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Sensory and Financial Analysis of Bottled Silver Therapon (*Leiopotherapon plumbeus*) in Corn Oil

Mark Nell C. Corpuz
Institute of Fisheries and Aquatic Sciences, College of Agriculture and Fisheries, Bataan Peninsula State University Orani Campus, Bayan, Orani, Bataan 2112, Philippines.
Corresponding author email id: mnccorpuz@bpsu.edu.ph

***Abstract* – This preliminary study developed a bottled product using silver therapon (*Leiopotherapon plumbeus*) or *ayungin* as the main fish ingredient and determined its sensorial acceptability and financial feasibility. Five treatment groups based on the amount of salt for brining were utilized: TI (without NaCl), T2 (50 g NaCl dissolved in 800 ml distilled water), T3 (100 g in 800 ml distilled water), T4 (150 g in 800 ml distilled water), and T5 (200 g in 800 ml of distilled water). The organoleptic test (9-point hedonic scale) showed that T2 (8.73 ± 0.52) had the highest mean rating in terms of taste nd was statistically similar to T3 (8.30 ± 0.70) ($P > 0.05$). It was followed by T4 (7.60 ± 0.81), T1 (7.00 ± 1.17), and T5 (4.27 ± 1.12). Other attributes including aroma, texture, and appearance were rated as *liked very much*, with T2 having the highest mean scores in all sensory attributes. According to the financial assumption, the daily production of 50 bottles, with a production period of 15 days per month (gate price = PhP 75 or USD 1.32) in 10 months of production can yield a total of PhP 562,500.00 (ca. USD 9,868) per annum. Cost and return analysis revealed the estimated internal rate of return was 38.61%; the return on investment was 33.89% and a payback period of 1.46.**

***Keywords* – *Ayungin*, Bataan, Bottling, Fish Processing, Income, ROI.**

I. INTRODUCTION

Fish is one of the most important sources of quality protein in the diet of less developed and developing countries [1]. Fish commodities however are highly perishable goods and a major concern in post-harvest fisheries due to the rapid deterioration of fish products [2]. In the Philippines, the lack of fish processing techniques, and inadequate packaging and storage practices are some of the factors that contribute to post-harvest loss [3], [4]; the scenario leads to massive economic losses to the fisheries sector [5]. To reduce post-harvest losses, Tadifa and her colleagues [4] recommend the utilization of fishery resources through the application of low-cost processing technologies and instigating livelihood assistance for small-scale fisherfolks.

Thermal processing technology utilizing glass bottles for fish processing and packaging has been proven to be feasible for small-scale fish processing operations in the Philippines [6]. The technology has advantages over other fish processing practices as bottled fish products can be stored at room temperatures with longer shelf-life [7]. Proper thermally-processed fish become commercially sterile (free from microorganisms); hermetically sealed (or fully sealed) bottles keep the sterility and the product shall remain shelf-stable provided that the bottles are maintained intact [6].

The province of Bataan is prospered with fresh- and seawater food products extracted from its rich aquatic environment. Silver therapon (*Leiopotherapon plumbeus* Kner 1864) is an important fishery resource thriving in inland waters and estuaries of Bataan in Luzon Island, Philippines [8], [9], [10]. Fisherfolks generally caught silver therapon or *ayungin* in fishponds and mangrove areas and were sold in the local market for $ 4 to $ 10 per kilogram [11]. It is one of the most expensive fish in the Philippines [12]. There is a high market demand for this fish despite the seasonality of supplies, but if available, it is marketed in fresh or chilled form. In other

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provinces in Luzon where the fish is also available seasonally, *ayungin* is being sold in a dried form. As the demand for this fish is year-round, it is necessary to improve its shelf-life and to innovate its market product form for consumers' satisfaction.

Except in dried *ayungin*, there is no known processed product form for silver therapon. Hence, this study developed a bottled silver therapon and evaluated the product acceptability and characteristics based on taste, aroma, appearance, and texture (organoleptic survey). Furthermore, an ex-ante financial analysis with emphasis on the financial internal rate of return, return on investment, and payback period was performed.

II. Materials and Methods

A. *Raw Materials*

The *L. plumbeus* were purchased from the local *concignacion* or fish port in Orani, Bataan, Philippines. Necessary ingredients including corn oil, carrots, pickles, black pepper, red pepper, bay leaf, and the like (Table 1) were acquired at Orani Public Market (Bataan, Philippines). All ingredients were transported to the Fish Processing Facility of Bataan Peninsula State University for fish bottling activity.

Table 1. Ingredients for one bottled silver therapon in a 300g-glass bottle. Source modified from Espejo-Hermes (2004).

Ingredients	Measurement and Proportion
Silver therapon/ *ayungin*	25 pcs (5 to 7 g each)
Corn oil	To fill
Carrots (sliced crosswise)	4 slices
Pickle (sliced crosswise)	4 slices
Black pepper (whole)	3 pcs
Red pepper (*labuyo*)	1 pc
Bay leaf	4 pcs

B. *Bottling of Fish Samples*

The protocol for bottling followed the standardized method of Espejo-Hermes (2004) with some modifications. The fish (6-12 cm) were dressed (i.e., head and fins cut, scales removed, and eviscerated) and were washed thoroughly in de-chlorinated tap water to remove the blood. The samples were drained for one minute using a colander. Fish samples were bulk-weighed using a digital balance. Fifty individuals of similar size were designated for each brine solution treatment (Table 2). Full immersion of designated samples in various treatments was done for 30 min. Thereafter, samples were uniformly drained for 1 min and air-dried under the sun for 1 h (1300 to 1400 h). After an hour, the air-dried samples were deep-fried in corn oil (150 ml) for about 2 min. The fried silver therapon and the other ingredients were placed accordingly in a 28-g glass bottle. Subsequently, corn oil was filled until the neck of the bottle. All bottles were tightly closed, and the bottled products were sterilized in a pressure cooker for about 1 h and 45 min (15 psi).

Table 2. Different treatments of brine solution used in the study.

Treatments	Descriptions
1	silver therapon immersed in 800 ml tap water without salt

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Treatments	Descriptions
2	Silver therapon immersed in 800 ml tap water with 50 g NaCl
3	Silver therapon immersed in 800 ml tap water with 100 g NaCl
4	Silver therapon immersed in 800 ml tap water with 150 g NaCl
5	Silver therapon immersed in 800 ml tap water with 200 g NaCl

C. *Sensory Analysis*

The products were presented to the evaluators/panelists (n = 100) in bite-sized form for the sensorial assessment. The acceptability and characteristics of the product were evaluated according to taste, aroma, texture, and color using the 9-point hedonic scale rating: 1 = *dislike extremely*, 2 = *dislike very much*, 3 = *dislike moderately*, 4 = *dislike slightly*, and 5 = *neither like nor dislike*, 6 = *like slightly*, 7 = *like moderately*, 8 = *like very much*, and 9 = *like extremely.* The general acceptability of the product was evaluated using the desirability composite index (DCI). The DCI was the mean percentage of each criterion given by the panelists.

D. *Data Analyses*

The data from the sensory test were tallied and the mean score of each treatment was compared using analysis of variance (ANOVA). Prior to the weighted mean comparison, the data were tested for normality (Komogorov-Smirnov Test, $P < 0.05$). Post-hoc analysis was done using Tukey's HSD Test. Descriptive statistics were used to determine the frequencies of each treatment per criteria of evaluation (SD). All statistical analyses were performed by SPSS (Windows version 15.0).

E. *Economic Analysis*

Cost and return analyses were verified, with financial measures including net income, and return to capital were considered for estimation on a one-year basis. Moreover, return on investment (%), and payback period (year) were determined to assess the profitability and success rate of the investment of this fish processing enterprise.

III. Results and Discussion

A. *Sensorial Evaluation*

Mean sensory rating of each treatment is presented in Figure 1. In terms of mean rating for taste, it was observed that there were significant differences among treatments (F = 96.34, $P < 0.01$) (Figure 1A). The T2 (8.73 ± 0.52) had the highest mean sensory rating, which was categorized by the consumer participants as *like extremely*. It was followed by T3 (8.30 ± 0.70), T4 (7.60 ± 0.81), and T1 (7.00 ± 1.17), respectively. The T5 (4.27 ± 1.12) being the saltiest treatment was *disliked slightly* by the participants. The T2 and T3 were statistically homogenous, whilst T5 was the least preferred treatment.

A significant variation in the mean sensory scores for aroma was observed (F = 28.44, $P < 0.01$), with T5 having the lowest score among the treatment groups (Figure 1B). Treatments 1, 2, 3, and 4 were homogenous and obtained a qualitative rating of *liked very much* by the participants. The T5 was statistically different from other treatments and received a rating of *like slightly*. Significant variation in hedonic scores was also observed for the appearance (F = 2.82, $P < 0.05$) and texture (F = 3.14, $P < 0.05$) of the bottled silver therapon. The mean

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sensory score for the appearance and texture of T2 was statistically comparable to that of T1, T3, and T4. However, a maximal difference in mean hedonic ratings was recognized between T2 and T5, albeit the ratings for these two sensorial attributes were categorized as *like moderately* to *like very much* (Figures 1C and 1D).

The results of the sensory analysis were complemented with the CDI ratings of the treatment groups. The T2 had the highest CDI weighted scores (8.36) with a qualitative assessment of *like very much*, reflecting the highest acceptability rating among the treatment groups. It was followed by T3 (7.91), T4 (7.68), and T1 (7.43), which were classed as *like moderately*. Due to its undesirable saline taste, the T5 received a lowest CDI score (5.91) with a qualitative assessment of *neither like nor dislike*.

Preserving fish in bottles with oil can significantly extend its shelf life while also providing a high-quality source of nutrition and protein for coastal communities. This preservation method helps to protect fish from oxidative spoilage, microbial growth, and enzymatic degradation, which are the primary causes of fish spoilage. Oil acts as a barrier to oxygen, slowing down lipid oxidation, a major contributor to fish spoilage. Additionally, it reduces moisture content, which inhibits microbial growth and the action of spoilage enzymes like lipases and proteases Pressure cooking fish and sealing it in bottles creates a sterile, airtight environment that prevents microbial growth. This method allows fish to be stored for months or even years without refrigeration, making it ideal for areas with limited access to cold storage facilities [13], [14].

This preservation approach is especially beneficial for coastal communities, where access to fresh fish may be seasonal or limited. By bottling fish in oil, these communities can maintain a steady supply of nutrient-dense food year-round, promoting food security and reducing reliance on fresh catches.

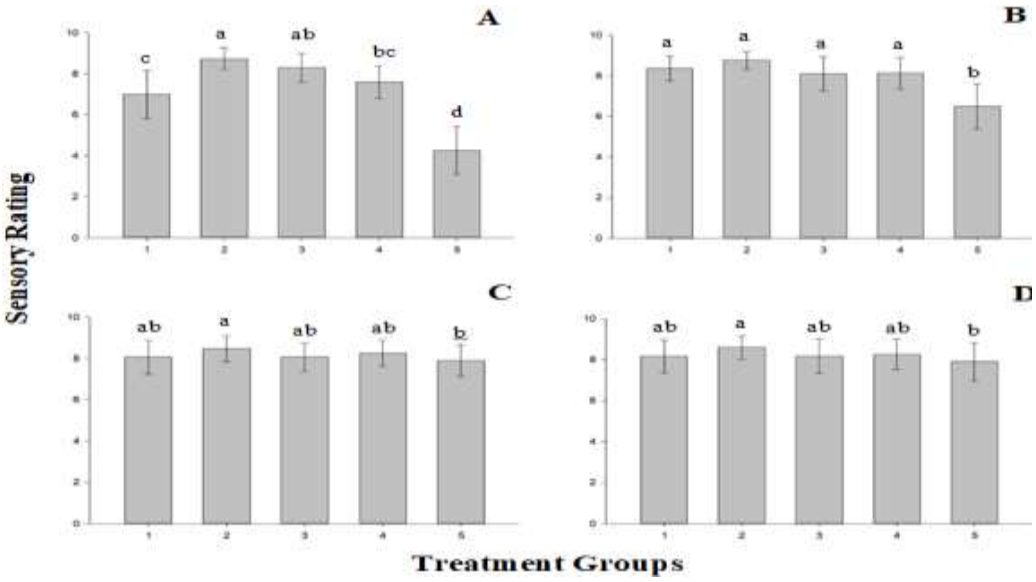

Fig. 1. Mean values (SD = error bars) and statistical difference of hedonic scores among treatments in each sensorial evaluation: taste (A), aroma (B), appearance (C), and texture (D). Different superscripts denote significant differences at $P < 0.05$. a > b > c > d.

A significant variation in the mean sensory scores for aroma was observed ($F = 28.44$, $P < 0.01$), with T5 having the lowest score among the treatment groups (Figure 1B). Treatments 1, 2, 3, and 4 were homogenous and obtained a qualitative rating of *liked very much* by the participants. The T5 was statistically different from other treatments and received a rating of *like slightly*. Significant variation in hedonic scores was also observed for the appearance ($F = 2.82$, $P < 0.05$) and texture ($F = 3.14$, $P < 0.05$) of the bottled silver therapon. The mean

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B. *Ex-Ante Cost and Return Analysis*

It was assumed that 50 bottles could be produced on a daily basis and a production period of 15 days per month. This will produce a total of 7,500 bottles per year at 10 months production period. If each bottle is sold at PhP 75 per bottle (1 USD = PhP 57), annual gross income/ sale is expected to yield a total of PhP 562,500.00 (Table 3). The operating and maintenance costs consisted of raw and packaging material costs (57.43%), labor costs (20.33%), operational and administrative costs (19.98%), and repair and maintenance costs (2.26%) had a total amount of PhP 311,730.30.

Table 3. Return of investment calculations.

Particulars	Amount
Average annual sales/income of bottled silver therapon (PhP)	562,500.00
Average annual operating and maintenance cost (PhP)	311,730.30
Average annual selling & administrative costs (PhP)	16,250.00
Average annual depreciation (PhP)	38,920.00
Average annual net income (PhP)	195,599.70
Initial fixed capital investment (PhP)	577,200.00
Return of investment (%)	33.89

The ROI of the bottled silver therapon project was estimated to be 33.89 and an estimated payback period of one year and six months of operation. A financial internal rate of return (FIRR) of 38.61% signifies a growth

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potential and profitability of potential investment for this business project. While there was a considerable reduction in FIRR in response to an assumption of a 10% decrease in sales (27.66 %) or a 10% increase in gross expenditures (28.66 %), the profitability remained positive (Figure 2).

Based on four criteria, the bottled silver therapon immersed in a brine solution containing 50 g of salt per 800 ml of water had the highest consumer's acceptability rate. The rating, *like extremely* which was achieved by T2 can be attributed to a well-balanced combination of salt and fish flesh. Based on cost-and-return analysis following the production and expenditure data, marketing of bottled silver therapon can be a profitable business enterprise. The local processors can adopt this processing method for silver therapon as one of their alternative sources of income.

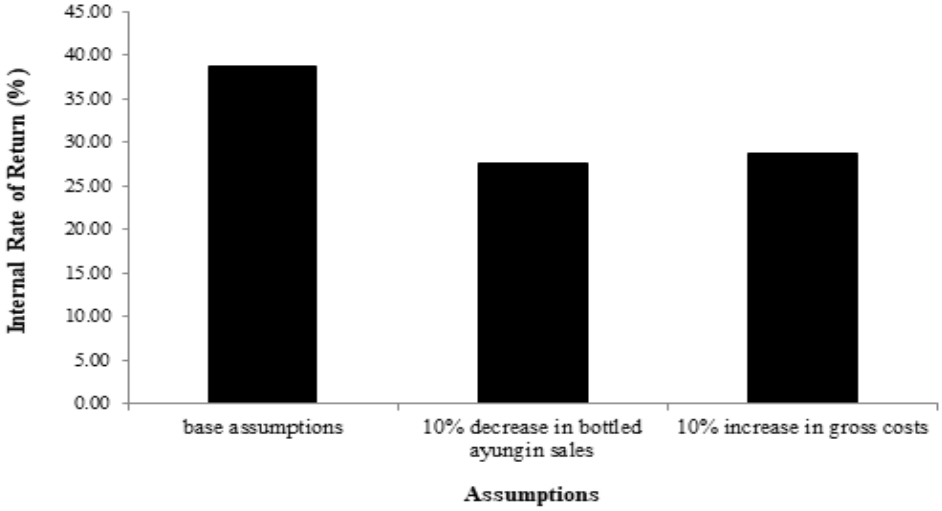

Fig. 2. Bar chart of the financial internal rate of return (%) in accordance with base assumption, a 10% decrease in sales and a 10% increase in gross expenditures.

As reported by FAO [15], Pressure-cooked fish retains essential nutrients, including high-quality protein, omega-3 fatty acids, and bioavailable minerals like calcium, iron, and zinc. This makes it a valuable food source for coastal and inland communities that may have limited access to fresh animal proteins involving coastal communities in the production and sale of bottled fish creates employment and entrepreneurship opportunities, especially for women, youth, and internally displaced persons. Training on fish processing, hygiene, and marketing enables these groups to diversify their income sources and improve household food security. By processing fish into bottled, coastal communities can reduce post-harvest losses can improve marketability.

IV. CONCLUSION

The present study has revealed a significant finding regarding the processing and financial viability of bottled silver therapon, a native aquatic resource with notable commercial value. This research demonstrated that by transforming silver therapon into a bottled product, we can not only preserve its potency but also significantly enhance its market value. This innovative approach opens up new avenues for sustainable utilization of the species, contributing to the economic empowerment of coastal communities while also supporting the health and well-being of a broader consumer base. It was suggested to incorporate other herbs and spices in the bottled silver therapon to improve the sensorial quality and nutritional attributes. Proximate, microbial, nutritional, and shelf-life analyses of the product can be done for future studies. Moreover, the product's marketability and dem-

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-and analyses are open for further investigation.

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REFERENCES

[1] N.B. Ikenweiwe, B.O. Bolaji, and G.A. Bola. (2014). Fabrication and performance assessment of a locally developed fish smoking kil. Ozean Journal of Applied Science, *Biotech. Bioengineering*. *3(4)*. pp. 1–12.
[2] S. Tesfay, M. Teferi. (2017). Assessment of fish post-harvest losses in Tekeze dam and Lake Hashenge fishery associations: northern Ethiopia. *Agriculture & Food Security*. *6(4)*. https://doi. org/10.1186/s40066-016-0081-5.
[3] A.R. Ward, D.Z. Jeffries. (2000). A manual for assessing postharvest fisheries losses. UK: Natural Resources Institute. p. 140. https:// gala.gre.ac.uk/id/eprint/12095.
[4] G.C. Tadifa, R.J.S. Banicod, D.M. Peralta, C.A. Ramos, and U.M. Montojo. (2022). A study on postharvest losses in fisheries owing to changes in market supply and demand in the Philippines. *The Philippine Journal of Fisheries*. *29(2)*. pp 97–114 https://doi.org/10.3 1398/tpjf/29.2.2020A0019.
[5] G. Akande, Y. Diei-Ouadi. (2010). Postharvest losses in small-scale fisheries: Case studies in five sub-Saharan African countries. FAO Fisheries and Aquaculture Department. Rome: FAO Fisheries Technical Paper 550. http://www.fao.org/3/i1798e/i1798e. pdf
[6] J. Espejo-Hermes, (2004). *Fish Processing Technology in the Tropics*. Quezon City, Philippines. Tawid Publications. 336 p.
[7] L. Bratt (2010). *Fish Canning Handbook*. Blackwell Publishing, 320 p.
[8] C.S. Romero, K.C. Villaflor, D. dela Rosa, and M.N.C. Corpuz. (2016). Environmental variables affecting the riverine ichthyofaunas and macroinvertebrate communities in Orani River system (Tala-Silahis continuum), Bataan Philippines. *2nd International Conference in Research, Education, Management, and the Social Sciences*. pp 31-48.
[9] K.J.A. Leon, A.D.C. Manliclic, and M.N.C. Corpuz. (2017). Spatial and sexual variation on morphometrics, length and weight, and condition factor dynamics of endemic silver therapon (*Leiopotherapon plumbeus*, Kner). *International Journal of Agricultural Technology. 13(7).* pp. 1567-1577.
[10] M.J.S. Consigna, M.N.C. Corpuz, M. Rabadon, and A.D.M. Manliclic. (2019). Hormone-induced spawning and gonadosomatic index of brackishwater silver therapon (*Leiootherapon plumbeus* Kner 1864). *Asia Life Sciences*. *28(2).* pp. 387–397. https://www.ukdr.up lb.edu.ph/ journal-articles/858.
[11] M.N.C. Corpuz, M.V.O. Espaldon. (2023). Socio-ecological system assessment for conservation planning in riverine and mangrove fishery areas in Bataan, Philippines. *AACL Bioflux, 16(2).* pp 1114–1126.
[12] D. Santos, A.D.C. Manliclic, and M.N.C. Corpuz. (2020). Length-weight relationship and condition factor of silver therapon, *Leiopot--herapon plumbeus* (Terapontidae) from two brackishwater habitats. *AACL Bioflux. 13(2).* pp. 1495–1503.
[13] A.E. Ghaly, D. Dave, S. Budge and M. S. Brooks. (2010). Fish spoilage mechanisms and preservation techniques: review. *American Journal of Applied Sciences. 7(7). pp.* 859–877.
[14] A. Ali, S. Wei, A. Ali, I. Khan, Q. Sun, Q. Xia, Z. Wang, Z. Han, Y. Liu, and S. Liu. (2022). Research progress on nutritional value, preservation and processing of fish-a review. *Foods. 11.* pp. 3669. https://doi.org/10.3390/foods11223669
[15] FAO. 2018. Sun-dried fish production to build resilient coastal communities in Somalia. https://www.fao.org/family-farming/detail/en/ c/1118415/

AUTHOR'S PROFILE

Mark Nell C. Corpuz, is an Research Faculty of Bataan Peninsula State University and currently the Head of the Institute of Fisheries and Aquatic Sciences. He published various scientific papers on zoology, environmental science, and aquacu--lture in several journals indexed in Web of Science and SCOPUS. He is also involved in several community development activities including mangrove rehabilitation, aquaculture biosecurity, Fishery Law awareness, and technology transfer and commercialization.

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