





SQUID SAVOR: DEVELOPMENT OF HIGH-PROTEIN, LOW-FAT SQUID-BASED SEASONING POWDER

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ABSTRACT

Food security and sustainability are crucial in addressing the rising demand for nutritious and convenient food options. This study develops a novel squid seasoning powder from "*lumayagan pusit*," a commonly caught squid in the Zamboanga Peninsula, Philippines. The product aims to utilize abundant squid resources to augment local fishermen's incomes while promoting food innovation and addressing marketing challenges. Four formulations of the seasoning powder were developed, varying the amounts of spices and dried squid. Each formulation was assessed for moisture content, water activity, sensory attributes, microbial safety and nutritional composition. Results indicated that the formulation containing 50% spices was the most preferred by consumers, receiving the highest scores in terms of taste, aroma, and overall acceptability. The product exhibited low moisture content (0.222 g) and low water activity values ranging from 0.42 to 0.53, which suggest enhanced product stability and reduced susceptibility to microbial growth. Sodium was measured at 6,669 mg per 100 g, about 289% of the Recommended Energy and Nutrient Intake (RENI). this seasoning offers a unique flavor and is healthier, even when used on a daily basis (133.38 mg per serving). Sodium content meets 26.68% of the RENI, emphasizing the need for mindful seasoning choices. Nutritional analysis of the preferred squid seasoning powder revealed a relatively higher protein content (1.3412 g), low fat content (0.053 g), and no detectable carbohydrates. The sodium content was measured at 133.38 mg per serving, which corresponds to approximately 26.676% of the Recommended Energy and Nutrient Intake (RENI) for sodium. Despite this sodium contribution, the

product remains comparable to commercially available seasoning powders in the Philippines, which are commonly marketed in granular form and typically contain zero protein but relatively high sodium levels, as indicated on their nutrition labels. The findings suggest that the squid seasoning powder can enhance culinary applications while providing economic opportunities for local fishers. Future research should explore the product's broader market appeal and potential as a functional food ingredient.

Keywords: Dried squid, Local fishers, Sensory evaluation, Squid seasoning powder, and Zamboanga Peninsula

1. INTRODUCTION

Food security and sustainability are important in our ever-changing world, encompassing food availability, access to nutritious options, and overall stability [13]. Sustainable Development Goal 2 (SDG 2): Zero hunger assumes immense importance as it addresses both food safety and security, aligning with the growing trend among consumers [12]. Today's consumers are increasingly discerning, seeking not only the latest market trends to satisfy their taste preferences but also convenient and healthier food choices. Through research and development, coupled with product innovation, the primary objectives of this study are to introduce novel condiments to the market, such as Squid Seasoning Powder made from Dried Squid (*Lumayagan pusit*), thus transforming it into a high demand condiment while maintaining the highest safety and quality standards.

Cephalopods, widely abundant within the world's oceans, offer a significant opportunity in this pursuit. Their widespread presence across diverse marine ecosystems, ranging from coastal lagoons and shallow waters to open oceans, is evident in their ecological significance. With approximately 800 distinct living species constituting a substantial portion of the molluscan class Cephalopoda, they represent a diverse and untapped resource. Among these cephalopods, squids belonging to the Teuthida order hold specific relevance. This species is abundantly evident in the Philippines [6-11].

The Zamboanga Peninsula Region is situated in the western part of Mindanao. The coastline of this region extends for approximately 700 kilometers, making up approximately 43% of Mindanao's total coastline. The primary economic activities in this area, as well as in neighboring provinces such as Jolo Sulu, Basilan, and Tawi-Tawi, are centered around agriculture and fishing. Furthermore, the region is renowned for its rich marine resources, including tuna, herring sardines, anchovies, and mackerel, as well as an abundance of shrimps, prawns, lobsters, crabs and cuttlefish [7].

Alongside the "*lumayagan pusit*" which is commonly used in dried squid production in the region, preservation techniques such as drying serve as a means of preserving squid. This is particularly

important because many islands lack refrigeration facilities to extend the shelf life of squid and other marine creatures. Given these challenges, the researcher has identified a significant opportunity for innovation in the development of a product called “Squid Savor: Seasoning Powder. This research and development initiative focused on the development of a seasoning powder formulated using pure dried squid powder to imparts a distinctive umami flavor.

The abundance and availability of squid, known as *lumayagan pusit*, utilized in the processing of dried squid in the region, have surged due to continuous squid harvesting by fisherfolk, especially in neighboring provinces such as Basilan, Jolo Sulu, and Tawi-tawi. However, dried squid suppliers and vendors experienced difficulties in marketing and disposing of medium- and large-sized dried squid, as these sizes were generally perceived as having a rubbery or gummy texture after drying. Consequently, only small-sized dried squid remained highly marketable, leading to the accumulation of unsold medium and large sizes in local markets and their subsequent devaluation. These observations and market challenges were identified based on interviews and survey data collected from selected dried squid suppliers and vendors in the region, which also contributed to identifying intermittent oversupply as a significant challenge. While there is a growing demand from consumers for new, healthy food options in the market that are also affordable, fisherfolk, suppliers, and vendors face obstacles when trying to sell their dried squid. This is primarily because dried squid is priced at a premium, and consumers typically do not include it in their daily meals.

This dilemma will persist unless alternative solutions are identified. Addressing these challenges and capitalizing on opportunities by introducing new value-added products derived from dried squid can provide a ray of hope for fisherfolk, suppliers, and vendors, potentially boosting their income and ensuring the sustainability of the product. Consequently, offering new condiment options in the form of seasoning powder to the market will provide a new opportunity for both consumers and business entrepreneurs, especially fisherfolk.

2. MATERIALS AND METHODS

2.1 Study sites

The research conducted at the Food Processing Laboratory, College of Agriculture, Western Mindanao State University, Zamboanga City.

2.2 Schematic Diagram:

Four samples (S1–S4) are prepared, each containing 100% dried squid with varying amounts of flavor enhancers and spices (100%, 75%, 50%, and 25%, respectively). The four formulations undergo microbial analysis to ensure safety and quality. Furthermore, statistical analysis is performed using sensory evaluation (7-point hedonic test) and one-way ANOVA. The sensory

attributes assessed include taste, color, texture, aroma, and overall acceptability. Lastly, laboratory analyses are conducted, focusing on proximate composition and nutritional analysis. Overall, the schematic diagram presents a structured approach to product formulation, emphasizing product testing, sensory evaluation, statistical validation, and nutritional assessment.

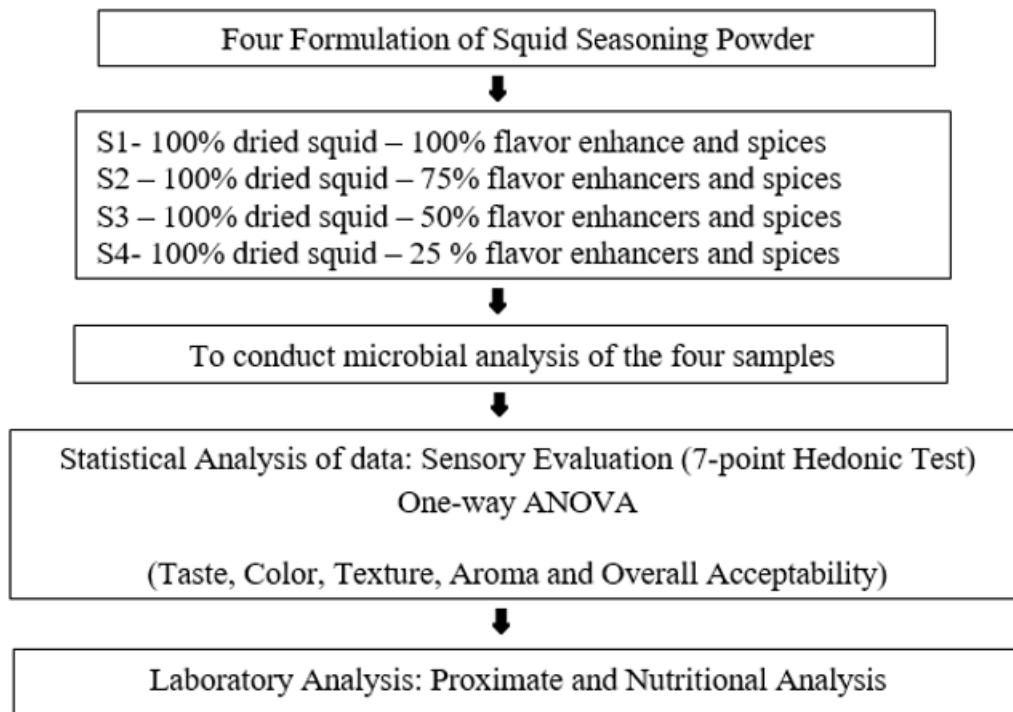


Figure 1. Squid seasoning powder (SSP) schematic diagram

2.3 Preparation

In a casserole, cut the dried squid into strips, and then pulverize it using a pulverizer. Weigh and measure out 400g. In another casserole, combine the remaining ingredients, including onion powder, garlic powder, pepper powder, salt, and flavor enhancers. Pulverize this mixture again to ensure homogenization. Place the powdered mixture into the oven and maintain a controlled temperature of 100°C (low heat) for 1 to 2 hours. You can achieve this using a temperature-controlled heating system. Check for the desired moisture content in the seasoning powder both before and after placing it in the oven. Pack the mixture into a cool, dry pouch and seal it. Figure 2 shows the *Lumayagan squid* (whole and strips)

2.4 Research Sampling



Figure 2. Lumayagan squid (whole and strips)

For the sensory evaluation, respondents were randomly selected panelists composed of students, faculty members, canteen owners, and other personnel residing within the campus. Based on records obtained from the Administration Office of WMSU Campus C, the campus has an estimated population of approximately 1,500 individuals. Following standard sampling practice, the number of participants represented at least 10% of the total population, resulting in 150 respondents who participated in the sensory evaluation.

Eligible participants were between 18 and 59 years old, as individuals below 18 years old and above 59 years old were excluded to avoid involving vulnerable population groups in the study. To further strengthen the integrity and objectivity of the research, participants were required to disclose any potential conflicts of interest that might influence their evaluation of the product.

Of the total respondents, 91 were female and 34 were male. Among the female participants, 57 were students, primarily BS Food Technology (BSFT) students who had prior exposure to sensory evaluation subjects, while 34 were faculty members, staff, and canteen owners. Among the male respondents, 21 were students and 13 were faculty members, staff, and canteen owners. This diverse group of panelists provided a balanced representation of individuals with varying levels of familiarity with food product evaluation.

2.5 Sampling Procedure

Informed consent was obtained from all randomly selected panelists prior to data collection. To uphold ethical standards, participants were provided with explicit disclosures regarding the study's

purpose and the confidentiality of their personal information. These measures ensured that involvement was voluntary and informed.

2.6 Sensory Evaluation

Sensory evaluation was conducted using a modified 7-point hedonic scale, ranging from 1 (dislike extremely) to 7 (like extremely), to determine the overall acceptability of four distinct formulations. A total of 150 respondents evaluated the samples, which were presented in a randomized and blinded format using coded labels. Participants assessed the samples based on flavor, aroma, color, texture, and overall acceptability. To minimize carryover effects, potable water was provided as a palate cleanser between sample evaluations. Individuals with known allergies to squid or other seafood products were discouraged from participating in order to prevent potential allergic reactions during or after the sensory evaluation.

3. RESULTS AND DISCUSSION

Four different samples of squid seasoning powder (SPP) were prepared, each containing varying amounts of spices but the same amount of squid powder: S1 - 100% spices, S2 - 75% spices, S3 - 50% spices, and S4 - 25% spices (Figure 4). Typically, a commercial seasoning powder (10 g) is dissolved in 1000 ml of hot water to create a soup stock. However, for the squid seasoning powder (SSP), the 10 g was dissolved in only 150 ml of water. This was because the commercial seasoning powder contained more spices and flavor enhancers, as indicated on the product label, while SSP contained lower sodium and fewer flavor enhancers. S1, with 100% spices, contained 400 g of squid powder, the same amount used in the other samples, but it had a higher amount of salt and other spices. It exhibited a strong salt content, as the squid powder itself was already salty, and the added salt contributed further to its saltiness. The color was darker compared to S2, S3, and S4. Similarly, S2, with 75% spices, was also somewhat salty, comparable to the saltiness level of S1, but its color was slightly lighter than S1. On the other hand, S4, with 25% spices, had the smallest amount of salt and other spices and was lighter in color than S3. S3, with 50% spices, contained fewer spices compared to S1 and S2. All samples had a fine texture, but the flakiness of the squid powder could still be felt when held. Salt was added not only as a flavor enhancer but also a preservative.

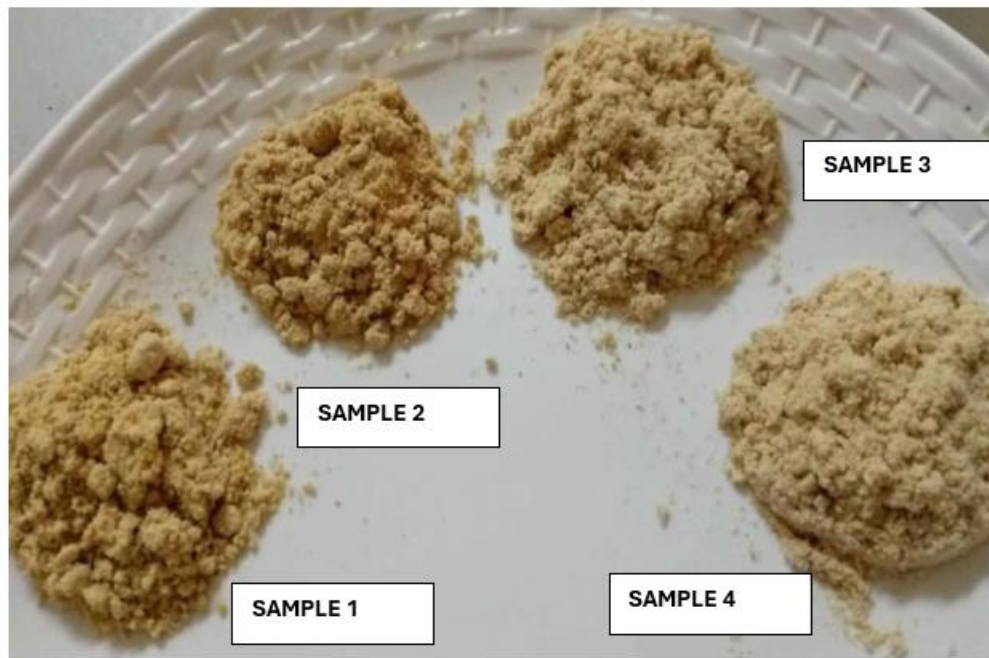


Figure 3. Four (4) different samples of squid seasoning powder

3.1 Moisture content and Water activity (A_w)

Moisture content is an important parameter in maintaining product quality and shelf stability, as it influences characteristics such as texture, flavor, and susceptibility to microbial growth. In this study, the squid seasoning powder exhibited a low moisture content of 0.222. Although the squid powder used as a raw material had a moisture content of 22.04%, which contributed to the overall moisture level of the formulation, the final product still maintained relatively low moisture content, indicating good drying efficiency during processing.

Unlike moisture content, which measures both free and bound water, water activity (A_w) determines the amount of free water available for microbial growth and enzymatic reactions that may lead to product spoilage. Therefore, A_w is an important parameter in assessing microbial stability and potential chemical reactions in food systems. The results showed low A_w values across all formulations (0.42–0.53), which are below the critical threshold of 0.60–0.70 for microbial growth (Pittia & Antonello, 2016). This indicates that the samples are microbiologically stable at room temperature and less susceptible to spoilage.

Furthermore, the presence of hydrophilic solutes such as salts contributes to the reduction of water activity by binding free water molecules, thereby acting as humectants. Consequently, salt played a significant role in reducing water availability and lowering the A_w of the product, further enhancing the shelf stability of the squid seasoning powder.

3.2 Microbial Analysis and Real-time shelf-life study

The aerobic plate count of the most preferred formulation (S3) of the squid seasoning powder was 4.1×10^4 CFU/g, while the yeast and mold count was 1.7×10^2 CFU/g. Based on FDA Circular No. 2022-012 guidelines for spices, the allowable limits are 10^6 CFU/g for aerobic plate count and 10^4 CFU/g for yeast and mold count, respectively. The results indicate that both the aerobic plate count and yeast and mold count were below the critical limits, suggesting that the sample is microbiologically safe for consumption. The low microbial counts may be attributed primarily to the low water activity (A_w) of the samples, which limits microbial growth. In addition to A_w , other factors that may contribute to the low microbial load include proper sanitation practices, adherence to Good Manufacturing Practices (GMP), and the implementation of Hazard Analysis and Critical Control Point (HACCP) systems.

The squid seasoning powder underwent a real-time shelf-life study under frozen storage conditions (vacuum sealed). The product was initially stored in a freezer in June 2025 and was continuously monitored up to March 2026, equivalent to approximately nine months of storage. The samples were maintained at an average freezer temperature of -18 °C (0 °F), which is the recommended temperature for frozen food storage to inhibit microbial growth and maintain product safety and quality (Attrey, D.P. (2017).

Throughout the storage period, no significant changes were observed in the product's color, odor, aroma, or overall palatability. Periodic product sampling was conducted through actual cooking applications, and the product remained acceptable and safe for consumption.

Microbiological evaluation was also performed to assess the physicochemical and microbial stability of the product. No visible signs of yeast or mold growth were observed. Laboratory analysis revealed that the Aerobic Plate Count (APC) was 6.2×10^5 CFU/g, which remains within the acceptable limit of 10^6 CFU/g. Meanwhile, the Yeast and Mold (YM) count was 6.42×10^2 CFU/g, which is within the acceptable limit of 10^3 CFU/g based on the standards set by the Food and Drug Administration Philippines, Circular No. 2022-012.

These results indicate that the squid seasoning powder maintained its sensory attributes and microbiological safety during the nine-month frozen storage period, demonstrating its suitability for long-term storage under recommended frozen conditions.

3.3 Sensory Evaluation

Table 1: Sensory evaluation results of squid seasoning powder

ATTRIBUTE	SAMPLE 1		SAMPLE 2		SAMPLE 3		SAMPLE 4	
	\bar{x}	VI	\bar{x}	VI	\bar{x}	VI	\bar{x}	VI
Aroma	5.13	SL	5.33	ML	5.77	ML	5.73	ML
Color	5.60	ML	5.30	ML	5.23	SL	4.93	SL
Flavor	4.90	SL	5.10	SL	5.27	SL	5.33	ML
Texture	4.47	SL	4.63	SL	4.80	SL	5.53	ML
General Acceptability	5.33	ML	5.23	SL	5.40	ML	5.20	SL
Overall Average Mean	5.09	SL	5.12	SL	5.29	SL	5.34	ML

Legend: 6.16-7.00 = Extremely Like (EL); 5.30-6.15 = Moderately Like (ML); 4.44 – 5.29 = Slightly Like (SL); 3.58 – 4.43 = Neither like or dislike (NLD) 2.272-3.57 = Slightly Dislike (SD); 1.86 – 2.71 = Moderately Dislike (MD); 1.00-1.85 = Extremely Dislike (ED)

Table 1. Shows the sensory evaluation of the squid seasoning powder revealed varying degrees of acceptability across the four samples, particularly in aroma, color, flavor, texture, and overall acceptability. Sample 4 received the highest mean score for aroma (5.73), indicating moderate liking, while samples 2 and 3 followed closely with means of 5.33 and 5.77. In terms of color, samples 1 and 2 scored moderately (5.60 and 5.30), while samples 3 and 4 received slightly lower ratings (5.23 and 4.93). Flavor ratings indicated sample 4 as the most preferred (5.33), whereas sample 1 was perceived as slightly liked (4.90). For texture, sample 4 has the highest mean score of 5.53, denoting moderate liking, while the other samples scored below 5.0. General acceptability scores placed sample 4 as the most favored with a mean of 5.34, reinforcing the overall preference across different sensory attributes. The overall average mean scores further confirmed that sample 4 was the most preferred option, revealing a score of 5.34, while the remaining samples were categorized as slightly liked. Overall, the sensory attributes of the squid seasoning powder, especially the aroma and flavor had a substantial influence on consumer preference, as revealed by the findings of sample 4.

Table 2: Normality test for the sensory evaluation results

Attribute	Sample Code	W value	df	p value	Interpretation
Aroma	Sample 1	0.876	30	0.002	not normally distributed
	Sample 2	0.855	30	0.001	not normally distributed
	Sample 3	0.873	30	0.002	not normally distributed
	Sample 4	0.857	30	0.001	not normally distributed
Color	Sample 1	0.834	30	0.000	not normally distributed
	Sample 2	0.795	30	0.000	not normally distributed
	Sample 3	0.772	30	0.000	not normally distributed
	Sample 4	0.616	30	0.000	not normally distributed
Flavor	Sample 1	0.907	30	0.013	not normally distributed
	Sample 2	0.921	30	0.028	not normally distributed
	Sample 3	0.836	30	0.000	not normally distributed
	Sample 4	0.878	30	0.003	not normally distributed
Texture	Sample 1	0.913	30	0.018	not normally distributed
	Sample 2	0.888	30	0.004	not normally distributed
	Sample 3	0.862	30	0.001	not normally distributed
	Sample 4	0.835	30	0.000	not normally distributed
General Acceptability	Sample 1	0.784	30	0.000	not normally distributed
	Sample 2	0.886	30	0.004	not normally distributed
	Sample 3	0.829	30	0.000	not normally distributed
	Sample 4	0.793	30	0.000	not normally distributed

p-value > .05 = Data is normally distributed; p-value ≤ .05 = Data is not normally distributed

The normality of sensory evaluation scores for squid seasoning powder samples was assessed using the Shapiro–Wilk test (Table 2). Results indicated that none of the samples satisfied the assumption of normality ($p < 0.05$ for all). For aroma, W values ranged from 0.855 to 0.876 (Sample 1: 0.876, $p = 0.002$; Sample 2: 0.855, $p = 0.001$; Sample 3: 0.873, $p = 0.002$; Sample 4: 0.857, $p = 0.001$). Color scores exhibited greater deviation, with W values decreasing from 0.834 (Sample 1) to 0.616 (Sample 4) ($p < 0.001$). Flavor scores also deviated from normality (Sample 1: $W = 0.907$, $p = 0.013$; Sample 2: $W = 0.921$, $p = 0.028$; Sample 3: $W = 0.836$, $p < 0.001$; Sample 4: $W = 0.878$, $p = 0.003$). Texture evaluations followed the same trend, with W values progressively declining from Sample 1 (0.913, $p = 0.018$) to Sample 4 (0.835, $p < 0.001$). General acceptability scores confirmed non-normality across all samples ($W = 0.784–0.886$; $p \leq 0.004$). Collectively, these findings demonstrate significant deviations from normality for all sensory attributes across the formulations. Consequently, non-parametric statistical approaches were deemed most appropriate. The Friedman test was employed to assess differences in sensory attributes among the

samples, and where significant effects were observed, pairwise comparisons were conducted using the Wilcoxon signed-rank test.

Table 3: Friedman test analysis

Attribute	Sample Code	Mean Rank	N	χ^2	df	p value	Interpretation
Aroma	Sample 1	2.12	30	9.518	3	.023	Significant
	Sample 2	2.27					
	Sample 3	2.75					
	Sample 4	2.87					
Flavor	Sample 1	2.17	30	4.764	3	.190	Not significant
	Sample 2	2.45					
	Sample 3	2.65					
	Sample 4	2.73					
Color	Sample 1	2.97	30	17.411	3	.001	Significant
	Sample 2	2.58					
	Sample 3	2.48					
	Sample 4	1.97					
Texture	Sample 1	2.27	30	5.753	3	.124	Not significant
	Sample 2	2.30					
	Sample 3	2.57					
	Sample 4	2.87					
General Acceptability	Sample 1	2.43	30	.358	3	.949	Not significant
	Sample 2	2.47					
	Sample 3	2.58					
	Sample 4	2.52					

p value < p 0.05 is significant; p value > p 0.05 is not significant

Table 3 presents the results of the Friedman test ($\alpha = 0.05$) used to evaluate differences across five sensory attributes of four squid seasoning powder samples. Significant differences were observed for aroma ($\chi^2 = 9.518$, $p = 0.023$), with mean ranks of Sample 1 = 2.12, Sample 2 = 2.27, Sample 3 = 2.75, and Sample 4 = 2.87, and for color ($\chi^2 = 17.411$, $p = 0.001$), with mean ranks of Sample 1 = 2.97, Sample 2 = 2.58, Sample 3 = 2.48, and Sample 4 = 1.97, indicating perceptible variation among samples for these attributes. In contrast, no statistically significant differences were detected for flavor ($\chi^2 = 4.764$, $p = 0.190$; mean ranks 2.17–2.73), texture ($\chi^2 = 5.753$, $p = 0.124$; mean ranks 2.27–2.87), or overall acceptability ($\chi^2 = 0.358$, $p = 0.949$; mean ranks 2.43–2.58), suggesting consistent evaluations across samples for these characteristics. These findings indicate that aroma and color are the primary sensory attributes differentiating squid seasoning formulations, whereas flavor, texture, and overall acceptability remain relatively the same.

Table 4: Post-Hoc Analysis

Attribute	Sample Code Comparisons	Z score	p value	Interpretation
Aroma	Sample 1 – Sample 2	-.738	.461	Not significant
	Sample 1 – Sample 3	-2.297	.022	Significant
	Sample 1 – Sample 4	-1.801	.072	Not significant
	Sample 2 – Sample 3	-1.818	.069	Not significant
	Sample 2 – Sample 4	-1.386	.166	Not significant
	Sample 3 – Sample 4	-.052	.959	Not significant
Color	Sample 1 – Sample 2	-2.066	.039	Significant
	Sample 1 – Sample 3	-2.221	.026	Significant
	Sample 1 – Sample 4	-3.262	.001	Significant
	Sample 2 – Sample 3	-.816	.414	Not significant
	Sample 2 – Sample 4	-2.524	.012	Significant
	Sample 3 – Sample 4	-2.065	.039	Significant

p value < p 0.05 is significant; p value > p 0.05 is not significant

A Wilcoxon signed-rank test was conducted to evaluate differences in aroma among four squid seasoning powder samples (Table 4). Of the six pairwise comparisons, only Sample 1 versus Sample 3 showed a significant difference, with $Z = 2.297$ and $p = 0.022$, indicating that Sample 3 had a distinct aromatic profile compared with Sample 1. The remaining comparisons, Sample 1 versus Sample 2 ($Z = 0.738$, $p = 0.461$), Sample 1 versus Sample 4 ($Z = 1.801$, $p = 0.072$), Sample 2 versus Sample 3 ($Z = 1.818$, $p = 0.069$), Sample 2 versus Sample 4 ($Z = 1.386$, $p = 0.166$), and Sample 3 versus Sample 4 ($Z = 0.052$, $p = 0.959$), were not statistically significant, suggesting that these samples had similar aroma characteristics.

In terms of color, significant differences were observed between Sample 1 and Sample 2 ($Z = 2.066$, $p = 0.039$), Sample 1 and Sample 3 ($Z = 2.221$, $p = 0.026$), Sample 1 and Sample 4 ($Z = 3.262$, $p = 0.001$), Sample 2 and Sample 4 ($Z = 2.524$, $p = 0.012$), and Sample 3 and Sample 4 ($Z = 2.065$, $p = 0.039$). The comparison between Sample 2 and Sample 3 ($Z = 0.816$, $p = 0.414$) was not significant, indicating perceptual similarity. These results indicate that Samples 1 and 4 had the most distinct color attributes, whereas Samples 2 and 3 were more similar, highlighting consistent and significant variation in the perceived color of the squid seasoning powders.

Table 5: Nutrition Information of Squid Seasoning Powder (Sample 3)

Net Content Per Pack: 10g		
Serving Size: 2g		
Serving Per Pack: 5		
	Amount Per Serving	% RENI*
Crude Protein (g)	1.3412	2.017
Total Fat (g)	0.053	0.081
Carbohydrates (g)	0	0
Sodium (mg)	133.38	26.676
Moisture (g)	0.222	-
Ash (g)	0.446	-

*Percent RENI values are based on 2015 PDRI reference adult requirement of 19-29 years old.

The nutritional composition of squid seasoning powder was evaluated based on a 2 g serving. Each 10 g package contained five servings, with the following nutrient content per serving: crude protein, 1.34 g; total fat, 0.05 g; carbohydrates, 0 g; sodium, 133.38 mg; moisture, 0.22 g; and ash, 0.45 g. This profile illustrates that the seasoning can enhance the flavor of dishes with minimal contribution to overall macronutrient intake. When compared to the 2015 Recommended Dietary Reference Intake (PDRI) for adults aged 19–29 years, a single serving provides approximately 2% of the recommended protein intake. The total fat content per serving accounts for less than 0.1% of daily needs. The absence of carbohydrates renders the seasoning naturally low in carbohydrates, which may be beneficial for individuals aiming to limit carbohydrate intake. Sodium content per serving corresponds to 26.68% of the daily recommended intake, indicating the need for moderation in consumption to avoid excessive sodium intake. Nevertheless, when compared with commercially available seasoning powders in the Philippines, which contain higher sodium levels of 516 mg, 260 mg, and 143 mg, respectively, across different popular brands, the squid seasoning powder (SSP) demonstrated a relatively lower sodium content based on the computed nutritional composition. Moreover, label declarations indicated that these three commercial brands contain zero protein, whereas SSP provides measurable protein derived from powdered squid.

The protein content suggests that the seasoning can provide a modest protein contribution. The minimal fat content allows for taste enhancement without substantially increasing dietary fat intake. Although sodium levels are lower than those found in many commercial powdered seasonings, careful portion control is still recommended. The seasoning thus offers a convenient option to enrich dishes with flavor while supporting mindful dietary management.

Table 6: Product Costing

Items	Amount per pack	Price	Amount utilized	Price of amount utilized
Dried squid	1kg	₱ 600.00	600g (powdered)	₱ 600.00
Garlic Powder	100g	₱ 50.00	45 g	₱ 22.50
Onion Powder	100g	₱ 50.00	45 g	₱ 22.50
Pepper powder	100g	₱ 60.00	45 g	₱ 27.00
Seasoning 1	1kg	₱ 22.00	600 g	₱ 13.20
Seasoning 2	1kg	₱ 100 .00	150 g	₱ 15.00
TOTAL				₱ 160.00
Total cost = Cost of ingredients utilized + Other expenses			₱ 700.02 pesos + ₱ 160 pesos	₱ 860.20
Labor cost (₱360.00) minimum wages per day with 8 hours working time)	₱ 360.00	Per 8 hours	1.5 hours	₱ 360/8*1.5 ₱ 67.50
Total cost with labor = Total cost + Labor cost			₱ 860.20 pesos + ₱ 67.5 pesos	₱ 927.70/225pcs = ₱ 4.12 10g of each squid seasoning powder costs ₱ 4.12
40% Mark up			4.12 x .40	₱ 1.65
Total amount with 40% mark up			4.12 + 1.65	₱ 5.77
Selling Price				₱ 6.00

Product costing is essential in business because it guides decision-makers in determining appropriate pricing and ensuring profitability. Based on the cost analysis presented in Table 6, the production of squid seasoning powder using 1 kg of dried squid powder as the primary ingredient was evaluated. The total cost of all ingredients, including flavor enhancers, amounted to ₱700.02, while additional operational expenses for light, water, gas, and transportation totaled ₱160.00. Labor costs for 1.5 hours of processing were estimated at ₱67.50, bringing the total production cost to ₱927.70. From this batch, approximately 225 packs of 10 g each were produced, resulting in a unit production cost of ₱4.12 per 10 g pack. After applying a 40% markup, the selling price was set at ₱6.00 per pack.

Compared to commercially available seasoning powders in the Philippines, which are sold in either powdered or granule form at ₱5.00 to ₱6.00 per 10 g pack, the developed squid seasoning powder offers a cost-competitive alternative despite being made with high-value pure dried squid (₱600/kg). Additionally, the product provides high protein and low-fat content, distinguishing it nutritionally from typical commercial seasonings that generally contain no protein and relatively high sodium. Moreover, the computed selling price of ₱6.00 per 10 g pack may still be adjusted or

potentially reduced when produced at a larger scale, as bulk purchasing of raw materials, improved processing efficiency, and optimized production operations can significantly lower the overall production cost. This demonstrates that small-scale production of squid seasoning powder can be both economically viable and nutritionally advantageous, providing fisherfolk with a value-added livelihood opportunity.

4. CONCLUSION

A clear preference for sample 4 was observed, consistently receiving the highest ratings in aroma, flavor, texture, and overall acceptability. These results indicate significant differences in sensory attributes and highlight the intricate nature of consumer preferences. Aroma emerged as a particularly influential attribute, highlighting its role in enhancing product appeal, while texture contributed to the distinctiveness of sample 4, suggesting potential applications in product formulation. Visual appeal was also recognized as an important determinant in consumer choices, reflecting the complex aspects of sensory perception that contribute overall satisfaction. Moreover, the physicochemical and microbiological analyses support the product's quality, safety, and shelf stability. The product exhibited low moisture content and water activity (A_w), indicating limited availability of free water necessary for microbial growth and enzymatic reactions that could lead to spoilage. The A_w values (0.42–0.53) were below the critical threshold for microbial proliferation, contributing to the microbiological stability of the product. Microbial analysis further confirmed that both the aerobic plate count and yeast and mold counts were within the acceptable limits established by Food and Drug Administration Philippines Circular No. 2022-012 for spices. Additionally, the real-time shelf-life study conducted under frozen storage conditions ($-18\text{ }^\circ\text{C}$) for nine months revealed no significant changes in sensory attributes such as color, odor, aroma, and overall palatability, while microbial levels remained within safe limits. Overall, these findings indicate that the squid seasoning powder is microbiologically safe, stable, and suitable for long-term storage, highlighting its potential as a value-added seafood-based seasoning product.

Nutritional analysis of the squid seasoning powder revealed a high protein content, moderate moisture, low fat, and zero carbohydrates, making it suitable for low-fat and low-carbohydrate diets. The significant mineral content not only enhances flavor but also provides additional nutritional benefits. The relative amount of sodium content enhances the rich and savory flavor, contributing to overall palatability while still allowing for mindful consumption.

Product variations, including low-sodium and fortified variants, could expand market demand, while evaluating consumer acceptance across different populations and exploring its potential as a functional food may further enhance its commercial value and nutritional significance.

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