated fatty acids in cell membranes are also beneficial to the body [7].

C. moschata seeds have the advantage of being able to be transformed into pumpkin seed flour, which can improve usability and make it easier to process into goods with high nutritional content that can become popular. Boba is a popular product among Indonesian youth right now. Boba is generally made from tapioca flour. This is a factor in the development of boba with the addition of pumpkin seed flour, which is expected to be a product that can be consumed and is beneficial to health, particularly for obese people. Boba can be made more nutritious by adding pumpkin seed flour, which contains fiber. Adequate fiber consumption can lower the risk of obesity. This study identifies the panelists' organoleptic preference level on four formulations of pumpkin seed flour boba with assessment factors such as taste, color, texture, and aroma. This study aims to determine the organoleptic test of boba with the substitution of pumpkin seed flour (*C. moschata*) as a drink topping which is high in protein and fiber. This is a consideration in the selection of product development and novelty in this study, namely in the form of boba with the addition of pumpkin seed flour which is expected to be a product that can be consumed and is beneficial for health, especially for obese people.

LITERATURE REVIEW

Pumpkin

According to Zufahmi and Mahajoeno [9] pumpkin (*C. moschata*) is a plant source of food with high nutritional content and fine fiber, making it easy to digest. Pumpkin plants are members of the Cucurbitaceae family, which includes melons (*Cucumis melo*) and cucumbers (*Cucumis sativum*). The pumpkin fruit is made up of two layers: a hard outer skin layer and a layer of fruit flesh that serves as a storage area for nourishment. Yellow pumpkins come in "nokor" (flat round and grooved), oval-shaped, and long cup-shaped varieties. Pumpkin seeds are found in the cavity covered by mucus and fiber in the center of the fruit flesh. The seeds have a flat form with a tapering tip [9]. Based on research conducted by Kaur and Sharma [10], the acceptability of pumpkin seed flour supplementation for processed cookies is tolerable. Products processed from pumpkin seed flour such as milk, cake were also found to have high fiber content with low calorie content, and have good yields, so pumpkin seeds are very good to be used as a source of daily fiber for consumption and have many benefits. Supplementation of pumpkin seed flour in either raw or baked form in the world's favorite bakery product, namely cookies, was more acceptable than the control sample. Pumpkin seed flour supplementation up to the maximum level of 30% is acceptable. Protein, fat, ash, iron, zinc, total carotenoid content, antioxidant activity was increased in cookies supplemented with raw or baked pumpkin seed flour [10]. Several studies in diabetic rats have shown that pumpkin extract (*C. moschata*) and its seed powder can improve pancreatic islet cells and insulin production, exert a hypoglycemic effect and act as antidiabetic [11]. Pumpkin seeds are also useful as an antidote to free radicals because they contain antioxidants.

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Pumpkin Seed Composition

Pumpkin seeds are high in macronutrients (magnesium, phosphorus, and calcium) and low in micronutrients (calcium, manganese, copper, and zinc). Pumpkin seeds can be utilized as a good food supplement because they are high in nutritious value; also, pumpkin is inexpensive [12].

Table 1. Nutrient Content and Nutritional Value

Nutrient Content	Nutritional Value	RDA Percentage
Energy	559 kcal	28
Carbohydrate	10.71 grams	8
Protein	30.23 grams	54
Total fat	49.05 grams	164
Cholesterol	0 mg	0
Fiber	6 grams	16
Folate	58 g	15
Niacin	4.987 mg	31
Pyridoxine	0.143 mg	11
Riboflavin	0.153 mg	12
Thiamine	0.273 mg	23
Potassium	809 mg	17
Calcium	46 mg	4.5
Iron	8.82 mg	110
Magnesium	592 mg	148
Phosphor	1233 mg	176
Selenium	9.4 mg	17
Zinc	7.81 mg	71
Carotene-β	9 p.m	-

Pumpkin Seeds Health Benefits

Pumpkin seeds are well-known for their nutritional value. Furthermore, pumpkin seeds can be used to treat joint inflammatory illnesses and prostate cancer [12]. Pumpkin seed oil (*C. moschata*) also includes chromium, a mineral known to play a role in carbohydrate metabolism, with the best chromium absorption at 40 mcg per serving [11].

Previous Empirical Research Related to the Study

Food products with the addition of pumpkin seed flour can increase the nutritional content of higher protein. This statement is supported by research conducted by Geethanjali Santhanam and Saratha Sathappan entitled "Evaluation of Nutrients Analysis and Organoleptic Characteristics of Pumpkin Seed Flour Incorporated Flavored Drink"; the results of this study concluded that the addition of pumpkin seed flour to drinks contains many nutrients such as energy. 0,2 kcal, 15 g carbohydrates, 3 g phytic acid and 13.3 g protein [13].

Food products with the addition of pumpkin seed flour can also increase consumer acceptance of the product. This statement is supported by research conducted by Manpreet Kaur and Sonika Sharma entitled "Formulation and Nutritional Evaluation of Cookies Supplemented

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With Pumpkin Seed (*C. moschata*) Flour", the results of this study concluded that supplementation of pumpkin seed flour to cookie products can increase 30% product acceptability [10].

RESEARCH METHOD

Research and Development Model

The procedural model was applied to conduct this research. The procedural model is a descriptive model that depicts the actions that must be taken in order to produce a product [14]. The procedure utilized in this research and development is based on opinion [15], and it is then modified based on the research demands.

Materials and tools

Tapioca flour, pumpkin seed flour, sugar, water, and food coloring were the ingredients used in this research. Among the tools used were a blender, basin, teflon, sieve, spatula, pan, knife, and a memmert oven.

Making pumpkin seed flour

The initial step is to select pumpkin seeds. Pumpkin seeds with no skin should be utilized to avoid a bitter taste. Furthermore, pumpkin seeds without skin are mashed in a blender for 8-10 minutes to make a powder, which is then filtered through a sieve with a mesh size of 60 to get a homogeneous particle size and smooth texture. The pumpkin seeds are then stored at a room temperature of 28-30^{o}C [16].

Making Boba

Weighing the ingredients according to the formulation is the first step in creating boba with pumpkin seed flour substitute. Each formulation contains the same amount of water and sugar, weighing 20 and 13 grams, respectively. The pumpkin seed flour and tapioca flour ingredients were then adjusted for each formulation F0 (0g:45g), F1 (4.5g:40.5g), F2 (9g:36g), and F3 (13.5g:31.5g). After weighing everything, add the water and sugar to the pan and cook until the sugar is melted, then add the flour little by little, stirring constantly, until the dough becomes smooth and ready to shape. After shaping the dough into a round, it will be boiled for 30 minutes, or until the surface becomes transparent.

Boba's Formula

This study's boba formula concentrated on variations in the size of pumpkin seed flour utilized, with four treatments: 0%, 10%, 20%, and 30%. In the production of boba, this concentration of pumpkin seed flour will replace the use of tapioca flour.

Table 2. Boba Formula

Ingredients	Boba's Formula (g)			
	F0	F1	F2	F3
Pumpkin Seed Flour	0	4,5	9	13,5
Tapioca Starch	45	40,5	36	31,5

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Palm sugar	13	13	13	13
Water	20	20	20	20
Food coloring (black)	0,67	0,67	0,67	0,67

Organoleptic Test Assessment

Organoleptic testing was carried to examine the panelists' response to boba products. Color, aroma, taste, and texture are among the parameters assessed in the organoleptic implementation. The organoleptic test was performed using a hedonic scale or a scale to evaluate the level of preference consisting of 5 scales: very much like (5), very like (4), like (3), somewhat like (2), dislike (1).

Trained Panelists

There are 3 nutritionists or culinary experts involved in data collection. This trained panelist is someone who has the ability and high sensitivity to product quality specifications and has knowledge and experience of organoleptic assessment methods. Based on National Standardization Agency [17], has stipulated SNI 2346:2015 regarding the instructions for Organoleptic and/or Sensory Testing which states that the minimum number of trained panelists in one test is 3 people.

Untrained Panelists

Students of the Faculty of Sports Science majoring in Public Health with a total of 30 people who were taken with the classification of 15 women and 15 boys, teenagers with an age range of 10-18 years to young adults with an age range of 19-24 years. Students as panelists are not trained in organoleptic assessment and testing. Based on National Standardization Agency [17], has stipulated SNI 2346:2015 regarding the instructions for Organoleptic and/or Sensory Testing which states that the minimum number of untrained panelists in one test is 30 people.

Data Collector

The data collection instrument used a questionnaire, with a hedonic scale. The hedonic test is the most widely used test to measure the level of preference for the product. This level of preference is called a hedonic scale, for example, like very much, like, somewhat like, somewhat dislike, dislike, very dislike and so on. The hedonic scale can be stretched or collapsed according to the desired scale range. In the analysis of the data, the hedonic scale is transformed into a number scale according to the level of preference (can be 5, 7 or 9 levels of preference). With this data, statistical analysis can be done. The hedonic scale used is 5 hedonic scale consisting of very much like (5), very like (4), like (3), somewhat like (2), dislike (1).

Statistic test

The results of the organoleptic test in the form of qualitative will be converted into quantitative and tabulated in a table, then analyzed by Friedman Test using data processing applications. The results of the organoleptic test assessment can be seen from the priority weight values of the product parameters which are the final choice of the panelists from all the organoleptic parameters tested. The results of the weighting order of product criteria based on the highest to lowest weight values

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are taste, aroma, color and texture. The results of the analysis of the weighting of the assessed product criteria can be used to develop product quality so that it is preferred by consumers.

FINDINGS AND DISCUSSION

Findings

Trained Panelists

The average value of organoleptic results from trained panelists on boba with pumpkin seed flour substitution is shown below.

Table 3. The Average Score of The Organoleptic Test of Boba Flour Substitute of Pumpkin Seed Flour Trained Panelists

Formulation	Average Score			
	Color	Aroma	Texture	Taste
F0	4,33	4,33	4,00	4,33
F1	2,67	3,67	3,33	2,67
F2	2,67	3,67	3,67	3,00
F3	3,33	4,33	4,00	4,00

According to Table 3, the highest color parameter assessment findings were discovered in the F0 formulation, namely 4.33, and the lowest in the F1 and F2 formulations, respectively 2,67. The F0 and F3 formulations had the highest aroma rating, 4,33, while the F1 and F2 formulations received the lowest, 3,67. Meanwhile, the highest texture assessment was in the F0 and F3 formulations, namely 4.00, and the lowest was in the F1 formulation, namely 3,33. The F0 formulation received the highest rating from the panelists, with a score of 4,33, and the F1 formulation received the lowest rating, with a score of 2,67. Friedman test analysis on the color parameter trial of trained panelists, with a p-value of 0,218, revealed that there was no significant difference in panelist acceptability between the four formulations. According to the aroma of the Friedman test results, the p-value of 0.644 indicates that there was no significant difference in the panelists' acceptability between the four formulations. The Friedman test findings for texture parameters have a p-value of 0.861, showing that there was no significant difference in panelist approval between the four formulations. The taste parameter has a Friedman test result with a p-value of 0.157, showing that there was no significant difference in panelist approval between the four formulae.

Untrained Panelists (Without Milk)

The average value of untrained panelists' organoleptic test results on boba with pumpkin seed flour substitution is as follows. According to Table 4, the color parameter of the control formulation (F0) had the highest average score of 3,33 out of the 30 panelists that assessed boba with pumpkin seed flour substitution. F3 has the lowest average value, with a score of 2,37. The aroma parameter was rated highest by the panelists in the F2 formulation, with a score of 2,80, and lowest in the F1 and F3 formulations, with a score of 2,50. The F0 formulation has the highest texture rating of 2,87, while the F3 formulation has the lowest texture rating of 2,20. The F2 formulation had the highest taste rating of 2.63, while the F1 formulation received the lowest, namely 2,07. The color and

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texture parameters in the Friedman test show p-values of 0.000 and 0.004, respectively, indicating there was a significant difference in panelist approval. The aroma and taste parameters exhibit p-values of 0.457 and 0.339, respectively, showing there was no significant difference in the panelists' acceptance of the four formulations.

Table 4. The Average Score of Untrained Panelists' Organoleptic Test of Pumpkin Seed Flour Substitute (Without Milk)

Formulation	Average Score			
	Color	Aroma	Texture	Taste
F0	3,33	2,77	2,87	2,27
F1	2,47	2,50	2,77	2,07
F2	2,70	2,80	2,27	2,63
F3	2,37	2,50	2,20	2,53

Untrained Panelists (Milk)

Table 5 shows the results of an organoleptic assessment of boba products with pumpkin seed flour substitution by untrained panelists.

Table 5. The Average Score of Untrained Panelists' Organoleptic Test of Pumpkin Seed Flour Substitute (With Milk)

Formulation	Average Score			
	Color	Aroma	Texture	Taste
F0	3,43	3,13	3,50	3,57
F1	3,37	3,00	3,53	3,67
F2	2,93	2,97	3,17	3,60
F3	2,80	2,93	2,70	3,17

Table 5 displays the organoleptic assessment results of 30 untrained panelists for boba products with complimentary milk drinks, specifically F0 and F1, which are the most favored formulations with high average values for each parameter. Friedman test results on each parameter, specifically the color and texture of the Friedman test results, had p-values of 0.001 and 0.005, showing a significant difference in panelist approval. The Friedman test results in aroma and taste have p-values of 0.496 and 0.107, respectively, showing that there was no significant difference in panelist approval amongst the four recipes.

Discussion

The panelists' organoleptic test findings from the four boba formulations with pumpkin seed flour substitution based on four organoleptic parameters, namely color, aroma, texture, and taste, revealed that all formalizations were acceptable. For boba without the addition of milk, the average score of the organoleptic test was 2,5-2,8, putting it in the "somewhat like" category. Meanwhile,

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the panelists enjoyed boba with the addition of a supplementary drink, namely milk. The average score of boba with milk is 2,9-3,4 or in the category of "somewhat like".

This is supported by statistical data on boba without complimentary drinks, which indicates no significant variations in the aroma and taste parameters. In the meantime, the color and texture parameters had a significant impact. The statistical results on boba with milk drinks reveal that there is no difference in taste and aroma parameters. Meanwhile, the color and texture parameters have a significant impact. Based on the highest overall evaluation score for boba without supplementary drinks, namely the control formulation (F0). Meanwhile, the control formulation (F0) and the first formulation (F1) with a concentration of 4.5 grams of pumpkin seed flour have the highest overall score for boba with a supplementary beverage. It can be inferred from this study that when boba was made with pumpkin seed flour substitution, four formulations were obtained in a row as much as 0, 4,5, 9, 13.5 grams with a combination of tapioca flour in rows 45, 40.5, 36, 31, 5 grams, 13 grams of sugar, and 20 grams of water.

CONCLUSION & FURTHER RESEARCH

This research and development resulted in four different product formulations. The four formulations consisted of one control formulation with or without pumpkin seed flour substitution (F0) and three formulations with pumpkin seed flour substitution, namely F1, F2, F3. There are differences in the composition of pumpkin seed flour and tapioca flour in each formulation. The control formulation (F0) had a ratio of (0:45), F1 (4,5:40,5), F2 (9:36), and F3 (13.5:31,5). The percentage of formulation used in F0:F1:F2:F3 is 0%:10%:20%:30%. The production of boba in this research and development uses ingredients such as pumpkin seed flour, tapioca flour, sugar, and water.

The product specification produced from boba with pumpkin seed flour substitution is that it has a round shape with a diameter of 1 cm. The results of organoleptic tests on color parameters showed that the color of the boba became more concentrated. Boba with pumpkin seed flour substitution has a green color due to the addition of food coloring. The results of the organoleptic test of the aroma parameters there was no significant difference this was because the aroma of the pumpkin seeds was not too strong. The results of the organoleptic test of the texture parameter are that the boba is less chewy. The results of organoleptic tests on taste parameters, namely pumpkin seed flour contains protein and fat that can bring out the savory taste of boba products.

APPENDIX A. Supplementary Data

Supplementary data related to this article can be found at https://bit.ly/OrganolepticTest

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