

Development and Sensory Evaluation of Squash (*Cucurbita Maxima*) Kroepeks Enhanced with Different Levels of White Oyster Mushroom

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DOI: <https://dx.doi.org/10.47772/IJRISS.2026.10200390>

Received: 18 February 2026; Accepted: 24 February 2026; Published: 11 March 2026

ABSTRACT

This study evaluated the development, sensory quality, acceptability, and profitability of squash (*Cucurbita maxima*) kroepek enhanced with varying levels of oyster mushroom (*Pleurotus ostreatus*). Four formulations were assessed by 30 respondents using the 9-point Hedonic Scale, focusing on color, odor, texture, taste, and general acceptability. Results showed no significant differences among treatments for all sensory attributes, indicating that the incorporation of oyster mushroom did not adversely affect product quality. All samples were rated from “very like” to “extremely like,” with the 100% squash formulation receiving the highest general acceptability. Profitability analysis revealed that both cooked and uncooked kroepek were financially viable. Cooked kroepek yielded a higher net income per peso cost (0.51) compared to uncooked kroepek (0.39). Overall, the findings indicate that oyster mushroom can be added to squash kroepek without compromising sensory quality while offering strong market potential and economic feasibility for small-scale producers.

Keywords: Squash kroepek; Oyster mushroom; Sensory evaluation; Product development; Profitability analysis

The Problem and Its Background

INTRODUCTION

Squash is a general term that refers to several species of the *Cucurbita* plant, which are widely cultivated for their edible fruits. These plants produce orange or yellow blossoms and fruits with smooth or ridged skins that may appear in shades of green, white, or yellow, and come in various shapes and sizes. *Cucurbita maxima*, commonly known as kalabasa in the Visayan language, has long been used in the Philippines as a fleshy vegetable. Belonging to the same plant family as melons and cucumbers, squash exists in numerous varieties, some of which also yield edible flowers. Although each type differs in shape, color, size, and flavor, all varieties share similar characteristics (Kubo et al., 2010).

In the Philippines, kroepek is typically produced by small-scale manufacturers. To make this product more commercially viable and widely accepted, a standardized formulation is necessary to help producers develop a low-cost yet high-quality snack (Taewee, 2011). Meanwhile, oyster mushrooms (*Pleurotus ostreatus*) have gained considerable attention in the culinary field due to their distinctive flavor, impressive nutritional profile, and potential health benefits (Jayakumar, Manikandan, & Rajarathinam,

2019). They are recognized for their high levels of protein, essential amino acids, dietary fiber, vitamins, and minerals (Amin et al., 2018). Incorporating oyster mushrooms into squash kroepek offers a promising opportunity to enhance its nutritional value, particularly in terms of protein content, flavor, and overall product quality. However, despite these advantages, there remains limited research on the specific effects and benefits of integrating oyster mushrooms into squash kroepek. Understanding how these mushrooms influence the product’s sensory properties, nutritional content, and shelf stability is essential for optimizing its formulation and production process.

The Department of Agriculture (DA) in the Philippines actively promotes oyster mushroom cultivation through community-based programs. Similarly, the Agricultural Training Institute (ATI) provides training and seminars to assist farmers in mushroom production. Despite these government initiatives, the Davao Region continues to have few growers, resulting in a limited supply of mushrooms and mushroom-based products. Although consumer demand is rising, the industry faces persistent challenges such as limited farmland and recurring drought conditions (Felisilda, 2014). To maximize the potential of this resource and respond to the increasing demand for healthier snack alternatives, this study focuses on the development and sensory evaluation of squash kropeks enriched with varying levels of oyster mushroom powder. The findings of this study aim to benefit small-scale entrepreneurs by offering an innovative and nutritious product that can serve as an additional source of income.

Statement of the Problem

This study was conducted to determine the development and sensory evaluation of squash (*Cucurbita maxima*) kropeks enhanced with different levels of oyster mushroom. Thus, it sought to answer the following questions:

Is there a significant difference on the sensory qualities and acceptability of squash (*Cucurbita maxima*) kropeks enhanced with different levels of oyster mushroom in terms of;

1. Color
2. Odor
3. Texture
4. Taste

Is there a significant difference on the general acceptability of the squash (*Cucurbita maxima*) kropeks enhanced with different levels of oyster mushroom?

What is the cost and return of processing squash (*Cucurbita maxima*) kropeks enhanced with different levels of oyster mushroom?

Significance of the Study

The purpose of this study was to evaluate the development and sensory attributes of squash (*Cucurbita maxima*) kropeks enhanced with varying levels of oyster mushroom. The findings of this research aim to provide valuable insights for the potential commercialization of squash-based kropeks. The data gathered also served to identify the optimal formulation and ingredient proportions necessary for producing a high-quality product. Furthermore, this study may serve as a reference for future researchers who wish to explore the use of different varieties of oyster mushrooms in the production of squash kropeks. The overall outcomes of this study are expected to benefit small-scale entrepreneurs by offering an additional source of income, and BSAB students by enhancing their knowledge and skills in the preparation of squash kropeks. Likewise, the results can assist the organization in promoting the product for marketing and community development purposes.

Scope and Limitation of the Study

This study was conducted in May 2024 at the Sustainable Agriculture and Fisheries Enterprise (SAFE), SPAMAST Buhangin Campus. It was limited to the development and sensory evaluation of squash (*Cucurbita maxima*) kropeks enhanced with varying levels of oyster mushroom, focusing on the attributes of odor, color, texture, and overall acceptability. The Return on Investment (ROI) was also determined. The sensory evaluation was conducted by 30 selected students and faculty members of the Southern Philippines Agribusiness and Marine and Aquatic School of Technology (SPAMAST) Buhangin Campus.

Definition of Terms

To give great emphasis on the terms, it was defined how it was used in the study.

Acceptability. It refers to the acceptance of the respondents on the oyster mushroom fries on the different criteria during the sensory evaluation.

Color. It refers to the physical appearance of the process product that relies on the complexity of the color. It is also included in the criteria for acceptability.

Development. It refers to the development process of the oyster mushroom fries added with squash flour as the main ingredient.

Odor. It refers to the smell or aroma of oyster mushroom. It is also one of the criteria for general acceptability.

Sensory Evaluation. It refers to the evaluation of oyster mushroom through human senses like seeing, smelling, touching, and tasting.

Taste. It refers to the savory of the respondents on squash kroepoeks-like; sweetness, sourness, saltiness, bitterness, and savories.

Texture. It refers to the surface quality of oyster mushroom fries-like; rough, smooth, silky, shiny, fuzzy.

REVIEW OF RELATED LITERATURE

Uses of Squash

Squash (*Cucurbita maxima*), commonly known in the Visayan language as *kalabasa*, has long been cultivated in the Philippines as a fleshy vegetable. It belongs to the plant family that includes melons and cucumbers and comes in many varieties. Some varieties of squash also produce edible flowers. While each variety differs in shape, color, size, and flavor, they all share common characteristics. All parts of the squash are edible, including the flesh, seeds, and rind. Similar to other cucurbits, squash is an important source of vitamins A and C, as well as calcium and iron. It is low in calories, making it an ideal component of healthy diet plans. These vegetables, protected by a hard rind, are grown year-round in the country. To maximize their nutritional benefits, the green skin or rind should be consumed. Squash is commonly grown in backyard gardens and is marketed for its immature fruits, young shoots, flowers, and seeds (Kubo et al., 2010).

Squash is a highly versatile vegetable with numerous culinary and industrial applications. Researchers have developed a wide range of squash-derived products, demonstrating its adaptability and nutritional value. Garcia, Lopez, Fernandez, and Guinard (2019) studied the development of value-added squash products such as squash purée, chips, and soups, emphasizing the importance of sensory evaluation in the product development process. Similarly, Patel and Sharma (2020) highlighted the nutritional and medicinal properties of squash, emphasizing its potential role in addressing malnutrition in areas where it is widely available. Beyond culinary applications, squash has also been explored for non-food uses, including animal feed and the production of biodegradable packaging materials (Singh, Chauhan, & Sharma, 2018).

Nutritional Benefits of Squash

As a member of the Cucurbitaceae family, squash provides numerous nutritional benefits due to its high content of vitamins, minerals, and phytochemicals. Patel and Sharma (2020) identified squash as a nutrient-dense vegetable that offers significant health benefits. It is rich in vitamins A and C, which are essential for immune function, vision, and skin health. Studies have also shown that carotenoids found in squash may reduce the risk of chronic diseases, including cardiovascular disease and certain cancers.

Squash contains antioxidants such as beta-carotene and lutein, which help neutralize harmful free radicals in the body. Calcium, another essential nutrient found in squash, supports bone strength and density, particularly when paired with vitamin D (Ross et al., 2016). Altogether, squash's nutritional profile makes it a valuable component of a balanced and health-promoting diet.

Oyster Mushrooms (*Pleurotus ostreatus*)

Oyster mushrooms (*Pleurotus ostreatus*) have become a significant focus of nutritional and medicinal research due to their impressive health benefits. These edible fungi are rich in high-quality protein, essential amino acids, dietary fiber, vitamins, minerals, and antioxidants (Silva et al., 2005). Their protein content makes them a valuable meat substitute, especially for vegetarians and vegans (Mattila et al., 2001). Oyster mushrooms also contain beta-glucans, a type of soluble fiber that supports digestive health, regulates blood sugar, and promotes satiety (Yadav, Devi, & Gupta, 2015). In the Philippines, the Department of Agriculture (DA) promotes oyster mushroom production through community-based programs, while the Agricultural Training Institute (ATI) conducts training for local farmers. Despite these initiatives, there are still few growers, particularly in Bohol, resulting in limited supply. Challenges such as restricted farmland and drought conditions continue to constrain the industry's growth (Felisilda, 2014).

Nutritional and Medicinal Benefits of Oyster Mushrooms

Oyster mushrooms have attracted attention for their potential health-enhancing properties. Their betaglucan content stimulates immune function, while compounds such as lectins and polysaccharides exhibit anticancer activity (Zhang, Lin, & Hui, 2001; Roupas, Keogh, & Noakes, 2012). They are also rich in B vitamins—riboflavin (B2), niacin (B3), and pantothenic acid (B5)—as well as minerals like potassium, phosphorus, and copper (Drewnowska et al., 2017; Wang et al., 2001). When exposed to sunlight, oyster mushrooms can produce vitamin D, which is essential for bone and immune health (Koyyalamudi et al., 2009). Additionally, antioxidants such as ergothioneine and glutathione help combat oxidative stress and promote overall well-being (Kalaras et al., 2017).

Oyster Mushroom-Related Products

Oyster Mushroom can be Pickled mushroom soup combines the umami depth of mushrooms with tangy pickling spices to create a unique culinary experience (Llarena-Hernández, Andrade, & Martinez, 2021). Studies have also shown potential cognitive benefits from consuming pickled mushroom supplements, which were linked to enhanced brain activity and memory performance (Choi et al., 2021; Lee et al., 2022). Additionally, mushroom jam is a novel product that showcases the versatility of oyster mushrooms. Created by caramelizing mushrooms with sugar and spices, this condiment delivers a balance of sweet and savory flavors and pairs well with bread or cheese platters. The innovation highlights oyster mushrooms' potential beyond traditional cooking (Moonmoon et al., 2010). Oyster mushroom patties can be also served as plant-based alternatives to traditional meat products, offering high protein content and a satisfying umami flavor (Llarena-Hernández et al., 2021). Their bioactive compounds provide immune-boosting and anti-inflammatory benefits, and their fiber content supports digestion and weight management (Valverde et al., 2015). Lastly, mushroom pakoda combines oyster mushrooms with spiced batter and deep-frying techniques to produce a crispy, flavorful snack. This dish illustrates the fusion of traditional and modern culinary practices while promoting mushroom-based foods in popular cuisine (Chakraborty, Raychaudhuri, & Raychaudhuri, 2013).

Kroeppek

Kroeppek commonly known as prawn crackers, is a popular snack throughout Southeast Asia with high market potential. In the Philippines, it is referred to as *kropek* or *prawn crackers* in English. According to Dopico (2010), kroeppek is typically made from tapioca flour, powdered prawns or fish, spices, and water. British chef Meyrick (2021) noted that prawn-based crackers originated in the Malay Peninsula during the 16th century, when leftover crushed prawn heads from feasts were repurposed into crackers.

The term *kroeppek* later spread to other regions during the Dutch East Indies colonial era and eventually became part of Indonesian and Dutch culinary traditions. In Southeast Asia, similar versions of kroeppek are known as *keropok* in Malaysia, *kerupuk* in Indonesia, and *bánh phồng tôm* in Vietnam. The snack is typically deep-fried, made with rice flour and cornstarch, and often enriched with seafood powders such as fish protein concentrate (FPC) or shrimp powder. The inclusion of FPC increases the product's protein content relative to its carbohydrate base (Espejo-Hermes, 2016).

Squash kroeppek is a modern variation of the traditional cracker, valued for its unique flavor and texture. Closset et al. (2013) linked the distinctive flavor of squash kroeppek to aromatic compounds similar to those found in certain almond varieties. Understanding these sensory attributes is crucial for enhancing the product’s consumer appeal. Reyes et al. (2021) examined the sensory and nutritional properties of *kalabasa* kroeppek produced from different squash varieties and processing methods, concluding that these factors significantly affect its flavor, texture, and overall acceptability. Similarly, Santos and Cruz (2020) analyzed the nutritional profile of *kalabasa* kroeppek and found that it provides considerable levels of vitamins, minerals, and dietary fiber.

The sensory appeal of squash kroeppek is largely determined by its flavor, texture, and aroma—key factors influencing consumer preference (Hasibuan et al., 2023). Despite increasing interest in *kalabasa* kroeppek as a nutritious and culturally relevant snack, further studies are needed to improve production methods, assess consumer preferences, and promote wider commercialization in the Philippines.

Conceptual Framework of the Study

Independent Variable Dependent Variable

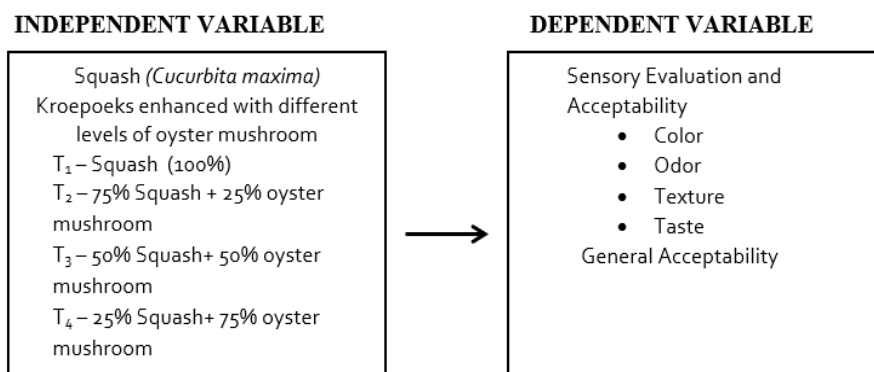


Fig. 1. Schematic Diagram of the study

Figure 1 shows the different levels of oyster mushroom (25%, 50% 75%) as the independent variables that are anticipated to influence the development and acceptability of squash (*Cucurbita maxima*) kroeppeks (dependent variables) in terms of color, odor, texture, taste and general acceptability.

Hypothesis

Ho₁: There is no significant difference on the sensory quality and acceptability of squash (*Cucurbita maxima*) kroeppeks enhanced with different levels of oyster mushroom in terms of odor.

Ho₂: There is no significant difference on the sensory quality and acceptability of squash (*Cucurbita maxima*) kroeppeks enhanced with different levels of oyster mushroom in terms of color.

Ho₃: There is no significant difference on the sensory quality and acceptability of squash (*Cucurbita maxima*) kroeppeks enhanced with different levels of oyster mushroom in terms of texture.

Ho₄: There is no significant difference on the sensory quality and acceptability of squash (*Cucurbita maxima*) kroeppeks enhanced with different levels of oyster mushroom in terms of taste.

Ho₅: There is no significant difference on the general acceptability of squash (*Cucurbita maxima*) kroeppeks enhanced with different levels of oyster mushroom.

METHODOLOGY RESEARCH LOCALE

The research environment where the study was conducted at Sustainable Agriculture and Fisheries Enterprise (SAFE), Southern Philippines Agri-Business and Marine and Aquatic School of Technology (SPAMAST), Buhangin Campus, Malita, Davao Occidental students and faculty members.

Research Design

To describe the acceptability of squash (*Cucurbita maxima*) kropeks enhanced with different levels of oyster mushroom in terms of taste, odor, color, texture, and general acceptability descriptive research design will be used.

Experimental Design and Treatments

The experiment was laid out in Complete Randomized Design (CRD). There will be four (4) treatments which are replicated three (3) times with thirty (30) samples per replication. The treatments were as follows: T₁ – Squash (100%), T₂ – 75% Squash + 25% oyster mushroom, T₃ – 50% Squash + 50% oyster mushroom T₄ – 25% Squash + 75% oyster mushroom. More so, the study was used a quantitative descriptive research approach. A descriptive research design, as defined by Calmorin (2007), compares two factors, establishes which is superior by a systematic technique, and describes the relationships between the factors. It was identifying research with adequate and thorough description and results in descriptive SerpaJuan (2014), and it was included the identification of features of a single phenomenon based on the observation or study of the link between two or more phenomena. Creswell (2003), claims that the outcomes of this kind of design may be predictive, explanatory, and confirmatory.

Procurement of Raw Materials

The oyster mushrooms used in the study were purchased at Purok 3, Bato, Toril, Davao City, Philippines. Other ingredients, including squash, cassava flour, cassava starch, pepper powder, salt, monosodium glutamate (MSG), and coconut oil, were procured from the Public Market located at Poblacion, Malita, Davao Occidental. The preparation began with cleaning and processing the fresh squash and oyster mushrooms. The squash was peeled, deseeded, and blended to produce squash flour, while the oyster mushrooms were finely chopped. All measured ingredients were combined in a mixing bowl, and the squash flour was added to the mixture to ensure uniform blending. Approximately three tablespoons of the prepared mixture were placed onto a pan and steamed for about three minutes or until the mixture became translucent. After steaming, the sheets were carefully removed from the pan and placed on a drying tray for primary drying. Once partially dried, the squash kropek was cut into square pieces and subjected to secondary drying to achieve the desired texture. Finally, the finished kropeks were vacuum-sealed, properly labeled, and stored for sensory evaluation (Figure 2).

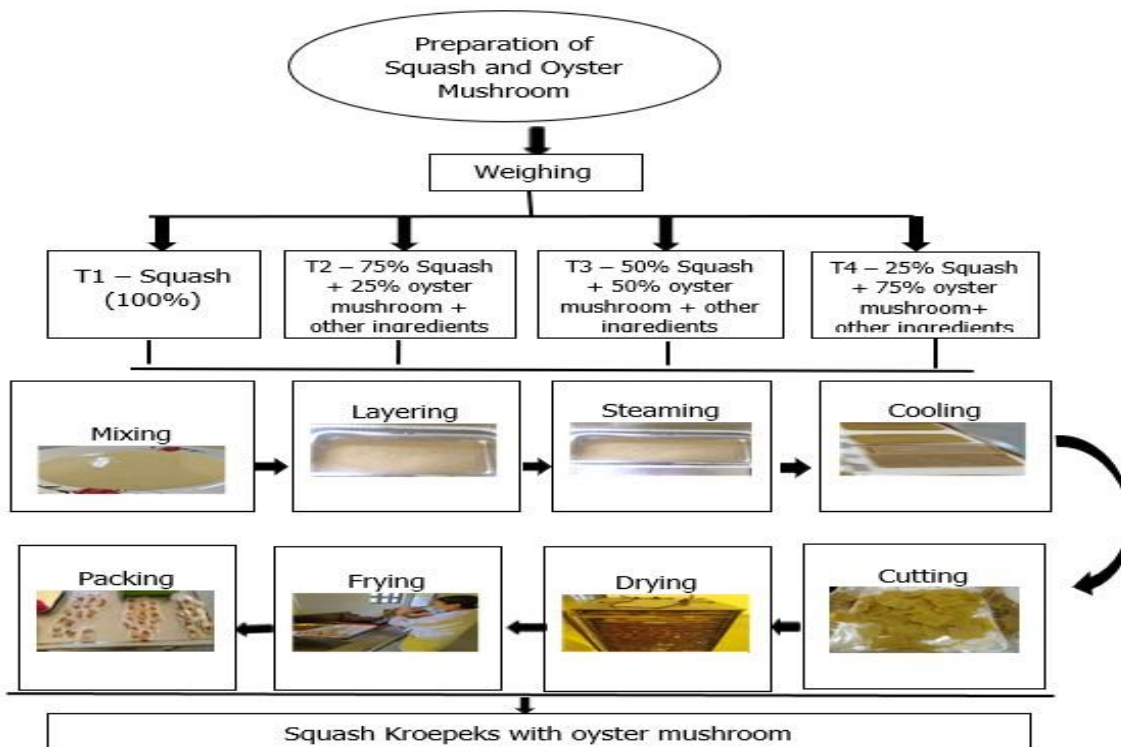


Figure 2. Procedure for making Squash Kropeks with different levels of oyster mushroom.

Sensory Evaluation

The sensory evaluation aimed to determine the acceptability of squash (*Cucurbita maxima*) kropeks enhanced with varying levels of oyster mushroom based on their quality attributes. According to Lepore (2017), sensory evaluation is the process of using human senses—taste, smell, touch, and sight—to assess the acceptability of food products.

To measure the acceptability of the samples, four formulations of squash kropeks containing different levels of oyster mushroom were evaluated by 30 respondents using the 9-point Hedonic Scale. The rating ranged from 1 (“extremely dislike”) to 9 (“extremely like”), where a higher score indicated greater consumer preference. The sensory qualities evaluated included color, odor, taste, texture, and overall acceptability. Data obtained were analyzed using descriptive statistics and one-way analysis of variance (ANOVA) to determine significant differences among treatments.

Respondents of the Study

The respondents of the study consisted of 30 selected students, faculty, and staff members of the Southern Philippines Agribusiness and Marine and Aquatic School of Technology (SPAMAST), Buhangin Campus, Malita, Davao Occidental. They were chosen for their accessibility and availability, making the data collection process more efficient. The sensory evaluation was conducted in May 2024.

The researchers established specific criteria to qualify respondents for participation in the study. The criteria were as follows: a) respondents were bona fide students, faculty, or staff members of SPAMAST Buhangin Campus for the school year 2023–2024; b) respondents were of legal age; and c) respondents voluntarily and knowingly provided their consent to participate in the sensory evaluation.

Sampling Design and Technique

The study utilized the simple random sampling technique with a total of 30 respondents. According to Thompson (2012), simple random sampling is a method of selecting a sample from a population wherein each individual has an equal chance of being chosen, ensuring fairness and representativeness.

This technique minimizes potential sampling bias and enhances both the internal and external validity of the study (McCombes, 2019; Tomas, 2020).

Furthermore, Khan (2022) emphasized that simple random sampling is the most straightforward of all probability sampling methods, as it requires minimal information about the population and involves only one round of random selection.

In this study, a free-tasting activity was conducted among the faculty and students of SPAMAST Buhangin Campus as part of the sampling process.

Research Instrument

The research instrument used in this study was a self-constructed checklist questionnaire, developed to align with the study’s objectives and research questions. The instrument was reviewed, validated, and approved by a panel of experts to ensure its reliability and content validity.

The questionnaire was divided into two parts. The first part focused on the sensory characteristics of squash (*Cucurbita maxima*) kropeks with varying levels of oyster mushroom, specifically evaluating color, odor, texture, and taste. The second part assessed the overall level of acceptability of the product.

Data Analysis

To determine the level of sensory characteristics of squash (*Cucurbita maxima*) kropek enhanced with different level of oyster mushroom in terms of its appearance, odor, taste, and texture, the 5-point Hedonic scale was used:

Table 1. Five-point Hedonic scale for the sensory characteristics of squash (*Cucurbita maxima*) kroeppek enhanced with different level of oyster mushroom

Numerical Value	Range of Interval	Color	Odor	Texture	Taste
5	4.21-5.00	Very appealing Golden Brown	Very Pleasant	Very Crunchy	Very Pleasant
4	3.41-4.20	Appealing Golden Brown	Pleasant	Crunchy	Pleasant
3	2.61–3.40	Slightly Golden Brown	Moderately Pleasant	Slightly Crunchy	Pleasant
2	1.81–2.60	Moderately Golden Brown	Slightly Pleasant	Stale	Slightly Pleasant
1	1.0 -1.80	Dark Brown	Unpleasant	Firm/ Hard	Unpleasant

Furthermore, to determine the general acceptability of squash (*Cucurbita maxima*) kroeppek enhanced with different level of oyster mushroom, the 9-point Hedonic scale was used.

Table 2. Nine-point Hedonic scale on the general acceptability of squash (*Cucurbita maxima*) kroeppek enhanced with different level of oyster mushroom.

Numerical Value	Range of Interval	Description
9	8.12 – 9.00	Extremely Like
8	7.23 – 8.11	Very Like
7	6.34 – 7.22	Moderately Like
6	5.45 – 6.33	Slightly Like
5	4.56 – 5.44	Neither Like nor Dislike
4	3.67 – 4.55	Slightly Dislike
3	2.78 – 3.66	Moderately Dislike
2	1.89 – 2.77	Very Dislike
1	1.00 – 1.88	Extremely Dislike

Cost and Return Analysis

The cost and return was computed using the following measurements;

Net profit margin (Total Returns – Total Cost), or simply net margin, measures how much net income or profit is generated as a percentage of revenue. It is the ratio of net profits to revenues for a product or business segment. The net profit margin illustrates how much of each peso in revenue collected by a company translates into profit.

Cost of production per unit (Total Cost/Product Sold) is divided by the number of units manufactured in the period covered by those costs. To break even, the sales price must cover the cost per unit. Prices that are greater than the cost per unit result in profits, whereas prices that are less than the cost per unit result in losses. Finally, it refers to the cost incurred in producing every unit of product.

Net Income/Peso cost (Net Return/Total Cost) refers to the net income earned in every peso cost incurred in producing a product. The higher the net income than the peso cost incurred shows the higher profitability of the operation.

Data Gathering Procedure

The research instrument used in the study was a self-constructed checklist questionnaire designed to align with the statement of the problem. The instrument was reviewed, validated, and approved by a panel of validators to ensure its content validity.

The first part of the questionnaire focused on the sensory evaluation and acceptability of squash kroepék enhanced with different levels of oyster mushroom, specifically assessing appearance, odor, texture, and taste. The second part measured the overall level of acceptability of the squash kroepék enhanced with varying levels of oyster mushroom.

Statistical Tools

The statistical results were calculated with a significance alpha level of 0.05. The mathematical instruments were used as follows:

Mean. This was used to determine the development and sensory evaluation of squash (*Cucurbita maxima*) kroepéks enhanced with different levels of oyster mushroom in terms of its color, odor, taste, and texture.

Analysis of Variance (ANOVA). This was used to determine the significant difference in the color, odor/aroma, texture, taste, and general acceptability of squash kroepék. If significant results obtained, these were further analyzed using the Least Significant Difference (LSD).

Ethical Considerations

Ethical aspect is also considered for this, in terms of privacy and confidentiality, the researcher attached a signed letter to the questionnaire addressing the respondents that the data gathered be kept confidential and treated academically. Upon asking for consent and permission from the location, the researcher structured a signed letter addressed to the respondents asking for their participation at their convenient time. The voluntary participation of the respondents was realized by giving them enough time to answer questions supported by interviews. Aside from that, the purpose of the study was stated. Another ethical consideration for this study was the unavailability of respondents due to being absent or busy during the deployment of the questionnaire. As a researcher, it was asked when it is possible to conduct an interview, or the questionnaire was left and picked up if it was accomplished. Lastly, Conflict of Interest was not tolerated. Respondents were not being paid as the motivation for participation; instead, the researcher asked for their voluntary participation and showed the deepest gratitude for making this study successful.

RESULTS AND DISCUSSION

Sensory Characteristics

Color

Table 1 presents the sensory quality and acceptability of squash (*Cucurbita maxima*) kroepék enhanced with different levels of oyster mushroom in terms of color. Treatment 2 (75% squash + 25% oyster mushroom) and Treatment 1 (100% squash) were evaluated as very appealing golden brown (4.21–5.00), while Treatment 4 (25% squash + 75% oyster mushroom) and Treatment 3 (50% squash + 50% oyster mushroom) were rated as appealing golden brown (3.41–4.20). In terms of acceptability, all treatments obtained ratings interpreted as “very like” (7.23–8.11), indicating comparable acceptability across formulations. Based on the one-way Analysis of Variance (ANOVA), results revealed no significant difference among treatments in terms of color, as the computed F-value was lower than the F-tabulated value. This implies that the color of squash kroepék remains comparable regardless of the level of oyster mushroom incorporated, and all formulations were highly liked by respondents.

These findings support previous literature suggesting that the addition of oyster mushroom can enhance the nutritional value of food products without adversely affecting sensory characteristics (de Mattos et al., 2016). However, oyster mushrooms typically possess a pale to light brown pigmentation; therefore, substantial color changes are not expected when incorporated into kroeppek, as overall coloration still primarily depends on other ingredients in the formulation (Nakov, 2020). Reyes (2009) further emphasized that the choice of ingredients used in producing mushroom-based kroeppek influences its resulting color. Additionally, the appealing goldenbrown color commonly observed in fried kroeppek products is attributed to Maillard reaction and caramelization during frying, enhanced by interactions among specific ingredients (Cohen, 2021).

Table 1. Sensory Quality and acceptability of squash (*Cucurbita maxima*) kroeppek enhanced with different level of oyster mushroom in terms of color.

TREATMENT	MEAN SENSORY SCORE	FC	MEAN ACCEPTABILITY SCORE	FC	TABULAR 1%	5%
T1 (control)	4.24 VAGB	3.31 ^{ns}	7.96 VL	0.35 ^{ns}	4.070	7.59
T2- 25%	4.33 VAGB		7.99 VL			
T3- 50%	4.00 AGB		7.86 VL			
T4- 75%	4.10 AGB		7.87 VL			
CV=3.42%			CV=2.31 %			

Legend: ns= not significant VAGB - Very Appealing Golden Brown VL- Very Like AGB - Appealing

Golden Brown

Odor

Table 2 presents the sensory quality and acceptability of squash (*Cucurbita maxima*) kroeppek enhanced with different levels of oyster mushroom in terms of odor.

Treatment 1 (100% squash) was evaluated as very pleasant (4.21–5.00), while Treatment 3 (50% squash + 50% oyster mushroom), Treatment 4 (25% squash + 75% oyster mushroom), and Treatment 2 (75% squash + 25% oyster mushroom) were all rated as pleasant (3.41– 4.20).

Regarding odor acceptability, all treatments obtained ratings interpreted as “very like” (7.23–8.11), indicating that the samples were comparable and highly acceptable to the respondents. These results were analyzed using one-way Analysis of Variance (ANOVA), which showed no significant difference among treatments in terms of odor. This indicates that the presence or absence of oyster mushroom did not significantly affect the odor of the squash kroeppek. Regardless of formulation, all samples remained comparable and wellliked.

The absence of a significant difference may be attributed to the natural aroma profile of the raw ingredients. Squash has a mildly sweet and earthy scent that becomes more pronounced during cooking or frying, contributing a pleasant base aroma to the kroeppek.

Oyster mushrooms, meanwhile, are known for their rich umami aroma, characterized by a savory and slightly woody scent when cooked; this complements the mild sweetness of squash (Reyes et al., 2021). The interaction between the earthy notes of squash and the savory qualities of oyster mushroom creates a balanced, appealing aroma profile (Espejo-Hermes, 2016).

Furthermore, the frying process enhances the overall aroma of the product. Heat breaks down the cellular structure of both squash and oyster mushrooms, releasing their aromatic compounds and allowing them to blend harmoniously (Closset et al., 2013). Seasonings such as garlic, onion, or herbs also contribute additional layers of fragrance, making the kroeppek even more aromatic and appealing (Lavis, 2016).

Table 2. Sensory Quality and acceptability of squash (*Cucurbita maxima*) kroeppek enhanced with different level of oyster mushroom in terms of odor

TREATMENT	Mean Sensory Score	Fc	Mean Acceptability Score	Fc	Tabular 5%	1%
T1 (control)	4.23 VP	0.60 ^{ns}	7.72 VL	0.81 ^{ns}	4.070	7.59
T2- 25%	4.08 P		7.94 VL			
T3- 50%	4.16 P		7.99 VL			
T4- 75%	4.13 P		7.92 VL			
CV=3.38%			CV=2.91%			

Legend: VP= Very Pleasant VL- Very Like P= Pleasant ns= not significant

Texture

TREATMENT	MEAN SENSORY SCORE	Fc	MEAN ACCEPTABILITY SCORE	Fc	TABULAR 5%	1%
T1 (control)	4.53 VC	1.21 ^{ns}	7.87 VL	0.56 ^{ns}	4.070	7.59
T2- 25%	4.46 VC		8.04 VL			
T3- 50%	4.38 VC		7.96 VL			
T4- 75%	4.40 VC		7.86 VL			
CV=2.39%			CV=2.47%			

Table 3 presents the sensory quality and acceptability of squash (*Cucurbita maxima*) kroeppek enhanced with different levels of oyster mushroom in terms of texture. All treatments—Treatment 1 (100% squash), Treatment 2 (75% squash + 25% oyster mushroom), Treatment 3 (50% squash + 50% oyster mushroom), and Treatment 4 (25% squash + 75% oyster mushroom)—were evaluated as very crunchy (4.21–5.00). In terms of texture acceptability, all treatments were rated as “very like” (7.23–8.11), indicating that respondents found all formulations similarly acceptable. The results of the one-way Analysis of Variance (ANOVA) showed no significant difference among the four treatments in terms of texture.

This suggests that the varying levels of oyster mushroom incorporated into the formulations did not significantly affect the texture of the squash kroeppek. In other words, the texture remained consistent and comparable across all treatments, regardless of the proportion of oyster mushroom added. These findings align with Heinzelmann (2018), who reported that incorporating oyster mushroom into cracker-type products does not substantially alter their textural properties. This is likely because textural characteristics such as crunchiness are influenced more by factors like starch content, drying process, and frying conditions rather than by the amount of mushroom incorporated. Consequently, the squash kroeppek maintained a uniform and desirable crunchy texture across all formulations.

Table 3. Sensory Quality and acceptability of squash (*Cucurbita maxima*) kroeppek enhanced with different level of oyster mushroom in terms of texture

Legend: ns= VC= Very Crunchy VL= Very Like ns= not significant

Taste

Table 4 presents the sensory quality and acceptability of squash (*Cucurbita maxima*) kroeppek enhanced with different levels of oyster mushroom in terms of taste. Treatment 1 (100% squash) was evaluated as very pleasant (4.21–5.00), while Treatment 3 (50% squash + 50% oyster mushroom), Treatment 4 (25% squash + 75% oyster mushroom), and Treatment 2 (75% squash + 25% oyster mushroom) were all rated as pleasant (3.41– 4.20). In terms of taste acceptability, all treatments were rated as “very like” (7.23–8.11), indicating that the samples were highly acceptable and comparable across formulations.

These results suggest that the incorporation of oyster mushroom contributed to a flavor profile characterized by umami and mild aromatic notes, which blended well with the natural sweetness of squash.

Oyster mushrooms are known for their rich umami compounds, and their flavor becomes more pronounced during cooking processes that enhance and concentrate their aromatic components. This finding supports the study of Hossain et al. (2024), who noted that variations in umami taste and aroma among mushrooms are influenced by their biochemical composition and the thermal processes applied during preparation. Overall, regardless of the level of oyster mushroom added, the taste of the squash kroeppek remained pleasant and wellliked, demonstrating that oyster mushroom can be incorporated without negatively affecting flavor acceptability.

Table 4. Sensory Quality and acceptability of squash (*Cucurbita maxima*) kroeppek enhanced with different level of oyster mushroom in terms of taste

TREATMENT	MEAN SENSORY SCORE	Fc	MEAN ACCEPTABILITY SCORE	Fc	TABULAR 5% 1%
T1 (control)	4.29 VP	1.66	8.12 VL	0.00	4.070 7.59
T2- 25%	4.00 P		8.01 VL		
T3- 50%	4.07 P		8.06 VL		
T4- 75%	4.00 P		7.87 VL		
CV=4.51%			CV=34.19%		

Legend:Fc-frictional coefficient VP=Very PLeasant P=Pleasant ns= not significant MD = Moderately Pleasant

General Acceptability

Table 5 presents the sensory quality and acceptability of squash (*Cucurbita maxima*) kroeppek enhanced with different levels of oyster mushroom in terms of general acceptability.

Treatments 1 (100% squash), 2 (75% squash + 25% oyster mushroom), and 3 (50% squash + 50% oyster mushroom) were rated as “extremely like” (8.12–9.00). Meanwhile, Treatment 4 (25% squash + 75% oyster mushroom) received a rating of “very like”

(7.23–8.11). These results indicate that most respondents—composed of students, faculty, and staff—preferred Treatment 1 over the other formulations in terms of overall acceptability. The 100% squash kroeppek was perceived as the most appealing and was evaluated as highly acceptable by the panel.

This suggests that Treatment 1 has a stronger potential for consumer acceptance and marketability compared to the treatments containing higher proportions of oyster mushroom. Overall, while all formulations were well-liked, the results demonstrate that maintaining a higher proportion of squash contributes to superior general acceptability among the respondents.

Table 5. Sensory Quality and acceptability of squash (*Cucurbita maxima*) kroeppek enhanced with different level of oyster mushroom in terms of general acceptability

PARTICULAR	MEAN ACCEPTABILITY SCORE	DESCRIPTION	Fc	TABULAR	
				5%	1%
T1 (control)	8.34	Extremely Like	0.00 ^{ns}	4.070	7.59
T2- 25%	8.25	Extremely Like			
T3- 50%	8.14	Extremely Like			
T4- 75%	8.05	Very Like			
CV=33.61%					

Legend:ns= not significant

Cost And Return

Table 6.1 presents the cost and return of producing cooked squash (*Cucurbita maxima*) kroeppek enhanced with different levels of oyster mushroom. The computation included the cost of raw materials as well as other expenses such as cooking oil, butane fuel, and ziplock packaging.

The total production cost for cooked squash–oyster mushroom kroeppek amounted to ₱330.04, while the net return was ₱169.97. Based on the cost-based pricing method, the computed selling price for the cooked kroeppek is ₱2.00 per unit. The calculated net income per peso cost is 0.51, indicating that for every peso invested in production, a return of ₱0.51 is generated. These results suggest that producing cooked squash–oyster mushroom kroeppek is financially viable and capable of yielding a positive return on investment.

Table 6.1. Cost and Return in processing Cooked Squash -White Oyster Mushroom Kroeppek

PARTICULARS	QTY	UNIT	PRICE / UNIT	AMOUNT
RETURNS				
Squash-Oyster mushroom kroeppek (Cooked)	250	Grams	2	500.00
TOTAL RETURN				500.00
COST OF PRODUCTION				
Oyster Mushroom	112	Grams	0.25	28.00
Squash	25	Grams	0.035	0.88
Cassava flour	250	Grams	0.054	13.50
Cassava Starch	250	Grams	0.06	15.00
Salt	5	Grams	0.012	0.06
Pepper powder	2	Grams	0.03	0.06
MSG	2	Grams	0.02	0.04

	Electricity	6	Hours	30	180.00
	Butane	1	Bottle	25	25.00
	Water	250	ML	0.03	7.50
	Cooking Oil	500	Grams	0.08	40.00
	Packaging (250g/25g per pack)	10	Ziplock	1	10.00
	Labelling	10	Pcs	1	10.00
	TOTAL COST				330.04
NET RETURNS/NET MARGIN					169.97
PRODUCTION COST PER UNIT					1.32
NET INCOME PER PESO COST					0.51

Table 6.2 presents the cost and return of producing uncooked squash (*Cucurbita maxima*) kroeppek enhanced with different levels of oyster mushroom. The computation included expenditures for raw materials and other production-related costs. The total production cost for uncooked squash–oyster mushroom kroeppek amounted to ₱270.04, while the net return was ₱104.97. Using the cost-based pricing method, the selling price for the uncooked kroeppek was computed at ₱1.50 per unit. The resulting net income per peso cost is 0.39, indicating that for every peso invested, a return of ₱0.39 is generated. These results demonstrate that the production of uncooked squash–oyster mushroom kroeppek is profitable, although it yields a lower return compared to the cooked variant due to differences in production cost and selling price.

Table 6.2. Cost and Return in processing Uncooked Squash-Oyster Mushroom White Kroeppek

PARTICULARS		QTY	UNIT	PRICE/ UNIT	AMOUNT
RETURNS					
	Squash-Oyster mushroom kroeppek (uncooked)	250	grams	1.5	375.00
	TOTAL RETURN				375.00
COST OF PRODUCTION					
	Oyster Mushroom	112	grams	0.25	28.00
	Squash	25	grams	0.035	0.88
	Cassava flour	250	grams	0.054	13.50
	Cassava Starch	250	grams	0.06	15.00
	Salt	5	grams	0.012	0.06
	Pepper powder	2	grams	0.03	0.06

	MSG	2	grams	0.02	0.04
	Electricity	6	Hours	30	180.00
	Butane	1	Bottle	25	25.00
	Water	250	ML	0.03	7.50
	TOTAL COST				270.04
NET RETURNS/NET MARGIN					104.97
PRODUCTION COST PER UNIT					1.08
NET INCOME PER PESO COST					0.39

SUMMARY, CONCLUSION, AND RECOMMENDATIONS

This study evaluated the development, sensory quality, acceptability, and profitability of squash (*Cucurbita maxima*) kroepék enhanced with different levels of oyster mushroom. Four treatments were formulated—100% squash, 75% squash with 25% oyster mushroom, 50% squash with 50% oyster mushroom, and 25% squash with 75% oyster mushroom—and were subjected to sensory evaluation by 30 randomly selected respondents from SPAMAST Buhangin Campus using the 9-point Hedonic Scale.

The sensory attributes assessed included color, odor, texture, taste, and general acceptability, while profitability was examined through cost and return analysis for both cooked and uncooked kroepék products.

The findings revealed that the addition of oyster mushroom at varying levels did not significantly affect the sensory qualities of the kroepék. All treatments received favorable ratings in terms of color, odor, texture, and taste, with results showing no significant differences across treatments. Respondents consistently rated the products from “very pleasant” to “pleasant” and from “very like” to “extremely like,” indicating high consumer acceptance.

Among the treatments, the 100% squash formulation obtained the highest general acceptability rating, although the treatments containing oyster mushroom were likewise well liked. Profitability analysis further showed that both cooked and uncooked kroepék were financially viable, with cooked kroepék yielding a higher net income per peso cost (0.51) compared to uncooked kroepék (0.39), demonstrating the product’s potential as a profitable small-scale enterprise.

Based on these findings, the study concludes that oyster mushroom can be incorporated into squash kroepék without negatively affecting its sensory attributes, and the resulting products maintain good consumer acceptability. The 100% squash formulation remained the most preferred, but the treatments with oyster mushroom were also acceptable and marketable.

Moreover, the positive net returns indicate that producing both cooked and uncooked versions of the product is economically feasible, especially for small-scale entrepreneurs seeking affordable and nutritious snack alternatives.

In light of these conclusions, the study recommends exploring additional mushroom varieties or flavor enhancements to further improve product quality and expand market appeal. Future researchers are encouraged to conduct studies on shelf-life, nutritional analysis, and packaging optimization to support long-term product development. Entrepreneurs may consider producing both cooked and uncooked kroepék, with emphasis on the cooked variant due to its higher profitability. Lastly, institutions such as SPAMAST may integrate this product into livelihood and community-based training programs to support local employment and entrepreneurship.

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