Sensory Analysis of Puff Snacks: Impact of Tempeh Powder Addition on Product Quality

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ABSTRACT. Tempeh is a fermented food by the fungus Rhizopus Oligosporus and is made from soybean seeds which are rich in protein and dietary fiber. Tempeh has become a food choice that is rich in nutrients and has broad health potential. In this study, tempeh was incorporated into puff snacks using an extrusion machine as a substitute for wheat flour, aiming to determine the optimal formula. Different percentages of tempeh flour (5%, 10%, 15%, 20%, and 25%) were used. Organoleptic testing was conducted to assess the preferred formula. The findings of the organoleptic evaluation of the use of tempeh flour with a substitution rate of up to 10% were well received in terms of sensory attributes.

Keywords: Tempeh; organoleptic; puff snacks; extrusion; protein

1. INTRODUCTION

Tempe has several health benefits. It is a healthy food for all age groups due to its nutritional content. The fermentation process of soybeans into tempeh inactivates anti-nutritional components such as antitrypsin, antichymotrypsin, tannins, saponins, phytic acid, and hemagglutinin, making it safe for consumption (Aryanta, 2020).

This makes tempeh very good for consumption by all age groups. The amino acids contained in tempeh are also 24 times higher than soy milk (Menkes, 2022).

Tempeh, which originates in Indonesia, is a traditional food made by fermenting soybean seeds using either Rhizopus oligosporus or Rhizopus oryzae fungi. This fermentation process brings about a remarkable change in the soybeans, leading to the formation of food components that are rich in nutrients and possess a unique texture. As an exceptional plant-based protein source, tempeh is abundant in essential nutrients like fiber, iron, calcium, and various other beneficial elements. Additionally, tempeh contains enzymes that play a vital role in breaking down anti-nutritional compounds present in soybeans, thereby facilitating better absorption of nutrients by the body (Rahayu et all, 2015).

Since legumes often lack enough methionine, they are categorized as incomplete protein sources. Complete protein foods, on the other hand, are mostly found in animal-based products. It's crucial for children to have a varied diet to avoid stunting, which means combining animal-based foods with plant-based foods to achieve a balanced and sufficient diet. To enhance the nutritional value of tempeh, it can be consumed alongside other foods, like corn, which contains enough methionine (Mohamed et al, 2022).

Extrusion technology plays a significant role in the field of food technology science, offering a range of important applications. Among them, a prominent use lies in efficiently producing various products, including puff snacks. Puff snacks are a specific type of snack crafted from flour and undergo a process known as puffing or hot expansion. This method transforms the raw

ingredients into delectable treats with a distinct light and crunchy texture. Puff snacks often take on a round or hollow shape, making them enjoyable and satisfying to eat (Lindriati & Handayani, 2018). To make puff snacks, the main ingredients, like flour, are heated at high temperatures and pressure. The moisture inside the material gets trapped, and the pressure makes it explode and expand, forming a hollow structure. This process turns the snacks light, crispy, and much larger than before (Lindriati & Handayani, 2018).

The sensory organoleptic test is a technique employed to assess and gauge human sensory reactions towards the physical qualities of a product that can be observed, felt, and recognized through the senses, including taste, smell, appearance, texture, and color. One of the organoleptic tests includes the hedonic test. During this test, trained individuals or potential consumers will sample or use the product and share their personal evaluations and responses regarding its organoleptic attributes. The test utilizes a predefined rating method and scale to standardize the assessment process (Meilgaard et all, 2016).

The hedonic test is a technique to measure consumer preference for a product or ingredient. Participants rate product samples based on their liking levels, categorized from "dislike very much" to "like very much." This method is widely used in various industries to understand consumer preferences, compare products with competitors, and identify factors affecting consumer satisfaction. The test results are crucial for market research, product development, marketing strategies, and innovation (Lusas & Rooney, 2001).

Figure 1. Hedonic Rating Scale
Source: Lucas & Rooney, 2001

2. METHODOLOGY

Before starting the research, preliminary research was done to find the right formula. The formula was chosen based on its ability to create a snack texture that closely resembled the crispy and airy inside of puff snacks. The production of tempeh powder-based puff snacks was carried out using a twin-screw extrusion machine.

This study made snacks using a machine called a twin-screw extruder. The figure 2 shows how puff snacks are made using tempeh flour.

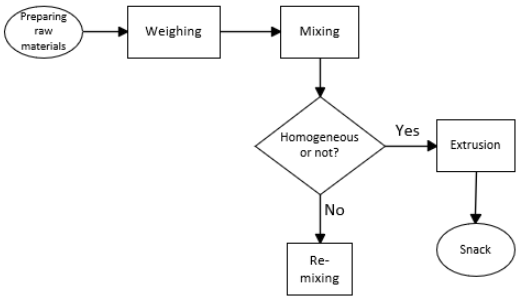

Figure 2. The process of making puff snacks

Various treatments were conducted to compare the effects of corn flour and tempeh flour, with the corn flour quantity decreasing by five percent of the total mass from the second treatment to the fifth treatment. "On the other hand, the tempeh powder quantity increased by five percent of the total mass from the second treatment to the fifth treatment (see table below).

Material	Formula A	Formula B	Formula C	Formula D	Formula E
Corn Flour	71%	66%	61%	56%	51%
Rice Flour	10%	10%	10%	10%	10%
Tempeh Flour	5%	10%	15%	20%	25%
Cocoa Powder	4.60%	4.60%	4.60%	4.60%	4.60%
Salt	1%	1%	1%	1%	1%
Baking Powder	0.40%	0.40%	0.40%	0.40%	0.40%
Water	8%	8%	8%	8%	8%

Figure 3. Formulation

Furthermore, after the five puff snack formulas were produced, sensory analysis using hedonics was carried out. The data collection for the organoleptic test relies on the panelists' sensory perception. Each participant sampled five snacks with various formulations, assessing five attributes: texture, aroma, taste, appearance, and aftertaste.

3. RESULT

The hedonic test was carried out by 30 panelists. Panelists were asked to provide scores based on attributes with a predetermined value scale. The results of the hedonic test can be seen in figure 4. When the notation column displays the same letter, it signifies that the numbers in the average preference column for the snacks are not significantly different at alpha = 0.05.

Formula	Texture	Aroma	Taste	Appearance	After Taste
A	5.3 a	4.633 ab	5.567 a	4.433 ab	4.7 a
B	4.933 a	4.7 ac	5.667 a	4.233 ac	4.8 a
C	2.367 bc	4.1 bcde	3.867 bc	3.267 de	3.833 b
D	2.167 bd	3.667 df	3.2 bd	3.667 bcd	2.9 c
E	2.9 cd	3.9 ef	3.6 cd	2.867 e	3.033 bc

Figure 4. Hedonic Test Result

In the figure 5 below, the dark blue color shows the results of formula A, the orange color shows the results of formula B, the gray color shows the results of formula C, the yellow color shows the results of formula D, and the bright blue color shows the results of formula E, with the height of the bar representing the score or average value of the organoleptic test results. If the stem height is higher, it means that the formula has a higher mean score in the organoleptic test, indicating a better preference.

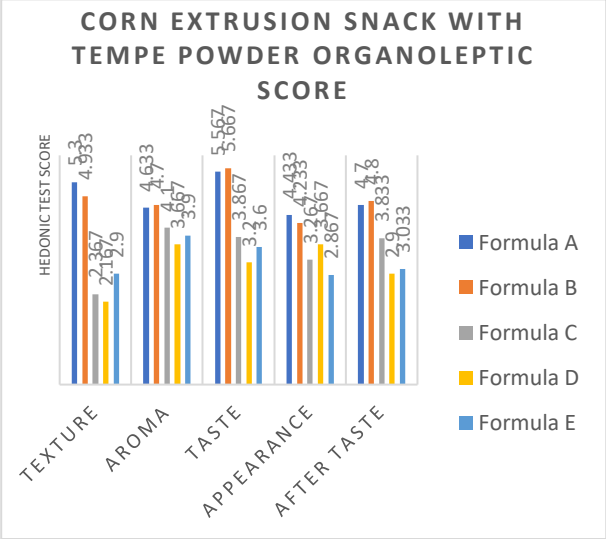

Figure 5. Organoleptic Score

Figure 5 shows that the panelists' preferences lean towards Formula A (blue line) or B (orange line) across various attributes. For texture and appearance, Formula A received the highest preference, with average scores of 5.3 and 4.433, respectively. On the other hand, Formula B was favored the most for aroma, taste, and aftertaste, obtaining average scores of 4.7, 5.667, and 4.8, respectively.

In the Formula A, the outcome of the product indicates that it meets the desired texture criteria. When consuming puff snacks made with Formula A, they exhibit a pleasing crunchiness without being excessively hard or brittle, making them less prone to breakage. The scent resembles that of cardboard. On the positive side, the taste is enjoyable; however, there is a lingering bitter aftertaste. In terms of appearance, they resemble light-colored nuts.

Figure 6. Puff Snack Formula A

Formula B produces similar results to Formula A. The texture is already in line with the desired crunchiness. Like Formula A, it has a cardboard-like smell, but the taste is an improvement. Although there is a slight bitter aftertaste, it's still enjoyable to eat on its own without adding anything like sugar. The appearance is also nut-like, with a good rise and a light brown color.

Figure 7. Puff Snack Formula B

This formula shows noticeable changes in its physical properties. For Formula C, the texture is harder compared to Formula A and B, making it less pleasant to chew. The aroma is similar to the other formulas, and the taste is even more bitter than Formula A and B. Additionally, the appearance is no longer nut-like; instead, it resembles a small pillow with a darker color than Formula A and B. The bitter aftertaste also persists more in Formula C than in Formula A and B.

Figure 8. Puff Snack Formula C

Formula D shares a texture similar to Formula C, lacking the puffiness or crunchiness seen before. Instead, it becomes difficult to chew, resulting in a denser appearance. The aroma shows no significant difference from other formulas, and the taste is even more bitter compared to the previous ones. The bitter aftertaste is also stronger than in the other formulas.

Figure 9. Puff Snack Formula D

The final formula, Formula E, bears similarities to Formula C and D. Its texture is cartilaginous, resembling the density observed in Formula D. The aroma is also similar to other formulas, and it possesses the most intense bitterness in taste, which consequently affects its aftertaste, making it the most bitter of all the formulas.

Figure 10. Puff Snack Formula E

4. CONCLUSION

This research indicates that the choice of different ingredients in the formula influences the preferences for texture, aroma, taste, appearance, and aftertaste. Based on the hedonic test, Formula A is the most favored for texture, receiving an average score of 5.3 (slightly liked), and appearance with 4.433 (neither liked nor disliked). On the other hand, Formula B is the top choice for aroma with a score of 4.7 (neither liked nor disliked), taste with 5.667 (slightly liked), and aftertaste with 4.8 (neither liked nor disliked).

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