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SHORT COMMUNICATION

Sensory Characteristics and Storage Analysis of Newly Developed Spider Conch Balls from the Spider Conch (*Lambis lambis*)

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A B S T R A C T

Street foods, particularly in Asia, are widely consumed and enjoyed by people. Among these street foods, meatballs made from various seafood products, including fish balls, shrimp balls, and squid balls, are particularly popular. Due to the growing demand for these street foods, there is a necessity to innovate and create novel types of meatballs using other seafood products, especially those that are abundant but less utilized. This work focused on developing and standardizing spider conch balls (*Lambis lambis*) using three different formulations with varying meat and binder ratios: Formulation A (50:50), Formulation B (60:40), and Formulation C (70:30). Sensory evaluation by semi-trained panelists was done to assess the characteristics of the products using the three formulations, including flavor, color, texture (chewiness and juiciness), and overall acceptability. The product with Formulation C emerged as the preferred choice, with the significantly highest overall score during the evaluation ($p < 0.05$). It was subjected to storage testing and comparison with commercially available squid balls. Additionally, consumer testing was conducted to evaluate the acceptability of the newly developed spider conch balls. Results revealed that the newly developed spider conch balls exhibited significantly greater acceptability ($p < 0.05$) than the commercially available squid balls. The storage analysis demonstrated that the frozen spider conch balls maintained high to moderate general acceptability scores, making them suitable for consumption for three (3) weeks. This study suggests that spider conch (*L. lambis*) can be an alternative raw material for preparing seafood meatballs.

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Street foods are a category of readily consumable food and beverages prepared and sold by street vendors and hawkers in public areas, primarily on streets (Steyn et al. 2014; Yulia et al. 2017). Additionally, food items sold around schools, excluding those originating from restaurants or school canteens, are also considered street foods (Steyn et al. 2014). The popularity of street foods among young consumers (Sanlier et al. 2018) stems from their affordability, accessibility, and function as an alternative to home-cooked meals (Steyn et al. 2011; Khairuzzaman et al. 2014; Yulia et al. 2017; Sanlier et al. 2018; Albuquerque et al. 2020; Sousa et al. 2021). A significant proportion of the global population incorporates street foods into their daily dietary practices (Al Mamun and Turin 2016). In 2007, it was estimated that approximately 2.5 billion individuals worldwide consumed street foods daily (Sousa et al. 2021). Particularly in developing countries, street foods play a significant role in offering socioeconomic and nutritional opportunities for low and middle-income communities (Simopoulos and Bhat 2000; Khairuzzaman et al. 2014; Steyn et al. 2014; Alimi and Workneh 2016). Moreover, street foods also serve as notable attractions for tourists, especially in Asia (Gupta et al. 2019).

Among the various street foods in Southeast Asia, fish balls stand out as one of the prominent delicacies. Traditionally served in diverse preparations, fish balls can be found in noodle and soup dishes, steamed with vegetables, or deep-fried. They go by different names depending on the country, such as 'yu huan' in Singapore, 'yu wan' in China, 'bebola ikan' in Malaysia and Indonesia, 'nga soke' in Myanmar, 'bola bola' in the Philippines, and 'look chin pla' in Thailand (Kok et al. 2013). Fish balls typically have a round, white appearance and consist of fish meat combined with ingredients such as sugar, salt, and starch. They are fried in oil and sold as popular street foods (Sarmiento et al. 2018). Meatball products, such as fish, shrimp, and squid balls, enjoy widespread popularity as famous street food delicacies in the Philippines (Sarmiento et al. 2018). In order to cater to the growing demand for street foods, it is essential to innovate and create novel ball-shaped food products using fishery resources. A recent study successfully formulated and standardized crab balls out of a blue swimming crab (*Portunus pelagicus*), which gained high acceptability with potential for commercialization (Ajik-Cerbas et al. 2022).

The spider conch (*Lambis lambis*) is a species commonly found in the intertidal and reef areas of the Indo-Pacific region, including countries such as Philippines, Indonesia, Solomon Islands, India, Japan, and Malaysia (Hamel and Mercier 2006; Mazo et al. 2013; Poutiers 1998). It is actively harvested in these areas for its use as a food source and in the shell craft industry (Mazo et al. 2013). Although there is no available statistical data on the production of spider conch collected from the wild in the Philippines, it has been estimated that in Tawi-Tawi, southern Philippines alone, there are about 12.5 tons per year of spider conch meat harvested through gleaning. This indicates the sustainability of this resource (Sakiran S. Damsik/Malinie T. Suhaili, personal communicaton, 09 Jan 2024). Spider conch has a great protein content of up to 55% (dry weight) as well as rich in minerals, including Na, K, Ca, and P. Its fresh and dried forms obtained fair to good consumer acceptability (Amin et al. 2020). Owing to its high nutritional value, spider conch meat has been developed and processed into various value-added products, such as dehydrated edible meat pieces, frozen hot smoked edible meat pieces, and instant dehydrated soup products, which have demonstrated excellent overall acceptability even after storage (Amin et al. 2023). Furthermore, when spider conch meat was used as a raw material for Kreopek preparation and compared with fish and squid, spider conch Kreopek exhibited the highest quality and received a rating of 'liked very much' (Pagatpatan et al. 2017). At present, there is a scarcity of research focused on spider conch balls globally. To the best of our understanding, there is a lack of existing studies examining the utilization of spider conch as a primary ingredient for ball-shaped food products. Given that the spider conch has a high nutritional content, incorporating it into a ball-shaped product would add value and provide an alternative nutritious option in the market. Thus, this study aimed to develop and standardize spider conch balls using spider conch (*L. lambis*), assess its acceptability and storage, compare it with the commercially available squid ball, and evaluate its potential as a street food product.

The research was conducted at the Fish Processing Laboratory, located in the College of Fisheries at Mindanao State University-Tawi-Tawi College of Technology and Oceanography in Bongao, Tawi-Tawi, Philippines. Before the experiment commenced, a series of formulations following the method of Ajik-Cerbas et al. (2022) with minor modifications were tested as preliminary experiments (data not shown) were prepared. This iterative process aimed to achieve the desired flavor and texture of the newly developed spider conch meat product. Various ingredients were added in specific ratios to develop the optimal formulation. Ultimately, three formulations were selected based on the sensory evaluation of the researchers and some panelists.

The raw material used in the study was spider conch (*L. lambis*), obtained from the Seafood Product Shops at Chinese Pier, Bongao, Tawi-Tawi, Philippines. The spider conch was procured in meat form, freshly extracted from the shells, thoroughly cleaned, and ensured to be free from any foreign materials. Upon arrival at the study site, the spider conch meat was carefully washed, subjected to brining in a solution of 1 part salt to 10 parts water, drained, and then minced using a mortar and pestle. The minced spider conch meat was set aside for further processing. Additionally, flour was sifted, and other ingredients such as corn starch, carrots, sugar, salt, MSG, garlic, onion, ginger, white pepper, and water were prepared according to the specifications provided in Table 1. Spider conch balls were processed according to the method of Ajik-Cerbas et al. (2022).

The spider conch meat was divided into three sub-lots, and specific pre-weighed quantities of ingredients, as outlined in Table 1, were added to each sub-lot. The mixtures were thoroughly combined manually until a paste-like consistency was achieved. Subsequently, uniform-sized balls with an approximate weight of 10 grams were manually formed from each mixture. These balls were then immersed in water heated to 90°C and cooked for 10 minutes. Prior to evaluation, the spider conch balls were fried at 135°C (oil temperature) for 5 minutes.

Table 1. List of ingredients using three different formulations**.

Ingredients	Weight (g) Formulation A (50:50)	Formulation B (60:40)	Formulation C (70:30)
Spider conch meat	250	300	350
Flour	150	120	90
Corn starch	100	80	60
Total	500	500	500
Other Ingredients			
Carrots	35	35	35
Sugar	10	10	10
Salt	6	6	6
MSG	8	8	8
Garlic (ground)	5	5	5
Onion (ground)	5	5	5
Ginger (ground)	1.5	1.5	1.5
White pepper	1	1	1
Water	40 mL	40 mL	40 mL

*500 mL mixture of one piece egg and water
**Formulation A (50:50) refers to the meat and binder ratio, which corresponds to a meat concentration of 50% and 50% binder (flour and corn starch); formulation B (60:40) has meat content of 60% and 40% binder; and formulation C (70:30) has meat content of 70% and 30% binder.

A sensory evaluation was conducted to determine the most preferred product. A semi-trained panel consisting of seven members was selected to evaluate the products. The characteristics of the products that were assessed included flavor, color, chewiness, juiciness, and general acceptability. A 3-point hedonic scale was used, with scores ranging from poor (1) to good (3) for flavor, dry (1) to extremely juicy (3) for juiciness, tough (1) to chewy (3) for chewiness, dirty white (1) to golden yellow (3) for color, and unacceptable (1) to highly acceptable (3) for general acceptability. In addition, a comparison was made between the spider conch balls and commercial squid balls as the control, given that the latter is a popular mollusk-derived product. The sensory attributes were assessed using the same 3-point hedonic scale. Palate cleansing was done between each sample evaluation by providing water.

The storage of the most preferred product formulation was determined by monitoring changes in moisture content, pH value, microbial activity, and sensory characteristics. A total of 75 spider conch ball pieces, divided into five packs with 15 pieces each, were stored in a freezer at a temperature of -20 to -25°C (Markes, Canada). Samples were retrieved every seven days for 35 days, with triplicate samples taken at each time point. Sensory evaluation of the frozen samples was conducted on the day of production (week 0) and after 1, 2, 3, 4, and 5 weeks of storage. Simultaneously, all withdrawn samples were analyzed to determine their moisture content, pH value, and microbial activity. The sensory evaluation involved deep-frying the products at 135°C for 5 minutes before presenting them to the panelists, who evaluated the samples using a 3-point hedonic scale. The moisture content of the spider conch balls was determined using the oven-drying method with an oven (Binder, Germany), following the guidelines provided by the Association of Official Analytical Chemists (AOAC 1975). The pH level of the product was measured using a pH meter (Sartorius, Germany) to assess its acidity or alkalinity. Total plate count (TPC) of the spider conch balls was conducted every week for five weeks to assess the microbial load. The TPC was determined by inoculating nutrient agar plates using the spread plate method. The samples were then incubated at 37°C for 18-24 hours (CMSF 1978).

Following the standardization of the product, a consumer acceptability test was conducted to assess the acceptability of the new product in the market. A total of 30 individuals participated in the actual consumer testing. The consumer test focused on evaluating the general acceptability of the product utilizing a 5-point hedonic scale where the participants were asked to rate their level of liking for the product, ranging from "dislike very much" (score: 1) to "like very much" (score: 5).

Figures 1, 2, 3, 4, and 5 illustrate the sensory characteristics of the newly developed spider conch ball. The flavor and juiciness scores of products with Formulations C and B were significantly higher ($p < 0.05$) than those of Formulation A, as shown in Figures 1 and 2, respectively. In terms of chewiness, the spider conch balls with Formulation C (2.83 ± 0.07) had the significantly highest score ($p < 0.05$) among the three formulations, while no significant differences ($p > 0.05$) were observed between products with Formulation A (2.24 ± 0.2) and Formulation B (2.64 ± 0.13). Figure 4 reveals that the color of the newly developed spider conch ball was not substantially affected ($p > 0.05$) by the various meat and binder ratios. In terms of general acceptability, Figure 5 demonstrates that the general acceptability of Formulation C (2.40 ± 0.09) and Formulation B (2.38 ± 0.09) were significantly higher ($p<0.05$) than that for Formulation A (1.93 ± 0.14). Therefore, Formulation C, with a meat and binder ratio of 70:30, was selected for subsequent analyses, including storage analysis, a comparison with existing commercial squid balls, and a commercial feasibility test.

The flavor, juiciness, chewiness, color, and general acceptability of the newly developed spider

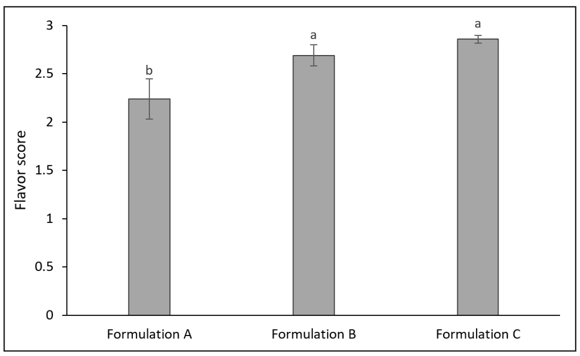

Figure 1. Flavor score of the newly developed spider conch ball at different formulations (meat and binder ratios): Formulation A (50:50), Formulation B (60:40), and Formulation C (70:30). Scale: 3 = Good, 2 = Fair, 1 = Poor.

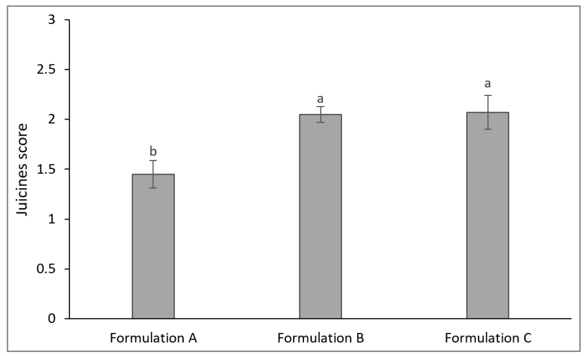

Figure 2. Juiciness score of the newly developed spider conch ball at different formulations (meat and binder ratios): Formulation A (50:50), Formulation B (60:40), and Formulation C (70:30). Scale: 3 = Extremely juicy, 2 = Just right juiciness, 1 = Dry.

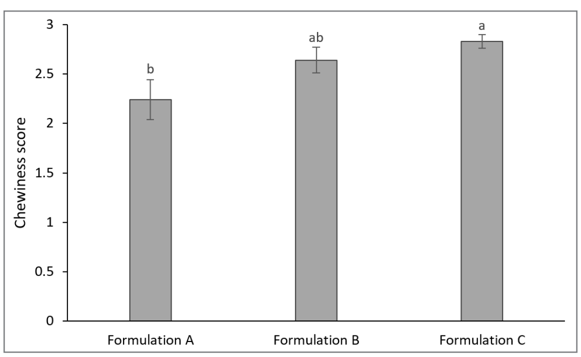

Figure 3. Chewiness score of the newly developed spider conch ball at different formulations (meat and binder ratios): Formulation A (50:50), Formulation B (60:40), and Formulation C (70:30). Scale: 3 = Chewy, 2 = Mushy, 1 = Tough.

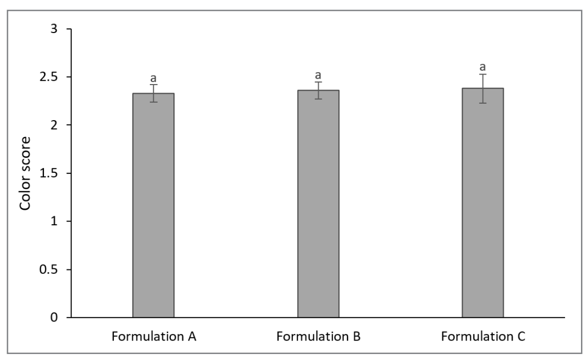

Figure 4. Color score of the newly developed spider conch ball at different formulations (meat and binder ratios): Formulation A (50:50), Formulation B (60:40), and Formulation C (70:30). Scale: 3 = Golden yellow, 2 = Light yellow, 1 = Dirty white.

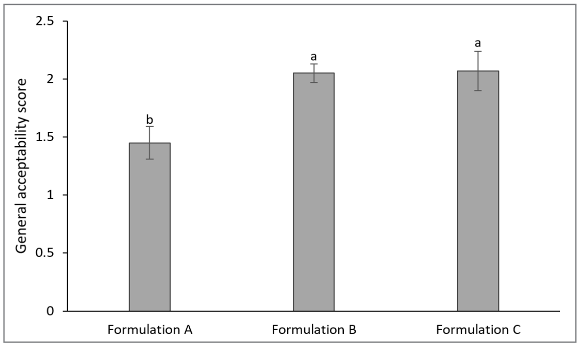

Figure 5. General acceptability score of the newly developed spider conch ball at different formulations (meat and binder ratios): Formulation A (50:50), Formulation B (60:40), and Formulation C (70:30). Scale: 3 = Highly acceptable, 2 = Acceptable, 1 = Unacceptable.

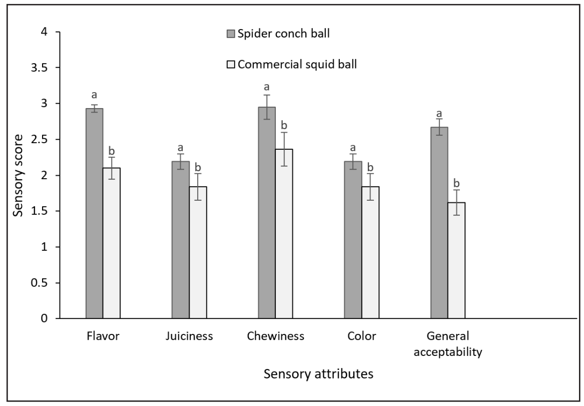

Figure 6. Sensory attributes of newly developed spider conch ball and commercial squid ball using a 3-point hedonic scale.

conch ball and commercial squid ball were evaluated by seven panelists. The t-test analysis revealed that the sensory characteristics of the newly developed spider conch ball were significantly superior ($p < 0.05$) to those of the commercial squid ball (Figure 6). Specifically, the newly developed spider conch ball received significantly higher scores ($p < 0.05$) in flavor (2.93 ± 0.05), juiciness (2.19 ± 0.10), chewiness (2.95 ± 0.17), and color (2.19 ± 0.11), compared to the commercial squid ball, which obtained scores of 2.10 ± 0.16, 1.84 ± 0.19, 2.36 ± 0.23, and 1.84 ± 0.19, respectively. Furthermore, regarding general acceptability, the newly developed spider conch ball achieved a significantly higher ($p < 0.05$) score of 2.67 ± 0.11, indicating it was rated as 'highly acceptable,' whereas the commercial squid ball received a score of 1.62 ± 0.17.

This study focused on examining key factors affecting frozen spider conch ball product's storage stability, including flavor, texture, color, general acceptability, moisture content, pH, and microbial load (TPC). Sensory evaluation was conducted to assess the flavor, texture (chewiness and juiciness), color, as well as general acceptability of the heat-sealed spider conch balls stored at a temperature of -20°C to -25°C. Figure 9 indicates that, at week 0, the panelists characterized the spider conch ball as possessing a favorable flavor, receiving a sensory score of 3.0. By week 5, the flavor score remained relatively high at 2.86, indicating it was still considered highly acceptable. Figure 7 illustrates the sensory characteristics of the spider conch ball during the 5-week storage. It can be seen that the juiciness of the spider conch ball was evaluated as 1.88 at week 0, while after five weeks, the juiciness score increased to 2.14, signifying a moderate level of juiciness. The chewiness score showed minimal change throughout the storage period, ranging from 2.43 at week 0 to 2.57 after five weeks. The color evaluation of the spider conch ball received a sensory score of 3.0 at week 0. Although the color slightly declined between weeks 2 and 4, it returned to 3.0 at week 5, corresponding to a "golden yellow" appearance. Due to the added ingredients, the fried spider conch ball maintained an attractive golden-yellow color throughout the storage period. Finally, the general acceptability score, initially rated as nearly "highly acceptable" at week 0 with a sensory score of 2.71, increased to 2.86 by week 5.

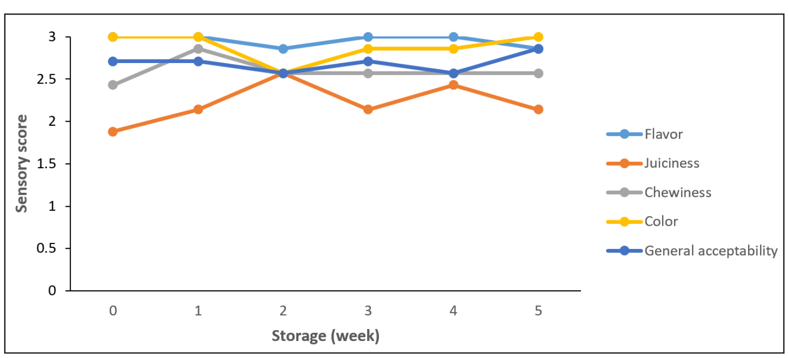

Figure 7. Changes in sensory characteristics of polyethylene-packed spider conch ball.

Table 2 illustrates the changes in the physicochemical composition (pH and moisture content) and microbial load (TPC) of polyethylene-packed spider conch balls. Initially, the spider conch balls exhibited a pH value of 8.1, gradually decreasing to 6.54 over the 5-week storage period. In terms of moisture content, the samples started with an initial value of 63.6%. Despite slight fluctuations during storage, the moisture content generally remained stable with minimal changes. Regarding microbial load, the total plate count (TPC) for spider conch balls was initially recorded at 2.92 log CFU g^{-1}. By week one, it increased to 3.77 log CFU g^{-1}, followed by a further rise to 4.09 log CFU g^{-1} by week 2. Weeks 3 and 4 witnessed a significant escalation, reaching levels of 5.95 log CFU g^{-1} and 7.97 log CFU g^{-1}, respectively. By week 5, the TPC reached its peak at 11.36 log CFU g^{-1}.

The acceptability of newly developed spider conch balls among the 30 panelists and the potential commercialization of the product are presented in Table 3. The results indicate that newly developed spider conch balls were highly accepted by consumers, with 96.67% expressing that they 'liked very much' the product, while only 3.33% indicated slightly liking the product. Additionally, all consumers (100%) recognized the great potential for commercialization of the spider conch ball.

Meatballs made from fishery products have gained popularity as street food in Asia and have become a regular part of the Asian diet. As the demand for these meatballs continues to rise, developing novel meatball varieties has become an appealing area of research for food scientists (Ajik-Cerbas et al. 2022). Therefore, this study aimed to develop a novel spider conch ball and assess its sensory characteristics, storage, and market acceptability. The results of our study revealed that formulations C and B, with meat-to-binder ratios of 70:30 and 60:40, respectively, received the highest sensory ratings from the panelists. Moreover, the newly developed spider conch ball (70:30 formulation) was highly favored by most consumers and demonstrated strong comparability to the commercial squid ball. This may be attributed to the higher concentration of spider conch meat, which imparts a unique and delicious flavor. Besides, fresh and dried forms of spider conch meat have received favorable acceptability ratings (Amin et al. 2020). These findings indicate that the newly developed spider conch ball has significant commercial potential, adding ball-shaped product varieties to the market. Storage testing analysis of the chosen spider conch ball formulation (C) showed that even after five weeks of storage at -20 to -25°C, the newly developed product remained highly to moderately acceptable for consumption based on sensory characteristics. Typically, fish balls are stored at -18°C to ensure product quality and wholesomeness, allowing them to maintain their quality for up to six months (Kok et al. 2013). Therefore, the fact that the newly developed spider conch ball still exhibited high acceptability scores after five weeks is a positive outcome. In contrast, fish balls stored in refrigerated environments (4°C) have a shorter shelf life, lasting from less than one week to two weeks (Boran and Köse 2007; Kok et al.

Table 2. Changes in the physicochemical composition and microbial load of the polyethylene-packed spider conch ball.

Physicochemical composition/ microbial load	**Storage period (week)**					
	0	*1*	*2*	*3*	*4*	*5*
pH	**8.1**	**7.64**	**7.62**	**7.60**	**6.58**	**6.54**
Moisture content (%)	**63.60**	**59.70**	**61.00**	**61.00**	**64.00**	**63.40**
Microbial load (TPC, log CFU g-1)	**2.92**	**3.77**	**4.09**	**5.95**	**7.97**	**11.36**

Table 3. General acceptability of consumers and their response to potential commercialization of newly developed spider conch ball using a 5-point hedonic scale.

General acceptability	**Consumers' percentage**	**Consumer response for potential commercialization**
Like very much	**96.67**	**Yes**
Slightly like	**3.33**	**Yes**
Neither like nor dislike		
Slightly dislike		
Dislike very much		

2013). Various methods have been explored to extend the shelf life of fish balls, such as using salt solutions (Noordin et al. 2014) and vacuum packaging, which has proven advantageous in prolonging shelf life (Kok et al. 2013; Noordin et al. 2014). Radiation processing has been used to lengthen the shelf life of squid balls (Dela Rosa 2001). Fish balls are typically packaged in styrofoam trays, wrapped with plastic films, and distributed to supermarkets. Alternatively, they may be packed in bulk in polyethylene bags for distribution in open markets or restaurants (Kok et al. 2013).

The total plate count (TPC) is a valuable parameter for assessing sanitary quality and adherence to good manufacturing practices (GMPs). The results of TPC analysis can provide insights into the shelf-life and potential sensory changes in a food product (Mendonca et al. 2020). Elevated TPC values suggest increased microbial activity, potentially impacting the product's freshness and quality, which can influence its shelf-life. In this study, the initial TPC of spider conch balls has a low microbial load and was determined to be 2.92 log CFU g^{-1}. This finding aligns with the initial TPC reported for crab balls (Ajik-Cerbas et al. 2022). However, it is lower than the reported initial TPC of fish balls (4 log CFU g^{-1}) (Alkuraieef et al. 2020) and relatively higher than the initial TPC of fish ball curry (Kolekar and Pagarkar 2013). In the fresh and dried form of spider conch, the aerobic plate count (APC) ranged between 5 and 6 log CFU g^{-1} (Amin et al. 2020). The maximum microbiological limit for frozen products is typically set at 7 log CFU g^{-1} (International Commission on Microbiological Specification for Foods 1986). As the storage period increased, the TPC of the spider conch balls in the present study exhibited an upward trend. This is consistent with previous studies that have reported an increase in TPC over time for fish balls (Öksüztepe et al. 2010; Noordin et al. 2014) and crab balls (Ajik-Cerbas et al. 2022). Similarly, the total viable count in fish balls has been shown to increase during storage (Duman and Peksezer 2016). A bacterial count of 7 Log CFU g^{-1} is the approximate point at which meat is considered spoiled or unacceptable (International Commission on Microbiological Specification for Foods 1986; Dainty and Mackey 1992). In the present study, the final TPC at week 5 reached 11.36 log Log CFU g^{-1}. Surprisingly, the sensory evaluation indicates that the cooked spider conch ball is still deemed acceptable until week 5, despite the high bacterial load. This observation warrants further research. For safety reasons, storage of up to week 3, when the TPC count was 5.95 Log CFU g^{-1}, may be considered for consuming frozen spider conch balls.

The pH of a food product is a chemical factor that significantly influences microbial growth and indicates food spoilage. Bacterial proliferation is typically more rapid within a pH range of 6.0 to 8.0 (Valero Díaz et al. 2012). In our study, the pH levels of the newly developed spider conch balls remained between approximately 8 and 7 throughout the storage period. Generally, the pH of spider conch balls has been observed to decrease during storage, as observed in the present study. The current findings are comparable with other previous studies. For example, in crab balls made from *P. pelagicus*, the pH changed from 9 to 7 after five weeks (Ajik-Cerbas et al. 2022). Kok and Park (2007) also noted a decline in the pH of fish balls over time, decreasing from 7 to 5 after three weeks of storage at 4°C. Fish balls preserved with coconut shell liquid smoke, with an initial pH of 5.7-5.8, retained their pH levels during almost three weeks of storage at 4°C (Zuraida and Budijanto 2011). Similarly, in curry fish balls, the pH decreased from 6.38 to 6.07 within nearly two weeks of storage at -2°C (Kolekar and Pagarkar 2013). The accumulation of psychrotrophic bacteria and denaturation of myofibrillar proteins in fish balls also contribute to a decrease in pH (Frazier et al. 1968; Kok and Park 2007). Therefore, the observed decrease in pH in our study may have been caused by these processes, particularly considering the increase in TPC observed in the spider conch balls during storage.

Water plays a crucial role in facilitating the growth of microorganisms in food products (Scott 1957). Most microorganisms thrive in environments with a moisture content higher than 15%–17% (Mahapatra and Lan 2007). In our study, the initial moisture content of the spider conch balls was 63.6%. Although there were slight fluctuations in moisture content after five weeks of storage, it generally remained relatively stable. These findings align with a recent study by Ajik-Cerbas et al. (2022), where formulated crab balls (*P. pelagicus*) exhibited an initial moisture content of approximately 63%, which fluctuated to around 64% after five weeks of storage. However, compared to other studies on fish balls, the moisture content of the spider conch balls in our study appears to be lower. For example, Malaysian fish balls had moisture content ranging from 73.80% to 88.71% (Huda et al. 2010). Fish balls made from *Alburnus mossulensis* mince had a moisture content of 71.3% when stored at -18°C (Duman and Peksezer 2016). Fish balls made from Indian mackerel, which were kept at -18°C, exhibited a minimal reduction in moisture content from 73.84% on day 0 to 72.69% after 180 days of storage (Alkuraieef et al. 2020). Fish balls made from cod surimi had a moisture content of 42.14% (Lin et al. 2011). Typically, due to their high moisture and protein contents, fish balls are highly perishable (Kok and Park 2007) as these conditions are favorable for the growth of spoilage microorganisms (Gram and Huss 1996; Tahiluddin et al. 2022).

The successful formulation and standardization of spider conch (*Lambis lambis*) as a potential raw material for balls have been achieved in this study. The positive reception and high acceptability of the newly developed spider conch ball, as evaluated by both panelists and consumers, indicate that its commercialization is not only feasible but also has the potential to compete with existing fish balls, shrimp balls, and squid balls in the market. This research opens opportunities for entrepreneurs interested in venturing into the spider conch ball industry. Furthermore, this study serves as a valuable foundation for future investigations into spider balls and other value-added products derived from spider conch. Subsequent studies focusing on the quality and shelf-life of spider conch balls would be valuable additions to the existing research.

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AUTHORS CONTRIBUTIONS

Saclot JJA: Conceptualization, Investigation, Data analysis, Writing - Original draft preparation. **Jumdain RT**: Conceptualization, Writing - Reviewing and Editing, Supervision. **Toring-Farquerabao MLB*:*** Writing - Reviewing and Editing. **Ajik KO**: Writing - Reviewing and Editing. **Jumsali MH:** Writing - Reviewing and Editing. **Tahiluddin AB**: Data analysis, Writing - Original draft preparation, Writing - Reviewing and Editing.

CONFLICTS OF INTEREST

We declare no conflict of interest in doing this work.

ETHICS STATEMENT

This study did not deal with live animals nor humans as subjects.

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