

Development And Acceptability Of Cookie Added With Shiitake Mushroom (*Lentinula Edodes*)

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Abstract

Shiitake mushrooms (*Lentinula edodes*) are nutrient-rich fungi, valued for their vitamins, minerals, and antioxidants, yet their use in functional bakery products remained limited. This study developed and evaluated cookies enriched with shiitake mushroom powder as a health-oriented, functional snack. The objectives were to determine sensory and consumer acceptability, assess proximate composition, and compare overall acceptability with traditional cookies. An experimental research design was employed. Three treatments with varying mushroom powder content and a control were prepared following a systematic procedure: cleaning, chopping, sautéing, cooling, powdering, sifting mushrooms, mixing ingredients, resting, rolling, cutting, baking, cooling, packaging, labeling, and storing. Sensory evaluation was conducted by ten semi-trained experts and forty randomly selected consumers using a Nine-Point Hedonic Scale, and data were analyzed using weighted mean and ANOVA. Moisture and ash contents were measured to determine product stability and mineral composition. Treatment 2, containing 15g of mushroom powder, consistently received the highest ratings: color (8.04), aroma (8.00), taste (8.02), texture (7.98), and overall acceptability (8.08). Proximate analysis showed moisture content of 5.02% and ash content of 1.68%, indicating stability and mineral adequacy. ANOVA revealed significant differences between shiitake mushroom cookies and the control ($F = 33.64$, $p < 0.05$), confirming enhanced sensory and nutritional qualities. Treatment 2 demonstrated superior acceptability, stability, and potential as a functional food. Recommendations included adopting Treatment 2 for commercial production, exploring shelf-life stability, marketing as a health-oriented snack, optimizing mushroom concentration, and implementing continuous sensory testing to ensure quality.

Keywords: *Shiitake mushroom, functional food, sensory evaluation, proximate analysis, consumer acceptability.*

INTRODUCTION

Shiitake mushroom (*Lentinula Edodes*) is an edible and medicinal wood-dwelling fungus native to East Asia. It is one of the most widely cultivated fungi worldwide. As a saprotroph, shiitake mushrooms decompose deadwood, particularly from broad-leaved trees such as oaks and other species in the order *Fagales*. In commercial cultivation, they are typically grown on logs, sawdust blocks, or sawdust pellets, thriving in warm, humid conditions with moderate airflow and indirect light (Petruzzello, 2025; Cornell Small Farms Program, 2023; Fungifun, 2023).

Shiitake mushrooms are a rich source of copper and selenium, providing 72% and 33% of the recommended daily intake, respectively. Copper supports healthy blood vessels, bones, and immune function, while selenium aids in antioxidant defense and thyroid health. They also promote cardiovascular and immune health by lowering cholesterol, reducing inflammation, and protecting cells. Their high lentinan content further strengthens immunity. Nutritionally, shiitake mushrooms offer vitamin D, B vitamins, potassium, and other essential minerals that contribute to overall well-being (WebMD, 2024; Health Benefit Times, 2024).

Shiitake mushrooms are native to the mountain regions of Japan, Korea, and China, where they naturally grow on fallen hardwood logs. They have been an integral part of East Asian cuisine and traditional medicine for centuries, prized for their rich umami flavor and health benefits. Cultivation dates back approximately 1,000 to 1,200 years in China, where they were known as *dongo* or *shanku*. This practice later spread to Japan, where samurai warriors-controlled production for the aristocracy. The name shiitake originates from the shii tree (*Castanopsis cuspidata*), a hardwood species where the mushrooms commonly grow, and *take*, the Japanese word for mushroom (Sakura.co, 2024)

Today, shiitake mushrooms are cultivated globally on both natural logs and artificial substrates. China dominates global production, accounting for about 80–90% of total shiitake cultivation, followed by Japan, the United States, Korea, and Brazil (Straits Research, 2024). In the Philippines, Nueva Vizcaya is emerging as a major producer of high-value shiitake mushrooms, where local farmers increasingly favor its cultivation due to profitability and low-input requirements, with a farmgate price of around ₱200 per kilogram (Agriculture Magazine, 2021).

Shiitake mushrooms are prized in the culinary world for their rich, earthy flavor and distinct meaty taste. Their large brown caps and creamy undersides make them both flavorful and visually appealing (WebMD, 2024). However, despite being highly regarded in global cuisine, the utilization of shiitake mushrooms as a value-added product remains limited.

Hence, the researchers aimed to develop cookie added with Shiitake mushroom, expanding the mushroom's use and contributing to its role as a value-added product in the culinary industry. This initiative transformed a traditional ingredient into a functional food that integrates the nutritional advantages of shiitake mushrooms into a familiar, accessible snack. Moreover, the product innovation supports local growers, promotes sustainable food production,



and aligns with the increasing consumer demand for health-oriented alternatives in the Philippine market.

MATERIALS AND METHODS

Research Design

This study employed experimental research design, which is a method used to determine cause-and-effect relationships by manipulating one or more variables while controlling others. It was chosen because it allows the researcher to observe how changes in a specific factor in this case, the proportion of shiitake mushroom powder affects the outcome or product quality. The study aimed to develop and assess the sensory acceptability of cookies added with Shiitake mushroom by evaluating how varying levels of shiitake powder influence color, aroma, taste, texture, and overall acceptability. By maintaining uniform preparation methods and testing conditions, any differences observed among treatments were attributed to the amount of shiitake powder used. This design was appropriate because it provided a systematic and objective approach to identifying the most acceptable and nutritionally enhanced cookie formulation.

Raw Materials and Ingredients

The raw materials used in the development of the cookie added with shiitake mushroom included shiitake mushroom, all-purpose flour, unsalted butter, baking powder, baking soda, salt, sugar, chocolate chips, egg, and vanilla. These ingredients were carefully measured and prepared to ensure consistency, quality, and the desired sensory characteristics of the product. Each ingredient contributed to achieving the appropriate balance of flavor, texture, aroma, and overall acceptability of the developed cookies.

The tools, utensils, and equipment used during the preparation and formulation process included mixing bowls, weighing scales, food processors, rubber scrapers, measuring cups, measuring spoons, sifters, baking trays, baking paper, and an oven. These materials were essential for accurately weighing, mixing, processing, and baking the cookie dough to achieve the intended structure, appearance, and final product quality.

Pre-Preparation of Shiitake Mushroom (Dried)

Dried Shiitake mushrooms were thoroughly cleaned to remove any dirt or impurities. After cleaning, the mushrooms were finely chopped into small pieces to ensure even processing. The chopped mushrooms were then lightly sautéed to enhance their flavor and aroma while removing excess moisture. Once cooled, the sautéed mushrooms were powderized using a food processor until a fine and uniform texture was achieved. The resulting mushroom powder was then sifted to obtain a smooth and consistent powder suitable for incorporation into the cookie formulation. The prepared Shiitake mushroom powder was stored in an airtight container until needed for product preparation.

General Procedure of Cookie added with Shiitake Mushroom

The cookie preparation process began by mixing the dry ingredients all-purpose flour, Shiitake mushroom powder, baking powder, salt, and sugar in a clean mixing bowl until evenly combined. The wet ingredients butter, eggs, and vanilla extract were whisked together separately until smooth. The wet mixture was gradually incorporated into the dry mixture, forming a cohesive dough. The dough was then allowed to rest for 10-15 minutes at room temperature to improve its handling properties.

After resting, the dough was rolled out on a floured surface to a uniform thickness of approximately 5-6 millimeters and shaped using cookie cutters. The shaped cookies were arranged on parchment-lined baking trays and baked in a preheated oven at 150-160°C for 25-35 minutes, or until golden brown. Once baked, the cookies were cooled on wire racks and stored in airtight containers to maintain freshness until further evaluation or consumption.

Formulation of the Cookie added with Shiitake Mushroom

The Shiitake Cookies were produced using shiitake mushroom powder along with other ingredients. Following the standard procedure for preparing shiitake mushrooms, three (3) treatments were formulated: Treatment 1 (10g shiitake mushroom powder), Treatment 2 (15g shiitake mushroom powder), Treatment 3 (20g shiitake mushroom powder). These treatments were subjected to sensory evaluation by five (5) experts from the Food Innovation Center (FIC) and five (5) semi-experts from the Food Technology Faculty who assessed the color, aroma, taste, texture, and general acceptability of the product. After three trials, the data collected were analyzed to determine which treatment produced the most acceptable shiitake cookie formulation.

Sensory Evaluation

The final cookie added with Shiitake mushroom were evaluated by semi-trained panelists based on specific sensory attributes, including color, aroma, taste, texture, and general acceptability. Sensory evaluation is described as a scientific method used to measure, analyze, and interpret responses to the sensory attributes of foods and materials as perceived through the senses of sight, taste, touch, smell, and hearing.

Consumers Acceptability

After three experimental trials and sensory evaluations by a laboratory panel, the most preferred formulation was selected for the consumer acceptability test, with the existing cookie serving as the control sample. A total of 40 individuals from different consumer groups participated in evaluating the final Cookie added with Shiitake Mushroom. Each participant received a packaged sample and a sensory evaluation form to assess its acceptability based on color, aroma, taste, texture, and overall impression. They were classified into the following groups:

Table 1. Distribution of Consumer's/Respondents

Consumers/Respondents	No.
Young Adults (19-25 years old)	20
Adults (26-59 years old)	10
Senior Citizen (60 up)	10
TOTAL	40

Proximate Analysis

Samples of the developed cookie added with Shiitake cookie were submitted to the Regional Feed Chemical Analysis Laboratory of the Department of Agriculture, Region II, in Tuguegarao City, for proximate composition analysis. This analysis determined the cookies' nutritional profile, specifically their moisture and ash content. These components served as key indicators of the product's nutritional value, stability, and overall quality, providing essential data to assess the functional benefits of incorporating shiitake mushroom into the cookie formulation.

Statistical Analysis

Weighted Mean was used to determine the acceptability of the developed cookie added with Shiitake mushroom in terms of color, aroma taste, texture and general acceptability. Analysis of variance (ANOVA) was used to determine the significant differences in the assessment of the evaluators on the quality of Shiitake cookie and existing cookies.

RESULTS AND DISCUSSION
Sensory Evaluation of the Developed Cookie added with Shiitake Mushroom to Determine the Best Formulation
Table 2. Sensory Evaluation of the Developed Cookie added with Shiitake Mushroom to Determine the Best Formulation

Quality Attributes	Treatments			
	Treatment 1	Treatment 2	Treatment 3	Control
Color	7.3 Pleasant Brown Tone	8.04 Rich Golden Brown	7.28 Pleasant Brown Tone	7.4 Pleasant Brown Tone
Aroma	6.98 Slightly Pleasant	8.0 Very Pleasant	7.7 Moderately Pleasant	7.8 Moderately Pleasant
Taste	7.06 Very Pleasing	8.02 Deeply Satisfying	7.32 Very Pleasing	7.68 Very Pleasing
Texture	7.2 Pleasantly Crisp	7.98 Very Crunchy and Light	7.16 Pleasantly Crisp	7.52 Pleasantly Crisp
General Acceptability	7.32 Moderately Acceptable	8.08 Very Much Acceptable	7.36 Moderately Acceptable	7.5 Moderately Acceptable

Table 2 presents the sensory evaluation of the cookie added with shiitake mushroom and shows that Treatment 2 was the most preferred formulation across all attributes color, aroma, taste, texture, and overall acceptability. This treatment achieved the ideal rich golden-brown color, which indicated proper baking and gave the cookie a visually appealing appearance. Treatment 2 also recorded the highest aroma rating, reflecting a well-balanced scent produced by browning reactions during baking. In terms of taste, Treatment 2 was rated the most satisfying, suggesting that its ingredient proportions created a richer and more balanced flavor compared to the other formulations. Its texture was likewise favored for being very crunchy, showing that the formulation achieved the ideal crispness expected of a well-baked cookie. Overall acceptability was highest for Treatment 2, confirming that this formulation offered the best combination of color, flavor, aroma, and texture. These findings indicate that the balanced ingredient ratio and optimized baking process used in Treatment 2 enhanced its sensory qualities, making it the most appealing and well-accepted version of the shiitake mushroom cookie.

Consumers Acceptability of the Developed Cookie added with Shiitake Mushroom

Table 3. Level of Consumer's Acceptability of the Best Formulation of the Cookie added with Shiitake Mushroom

Quality Attributes	Mean	Interpretation
Color	8.04	Like Very Much
Aroma	8.00	Like Very Much
Taste	8.02	Like Very Much
Texture	7.98	Like Very Much
General Acceptability	8.08	Like Extremely

Table 3 presents the level of consumer acceptability for the best formulation of the cookie added with shiitake mushroom, showing that Treatment 2 obtained the highest ratings in all sensory attributes. It received mean scores of 8.04 for color, 8.00 for aroma, 8.02 for taste, and 7.98 for texture, all interpreted as (like very much). For overall acceptability, it achieved the highest mean score of 8.08, classified as (like extremely). These results indicate that Treatment 2 was consistently preferred in terms of appearance, flavor, aroma, and texture, demonstrating that this formulation successfully met consumer expectations in every aspect. The findings suggest that Treatment 2 achieved an ideal balance of ingredients and proper control of baking characteristics, resulting in enhanced taste, texture, aroma, and overall product quality. This balance contributed to a well-developed cookie with appealing color, pleasant aroma, satisfying flavor, and desirable crunchiness, making Treatment 2 the most acceptable and favored formulation among all samples.

Proximate Composition of the Developed Cookie added with Shiitake Mushroom

Table 4. Proximate Composition of the Developed Cookie added with Shiitake Mushroom

Food description	Parameter	Value
Shiitake Cookie	Moisture content	5.02%
	Ash Content	1.68%

Source:
Regional
Feed

Analysis Laboratory D.A Regional Office

Table 4 presents the proximate composition of the developed cookie added with shiitake mushroom, showing that it has a moisture content of 5.02%. This places the product within the range of stable foods, meaning its low moisture level helps prevent microbial growth and contributes to a longer shelf life. The ash content of the cookie is 1.68%, which falls within the normal range for mineral content in food products. This indicates that the cookie contains an appropriate amount of essential minerals such as magnesium, phosphorus, potassium, calcium, manganese, zinc, iron, copper, and sodium. Overall, the results suggest that the cookie formulation meets acceptable standards for moisture and mineral content, supporting both product stability and nutritional value.

Significant Difference of Cookie added with Shiitake Mushroom

Table 5. Analysis of Variance on the Overall Acceptability of the Developed Cookie added with Shiitake Mushroom

<i>Source of Variation</i>	<i>F</i>	<i>P-value</i>	<i>F crit</i>	<i>p < .05 is Significant.</i>
Between Groups	33.64	8.27E-07	3.94	

The ANOVA results showed a significant difference in overall acceptability between the shiitake mushroom cookies and the traditional cookies. The statistical values confirmed that adding shiitake mushroom had a meaningful impact on how the cookies were rated by consumers. Respondents clearly perceived differences between the samples, and the shiitake mushroom cookies received higher acceptability scores. This increased preference was likely due to their improved sensory qualities, including better flavor, a more appealing color, and a desirable texture. These enhancements contributed to a more favorable overall impression, indicating that the incorporation of shiitake mushroom positively influenced both the quality and acceptability of the developed cookies.

Conclusion

Based on the findings of the study, the incorporation of shiitake mushroom flour significantly improved the sensory and nutritional qualities of cookies, making them a functional and consumer-preferred baked product. Among the four formulations, Treatment 2 received the highest ratings for color, aroma, taste, texture, and overall acceptability, indicating strong consumer preference. Its rich golden-brown color, pleasant aroma, balanced flavor, and crunchy texture reflected proper formulation and baking. The proximate analysis showed a low moisture content (5.02%) and normal ash level (1.68%), confirming product stability and good mineral composition. ANOVA results revealed a significant difference between cookie added with shiitake mushroom and traditional cookies ($p < 0.05$), demonstrating the positive effect of shiitake flour. Overall, the addition of shiitake mushroom flour enhanced both the sensory appeal and nutritional value of the cookies, resulting in a healthy and desirable functional food product.

Recommendations

Based on the findings and conclusions of the study, several recommendations are proposed. First, the formulation used in Treatment 2 should be adopted for commercial production, as it demonstrated the best balance of sensory qualities and nutritional value. Further research is encouraged to explore large-scale production methods while ensuring consistent quality, as well as to examine the product's shelf-life stability over time. The shiitake mushroom cookies may also be marketed as a functional product that highlights both taste and health benefits, appealing particularly to health-conscious consumers. In addition, exploring variations in mushroom powder concentration is recommended to fine-tune sensory characteristics and nutritional content for different market segments. Finally, continuous sensory evaluations and consumer feedback should be implemented after product launch to support ongoing improvement and maintain consumer satisfaction.

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