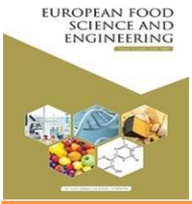

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Sensory, physicochemical, microbiological properties and commercialization preference of formulated spicy salted fish *Ginamos*

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ABSTRACT

The purpose of this study was to reintroduce the spicy salted fish *Ginamos* made from anchovies (*Stolephorus spp*.) as a commercial product. Two formulations were prepared: F1 (one part of salt and five parts of fish) and F2 (one part of salt and four parts of fish). Panelists evaluated the sensory properties and general acceptability of the two formulations packaged as last product, after 45 days of storage. The product formulation was further analyzed for its moisture content and microbial load. The results indicated that both formulations positively impacted sensory attributes such as color, odor, texture, flavor, and overall acceptability. Additionally, all panelist agreed that both formulated spicy salted fish *Ginamos* products were suitable for commercialization. Moreover, the moisture content of F1 was not significantly different ($P>0.05$) than the moisture content in F2. However, there was a significant difference between F1 and F2 in terms of microbial load, indicating that F1 had a microbial load of 3.279 log cfu/g, as opposed to F2, which had a microbial load of 2.827 log cfu/g. Hence, it was determined that the F2 formulation of spicy salted fish *Ginamos* product had a lower microbial load and was safer for human consumption.

1. Introduction

The quality of fresh fish deteriorates rapidly during handling and storage, which limits its shelf life since it is one of the most perishable food products (Sallam, 2007). Access to fresh fish is often an issue in tropical countries due to the lack of non-traditional preservation techniques, such as refrigeration in rural areas (Anihouvi et al., 2007). A lot of processing technology is applied to aquatic products to prevent or delay spoilage caused by microorganisms, enzymes, and physical or mechanical forces (Espejo-Hermes, 2004). A variety of traditional methods of preserving fish still exist, including drying, salting, fermenting, and smoking (Espejo-Hermes, 2004; Venugopal & Shahidi, 1998; Köse, 2010; Skåra et al., 2015; Adeyeye & Oyewole, 2016). One of the oldest methods of preserving fish is salting, an ancient method still widely practiced in many parts of the world today (Parvathy, 2018). Most traditional fermented fish products undergo salt fermentation, a process that varies depending on the quantity of salt added (Gassem, 2019). Many factors influence the salting process, such as the weather, the size of the fish, fish species, and the quality of salt (Thorainsdottir, 2010). During salting, the moisture content of the fish is reduced through osmosis, which reduces bacterial and enzyme activity (Gassem, 2019).

Raw fish proteins are broken down into smaller compound substances with high stability at normal storage temperatures during fermentation. A microbial or indigenous protease can cleave proteins into bioactive peptides, substantially enhancing the food's biological properties (Steinkraus, 2002; Majumdar et al., 2016). Fermentation improves the flavor, appearance, and nutritional value of fish, while decreasing cooking time and energy (Ohshima & Giri, 2014). Aside from their unique flavor, fermented fish products are more digestible, have improved therapeutic properties, and can be stored for a long period of time (Jeyaram et al., 2009; Zeng et al., 2013; Anggo et al., 2015). Many developing countries traditionally consume cured fish as a significant source of protein (Poulter, 1988). In Southeast Asia, fermented products are commonly highly salted until the fish flesh is reduced to simpler components. The Southeast Asian subregion ferments fish for several months (3-9 months), and the flesh liquefies or becomes paste-like (Huss

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& Valdimarson, 1990) and is mainly consumed as condiments (Majumdar et al., 2016). There are several fermented products from Vietnam, Cambodia, Thailand, and Japan, such as nuoc-mam, nam-pla, sushi, and patis from the Philippines (El Sheikha et al., 2014).

Ginamos is a Cebuano term an Austronesian language spoken in the southern Philippines, for salted brine products made from tiny fish species like silverfish, anchovies, or sometimes bigger fish like sardines and sold in glass jars or open buckets at the market. The appearance of it is not precisely appetizing as most are cloudy to muddy gray. Espejo-Hermes (2004) mentioned that it could be stored for 1 or 2 months and is usually eaten uncooked with vinegar. The brine of this salted product is called "Una," which is sold as seasoning for broth and vegetables. Anchovy is a small, common saltwater forage fish of the family *Engraulidae* (Hopman & Gilbert, 2014). In Southeast Asian countries, anchovies are known as ikan Teri in Indonesia, ikan bilis or Setipinna taty in Malaysia (ikan being the Malay word for fish), and dilis, gurayan, monamon, or bolinao in the Philippines. Considering the ongoing research for "new" products, the production and marketing of spicy *Ginamos* has a considerable potential; hence, this study was conducted. This study is designed to produce good quality spicy salted anchovy. Specifically, this study aims to determine the quality of the product with two different formulations to assess the commercial feasibility of the new product through a consumer acceptance test. Moreover, this study reintroduced salted anchovy with the addition of spices as a commercial product. This study was limited to the acceptance of quality and commercialization preference. Specifically, three analyses were done: Sensory evaluation, Microbial load, and Moisture Content.

2. Materials and methods

2.1. Raw materials

Anchovy (*Stolephorus* spp.) was used to prepare *Ginamos* and produced from the local market of Bongao, Tawi-Tawi. Afterward, it was immediately iced and transported for 30 min to the Marine Integrated Laboratory (MIL) of the Mindanao State University-Tawi-Tawi College of Technology and Oceanography (MSU-TCTO) College of Fisheries, Sanga-Sanga, Bongao, Tawi-Tawi, Philippines. The salt used in this study was iodized salt produced and manufactured in the Philippines. The added ingredients were cane vinegar, garlic, onion, ginger, chili, sugar, and MSG. All those ingredients were purchased from the local market.

2.2. Processing of spicy salted anchovy

The process used in the production of spicy salted anchovy is shown in Figure 1. Upon arrival, the raw materials were cleaned by removing adhering foreign materials, then washed and drained for 30 min. The fresh anchovies were divided into two (2) formulations (Formulation 1 and Formulation 2). Formulation 1 (1:5) had 100 g of salt and 500 g of anchovies mixed with pre-weighed ingredients, as shown in Table 1. Formulation 2 (1:4) had 100 g of salt with 400 g of anchovies with the same amount of added freshly ground spices. Each mixture was packed into sterile plastic containers and labeled. Then, the products were stored and matured for 45 d at room temperature (20-25 ºC), after which the products were evaluated for their sensory properties, moisture content, microbial load, and consumer acceptance.

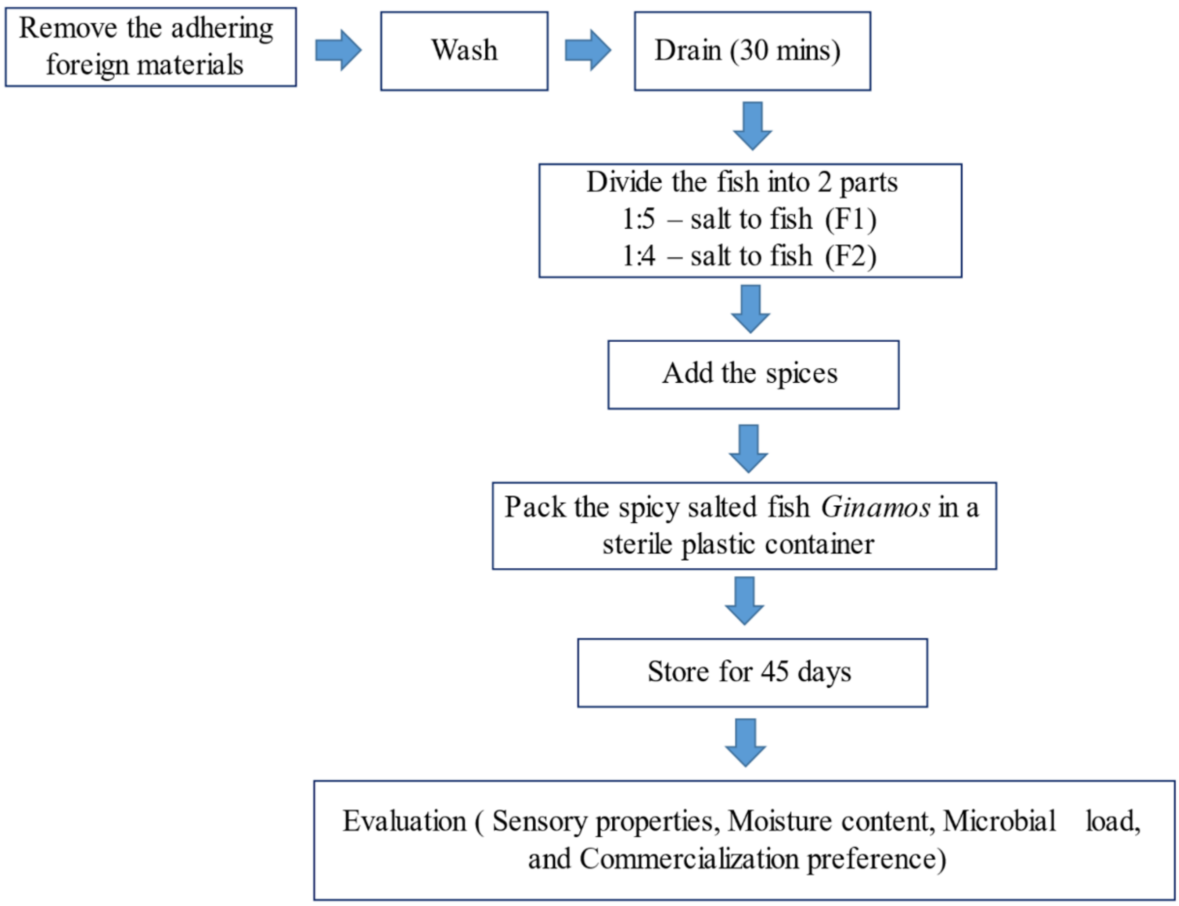

Figure 1. The process involved in the formulation and evaluation of spicy salted fish *Ginamos*

Table 1. List of ingredients of spicy salted anchovy with its measurement.

Ingredients (g)	Formulation	
	F1 (1:5)	F2 (1:4)
Anchovy	500	400
Salt	100	100
Chili	10	10
Vinegar	10	10
Ginger	6	6
Garlic	6	6
Onion	4	4
Sugar	5	5
MSG	2	2

2.3. Sensory evaluation

Sensory evaluation was performed after 45 d of storage to determine the acceptability of the product. The evaluation was conducted at the Marine Integrated Laboratory (MIL) of the College of Fisheries. The product was evaluated forty-five (45) panelists from the College of Fisheries, Tawi-Tawi, Philippines. Each sample treatment was placed on a separate plate, and the product was presented to each panelist on a clean, disposable plate. Additionally, bottled water was provided for them to drink before and after the tasting.

2.4. Moisture content

10 g of each sample was accurately weighed and placed in a pre-dried and pre-weighed aluminum pan or empty dish. The sample was then placed inside the oven set at 105 ºC for 20-24 h or until constant weight was attained. The percentage of moisture was computed using the formula given below:

$$Moisture\ content\ (\%) = \frac{Wi - Wf}{Wf} \times 100 \qquad (1)$$

Where Wi = Initial weight of sample, Wf = Final weight of sample

2.5. Microbiological analysis

A 180 mL of 0.1% peptone water was prepared and autoclaved at 121 ºC for 15 min. Nutrient Agar or plate count agar was prepared by weighing 23 g of agar per 1000 mL water. Furthermore, twenty grams of spicy salted fish *Ginamos* per formulation were weighed in a sterile petri dish, chopped, then macerated with 180 mL peptone water using a sterile pipette. Afterward, serial dilutions (10^{-1}, 10^{-2}, 10^{-3}…) were prepared, and combined with nutrient agar. The samples were incubated at 37 ºC for 18-24 h. The value was reported using the weighted mean count technique. Mean count was calculated according to the formula.

$$Weight\ mean\ count = \frac{n}{(fa \times 1) + (fb \times 0.1) + (fc \times 0.01 \ldots)} xdf \qquad (2)$$

Where n = Total number of colonies in all plates considered, fa = Number of plates counted of the lower dilution, fb = Number of plates counted for the next higher dilution, fc = Number of plates counted for the third dilution, df = Dilution factor (Reciprocal of the lowest dilution factors of the plates counted, referred back to the test portion and not the initial suspension of a solid).

2.6. Commercialization testing

After the product formulation, the consumer acceptability test was conducted to determine the commercial acceptance of the new product. The consumer test was conducted at the Marine Integrated Laboratory. Sixty (60) consumer panelists were asked to rate the acceptability and indicate the most feasible product for commercialization using a 5-Hedonic scale score sheet.

2.7. Statistical analysis

The statistical analysis of the sensory characteristics (color, odor, taste, texture, and general acceptability), moisture content, and microbial load between two treatments was conducted using an independent sample t-test in IBM software. This study used a 0.05 significance level. Data were presented as mean ± SE (standard error).

3. Results

3.1. Sensory evaluation

The sensory properties of formulated spicy salted fish *Ginamos* are presented in Figure 2. In this study, formulated *Ginamos* were classified as formulation 1 (F1, 1 part of salt: 5 parts of anchovies) and formulation 2 (F2, 1 part of salt: 4 parts of anchovies). The sensory properties of spicy salted fish *Ginamos* were evaluated after 45 days of storage. As a result of the research, the color properties, texture, flavor, and general acceptability of the formulated spicy salted fish *Ginamos* were not significantly different between treatments (P>0.05), which suggests that the product is acceptable for consumers. The texture properties of F2 are not significantly different (P<0.05) from F1, however both formulations remain acceptable in terms of sensory properties.

The moisture content of the formulated spicy salted fish *Ginamos* is shown in Figure 3. The percent moisture content of the formulations was 40.56% ± 0.03 (F1) and 40.05% ± 0.01 (F2), indicating no significant difference (P<0.05) after the 45-day storage period at room temperature. Additionally, the result of the microbial analysis is presented in Figure 4, where F1 (3.279 log cfu/g) was significantly higher (P<0.05) in microbial load than F2 with only 2.827 log cfu/g. Figure 5 shows the acceptability of the product for commercialization. It has been revealed that F1 was not significantly different than F2, indicating that the two formulations are acceptable for consumer preference. In addition, all evaluators agreed that the spicy salted fish *Ginamos'* formulated product was suitable for commercialization.

4. Discussion

4.1. Sensory evaluation

Several aquatic resources are found in the Philippines that can provide food for human consumption and provide livelihoods. Since the Philippines is dominated by anchovies, in which netting is the principal method of catching these fish (Siriraksophon et al., 2012; Alba et al., 2016). Therefore, there is a great potential for developing fisheries products in the Philippines as a source of livelihood. The sensory properties of a product provide insight into the consumer's perception (Stone et al., 2020).

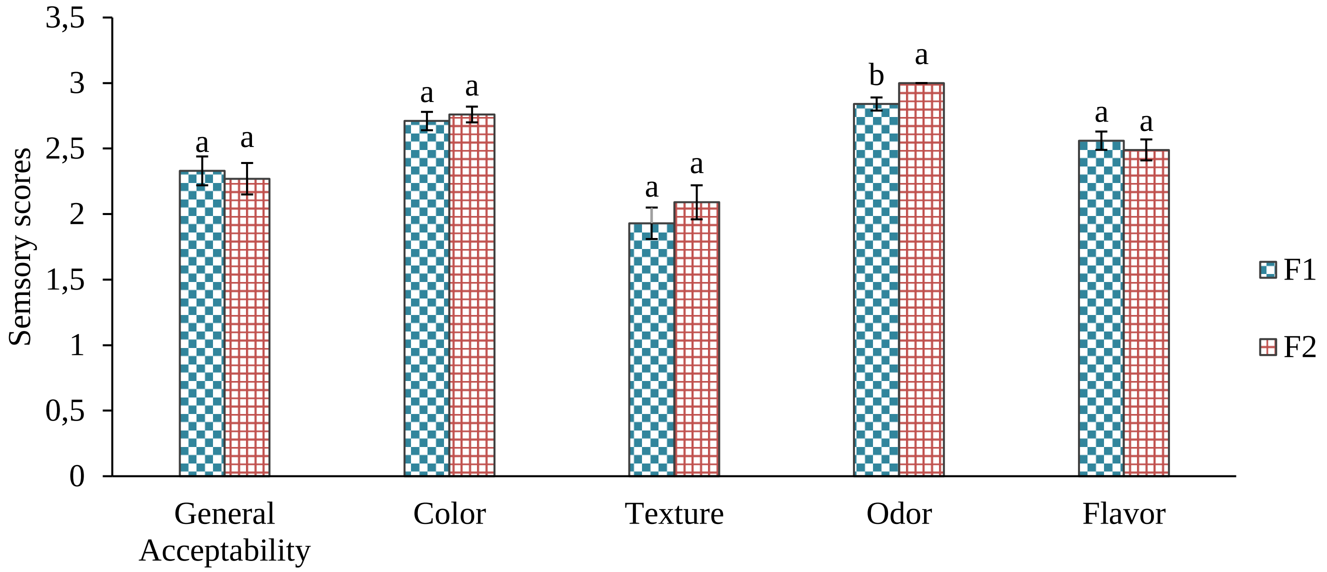

Figure 2. Sensory attributes scores of formulated spicy salted fish *Ginamos* at different fish amount and salt ratios: F1 (1:5) and F2 (1:4). A 3-point hedonic scale: 1 = Unacceptable, 2 = Acceptable, 3 = Highly acceptable. Values are means ± SEM (standard error mean). Means that different letters within the row are significantly different.

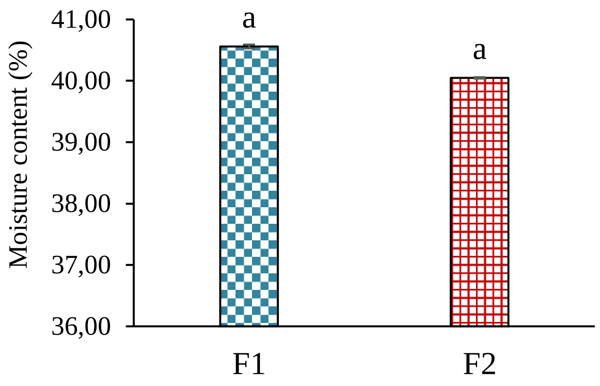

Figure 3. The percent moisture content of formulated spicy salted fish *Ginamos* at different fish amount and salt ratios: F1 (1:5) and F2 (1:4), after 45 days of the fermentation process. Values are means ± SEM (standard error mean). Means that different letters within the row are significantly different.

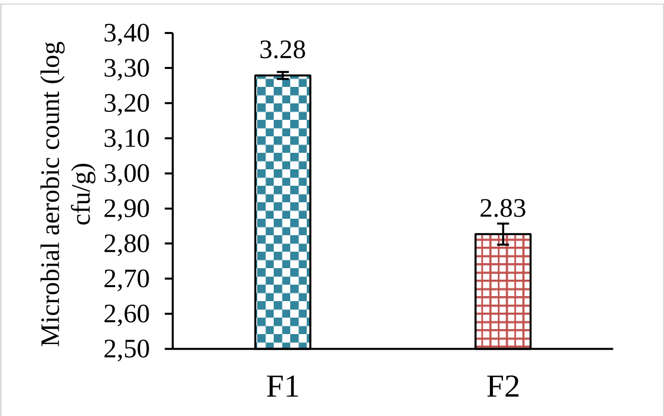

Figure 4. The microbial load (APC) of formulated spicy salted fish *Ginamos* after 45 days of the fermentation process expressed as log cfu/g. Values are means ± SEM (standard error mean). Means that different letters within the row are significantly different.

This study evaluated the sensory properties of spicy salted fish *Ginamos* with different formulation ratios, including 1 part salt and 5 parts anchovies (F1) and 1 part salt and 4 parts anchovies (F2). It is evident from this study that both F1 and F2 formulations positively affect the panelist on the sensory attributes, including color, texture, odor, and flavor, as well as the overall acceptability of spicy salted fish *Ginamos*. Many researchers investigated the sensory properties of different formulated fishery products (Ainul et al., 2020; Anandito et al., 2021; Ajik-Cerbas et al., 2022; Amlani et al., 2022; Palma et al., 2023). The formulated fishery products of sweet-spicy fish flakes based on stingray *Dasyatis khulii* were positively impacted by consumers in terms of their sensory attributes (Palma et al., 2023). In echinoderms, an evaluation of the sensory characteristics of dried and rehydrated sea urchin *Tripneustes gratilla* roe revealed good sensory attributes (Amlani et al., 2022). As for crustacean fishery products, it has been determined that formulated crab balls made from blue swimmer crabs have good sensory qualities (Ajik-Cerbas et al., 2022). Moreover, a customer's expectations of a product are influenced by its appearance and color prior to consumption. When the odor, taste, and flavor of a product are not accurately represented by its visual representation, a lower perception of "like" occurs (Fiorentini et al., 2020). Hence, sensory attributes and overall appearance are critical in influencing consumer perceptions of food products. In addition, the present study reported that all consumer evaluators agreed that the products were suitable for commercialization preferences.

4.2. Moisture content and microbial load

Numerous factors contribute to the significance of moisture content. Measurements of moisture content are the most common general analyses conducted on foods. Food stability and shelf life are highly dependent on moisture content since microbiological growth and most enzyme reactions depend on it (Isengard, 2001; Anggo et al., 2015). Moisture content represented the predominant constituent in fresh fish. Most studies have found that fermentation causes the moisture content in fermented fish to increase over time (Gassem, 2019; Anggo et al., 2015). This increase in moisture content was stated to be due to the absorption of water from the environment, and the release of volatile contents from fermentation reactions in fish indicated from the degradation process (Anggo et al., 2015). The moisture content in fermented fish also highly depends on the type of fish used as well as the method of fermentation (Chan et al., 2023). Salt is one of the major ingredients added to fermented fish. Salt provides additional flavor and reduces its water activity, thus preventing the unwanted growth of bacteria (Koo et al., 2016). Salt is a commonly used ingredient for traditionally fermented fish, which can be exemplified with *Bagoong*, a fish paste produced in the Philippines with approximately 25% salt (Hamm & Clague, 1950). In the present study, two formulations of spicy fish *Ginamos* were assessed: F1 with 1 part of salt and 5 parts of fish (15.5% salt concentration) and F2 with 1 part salt and 4 parts of fish (18% salt concentration). The percentage of moisture content of the two formulations was almost the same, with F1 (40.56%) slightly higher than F2 (40.05%) after 45 45-day storage period. The moisture content of the two formulations was within the approximate moisture content of fish paste (35-50%) (Adawyah, 2008). The formulation with a higher salt concentration (18%) showed a slightly lower moisture content after 45 days at room temperature (20-25 ºC), indicating a delay in the fermentation process and a decrease in moisture (Horner, 1997; Kingley-Ekow, 1999; Anihouvi et al., 2012). However, the moisture content of salt-fermented fish may vary due to the differences in the type of fish (lean or fatty fish), whole or by-products of the fish source, season, storage conditions, duration of fermentation, salting process, quality of salt used, and salt concentration (Anihouvi et al., 2012; Ibrahim et al., 2022) where high salt content gives a longer fermenting time (Anggo et al., 2015).

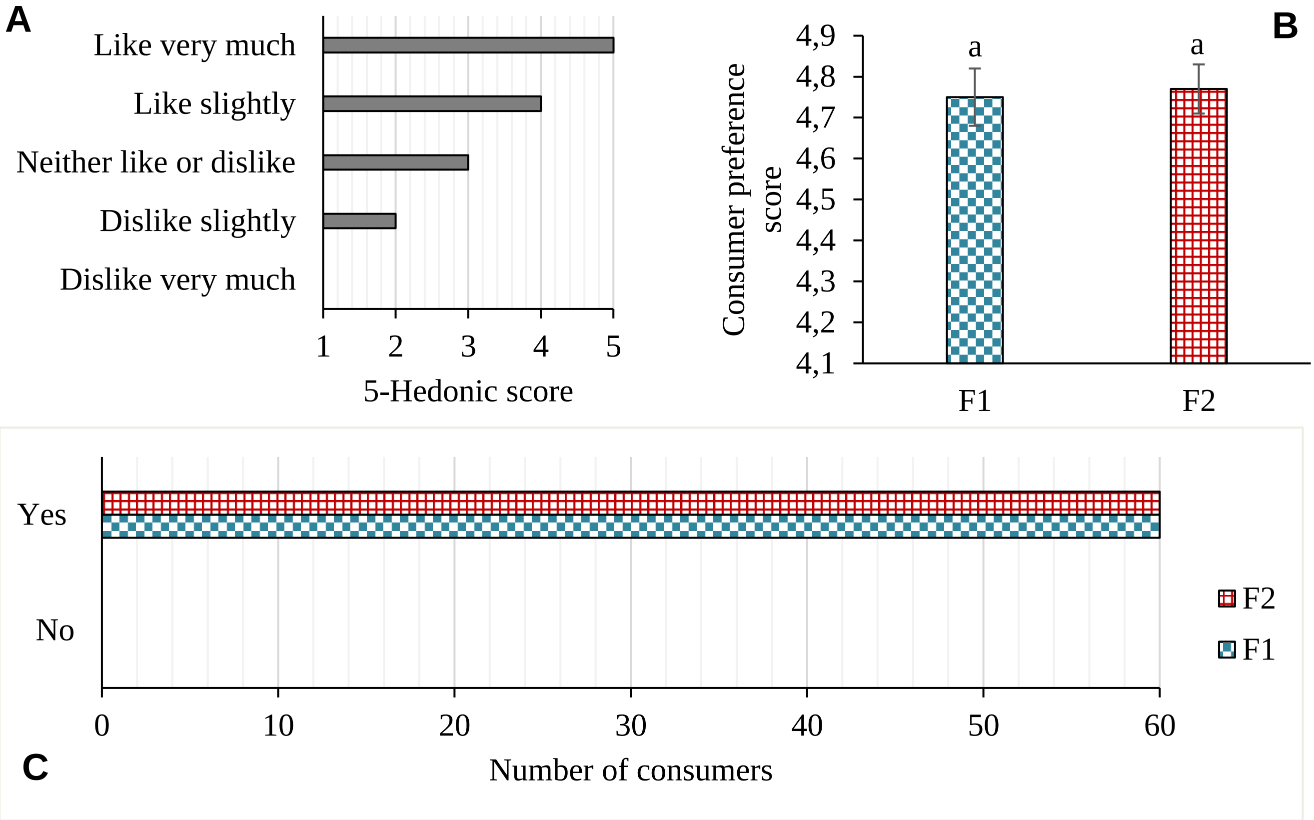

Figure 5. Acceptability for commercialization preference of formulated spicy salted fish *Ginamos* at different fish amount and salt ratios: F1 (1:5) and F2 (1:4). A = a 5-point hedonic scale, B = Consumers preference score, C = Commercialization preference of the formulated spicy salted fish *Ginamos*. Values are means ± SEM (standard error mean). Means that different letters within the row are significantly different.

The majority of microorganisms favor growth at moisture content higher than 15%-17% (Mahapatra & Lan, 2007). In the present study, F1 (3.279 log cfu/g) had a significantly higher microbial load than F2 (2.827 log cfu/g). This indicated an increased in bacterial load with the decreased of salt concentration, which corresponds with the result of Besas & Dizon (2012) for fermented Tuna viscera. This phenomenon can be attributed to reducing microbial cell activity due to the presence of high sodium chloride concentration, causing the withdrawal of water and other soluble contents from the cell through osmosis, thus retarding or inhibiting their growth (Muhammad et al., 2009). Nevertheless, adding salt can also benefit the growth of fermenting microbes; the amount of salt added should be controlled to prevent over-salting, hampering the growth of harmful bacteria (Chan et al., 2023).

5. Conclusions

A new product utilizing anchovies *Stelephorus spp*. as a raw material for spicy salted fish *Ginamos* has been successfully developed and introduced as a commercial product. The spicy salted fish *Ginamos*, which has a formulation of one part salt and four parts fish has been found to be safe and acceptable for human consumption due to its lower microbial load; therefore, it is considered a safe food. However, future studies, such as the shelf-life of spicy salted fish Ginamos, may be conducted.

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