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Microbiological, Nutrient Analysis, and Sensory Acceptability of Bottled Rice Eel (*Monopterus Albus*) in Spanish Oil Style with Different Fruit Flavorings

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ABSTRACT

This study was conducted to determine the acceptability of bottled rice eel flavored with different fruit extracts (guava, calamansi, camias, and tamarind) in Spanish oil style. The five treatments in this study were the inclusion of fruit flavorings and the non-inclusion of fruit flavoring was served as an experimental treatment. The microbial analysis, nutrient analysis, and sensory acceptability were determined using Total Plate Count (TPC), proximate analysis, and Hedonic scale. Moreover, overall acceptability was ranked using the Acceptability Composite Index (ACI). The population of TPC recorded varied from 10^3 to 10^6 samples. All treatments showed that there was no development of bacteria on day 1; however, all treatments from day 8 to day 32 had an increasing number of TPC from which day 16 recorded the lowest TPC, while day 32 gained the highest TPC. The result of ACI confirmed that Treatment 5 (with tamarind flavor) is the most acceptable treatment for the product of the other four treatments. In terms of the Return on Investment (ROI), T2 and T4 reflected the highest percentage and T1 attained the lowest. On the other hand, T3 and T5 obtained 45%, respectively.

Keywords: *Rice eel, Spanish style, microbiological analysis, fruit flavorings, value addition, food security, proximate composition*

Introduction

Fish is considered to have an excellent and high biological value in the human diet and can be used as an alternative to meat (lamb, pork, and chicken) because it contains an excellent source of proteins, minerals, vitamins, and polyunsaturated fatty acids (Adebowale et al., 2008; Adebayo-Tayo et al., 2012; Sriket et al., 2007).

Rice eel was introduced in the Philippines for aquaculture in 1905 without considering its impact on the environment; thus, it has become invasive (Guerrero, 2014; Juliano et al., 1989). Its invasiveness has been manifested in the damages and economic loss it has inflicted on rice farming in the region (BFAR R02, 2017). Reports of implicated damages are on the holes it dug on the dikes causing water draining, resulting in additional costs of irrigating the rice fields. Plant strands are also damaged in some areas as golden apple snails (Pomacea canaliculata), attached to rice stalks, feed on them. This damage leads to additional costs for irrigation and replanting. Furthermore, golden apple snails have been reported to feed on cultured fish in fishponds, thereby reducing stock populations (BFAR R02, 2017).

Moreover, value-added processing allows flexibility in supply and spoilage issues. A producer/processor can harvest fish and shellfish at times of optimum quality even if there are seasonality effects. Furthermore, the extended shelf-life that value-added offers allows the finished product to be released over an extended period rather than a short period. Conversely, in times of harvest shortages, value-added products can help to alleviate high demand for the product and satisfy customer demand. This blending of disciplines, safety, quality, and extended shelf life has provided opportunities in value-added product development that will hopefully expand in the aquaculture industry over the next several years and provide companies with a growing source of new and profitable market options (Morrisey, 2011).

Bottling continues to be an extremely important form of food preservation commercially, and bottled fish represents a source of relatively inexpensive, nutritious, and healthy food, that is stable at ambient temperatures, has a long shelf life, and in consequence, is eminently suitable for worldwide distribution. It is vitally important that all bottling operations are undertaken in keeping with the rigorous application of good manufacturing practices if the food is to be safe at the point of consumption. This demands that all personnel involved in bottling operations have a competent understanding of the technologies involved, including the basic requirements for container integrity and safe heat sterilization (Bratt, 2010).

In the Philippines, rice scientists are worried about *Monepterus albus* on their potentially damaging impact on rice fields. Farmers observed that these survive long periods of drought by burrowing in the moist earth such as dikes and rice fields. The burrowed holes destroy the rice dikes affecting irrigation during the vegetative stage of rice resulting in water loss that affects nutrient management. Farmers first reported the rice paddy eel as a pest to the Bureau of Fisheries and Aquatic Resources (BFAR) in Tuguegarao, Cagayan two years ago, complaining that these eels were eating fingerlings in fishponds. PhilRice declared then the rice paddy eels as "an indirect pest" during the last dry season of 2010 (Icamina, 2011). The best alternative practice to combat this problem is to process fish and develop it into a new product. This study also helps the farmers to control and eliminate the increasing population of rice eel.

Hence, the study aimed to determine the acceptability of bottled rice eel flavored with different fruit extracts such as guava, calamansi, camias, and tamarind in Spanish oil style. Specifically, this study aimed to determine the shelf life (microbiological) of bottled Spanish-style rice eel with different fruit flavorings, determine the proximate composition (nutrient analysis) of the finished products, determine the acceptability of bottled rice eel with different fruit flavorings in terms of color, aroma, texture, and taste using the hedonic scale and ACI, create labeling and packaging of the finished products, and determine the cost and return analysis of each treatment.

Methods

Research Design

The research design employed in this study was designed to answer the question of the acceptability of the bottled rice eel in Spanish style flavored with guava, calamansi, camias, and tamarind extract that was done by taste test procedure by the panelists using a hedonic scale. The ACI was used to show the rank of the acceptability of the bottled rice eel by the 50 panelists in terms of color, aroma, texture, and taste of each treatment.

Experimental Species and Preparation

In this study, the rice eel was used to produce bottled fish in Spanish style. It was purchased at Solana, Cagayan. Fish was placed in boxes, transported, and acclimatized at the Bureau of Fisheries and Aquatic Resources-Region 2, allowing it to maintain good performance across a range of environments for about 10-20 minutes to avoid stress. A total of 20 kg was used in the whole experiment. Before the preparation, the experimental species was conditioned for 24 hours before cleaning and washing. Each fish was prepared in steak form.

Experimental Treatments

The five treatments in this study were fruit flavorings such as guava, calamansi, camias, and tamarind, which served as an experimental treatment and no fruit extracts served as the control. The following experimental treatments are shown in Table 1.

Table 1. Experimental Treatments of the Study Using Different Fruit Flavorings

Treatment	Description
T1 (control)	Bottled Rice Eel in Spanish Style
T2	Bottled Rice Eel in Spanish Style with Guava Fruit Extracts
T3	Bottled Rice Eel in Spanish Style with Calamansi Fruit Extracts
T4	Bottled Rice Eel in Spanish Style with Camias Fruit Extracts
T5	Bottled Rice Eel in Spanish Style with Tamarind Fruit Extracts

Plant Flavorings and Extraction Procedure

The source of flavor enhancers that were used in this study include guava, calamansi, camias, and tamarind. These fruits were collected in Matusalem, Roxas, and Isabela. For extraction, the fruit of guava, calamansi, camias, and tamarind were prepared by cutting each into small pieces and then chop finely. The extracts of the different fruits were obtained separately by boiling 500 grams of fruit flavorings in 750 ml of tap water for about 30 minutes. This process was based on the procedure of Ligero (2019).

Experimental Ingredients

The ingredients and the proper measurement used in this study are shown in the table below.

Table 2. Ingredients and Measurement of Each Treatment

Ingredients	Treatment 1	Treatment 2	Treatment 3	Treatment 4	Treatment 5
Corn oil	50 ml	40 ml	40 ml	40 ml	40 ml
Carrots, sliced traversely	3 pcs	3 pcs	3 pcs	3 pcs	3 pcs
Whole black peppercorn	6 pcs	6 pcs	6 pcs	6 pcs	6 pcs
Siling labuyo	3 pcs	3 pcs	3 pcs	3 pcs	3 pcs
Bayleaf or laurel	1 pc	1 pc	1 pc	1 pc	1 pc
Rice eel steak	160 grams	160 grams	160 grams	160 grams	160 grams
Extracted flavorings		10 ml	10 ml	10 ml	10 ml

T1: Control, T2: Guava Extracts, T3: Calamansi Extracts, T4: Camias Extracts, T5: Tamarind Extracts

Experimental Materials and Equipment

The fish were dried using stainless steel plates. The burner was employed for deep-frying, and the pressure cooker was used to extract plant ingredients and cook the bottled rice eel. Fruit extracts and corn oil were measured using measuring cups. Various additional items were also used in the study, including plastic containers, knives, spoons, plates, glass jars, basins, chopping boards, and weighing scales. Laboratory gowns, gloves, and hairnets were required for personal hygiene and safety throughout fish processing and were used appropriately.

Experimental Procedures

The following steps were used to add value to rice eel in the form of bottled Spanish oil. First, the fish's head was chopped, eviscerated, and carefully washed to remove blood before being soaked in a 15% salt solution (brine: 4 parts glasses of water to 1 part salt) for three minutes. Secondly, the fish underwent sun drying for approximately 1 ½ hours. Subsequently, the fish were deep-fried in oil for about 30 seconds to one minute, followed by draining and placement at room temperature. Following this, the fish were placed into eight-ounce glass jars, with each bottle being filled with corn oil and extracts, leaving 1/6-to-1/4-inch headspace, and sealed tightly. The filled bottles then underwent processing in a pressure cooker for approximately 2 hours at 10 psi or 115°C. These filled bottles could cool at room temperature, and the glass jars were washed to remove adhering oils before being dried. Finally, each bottle was coded, labeled, and stored at room temperature. This procedure was adapted from the work of Ligero (2019), wherein the brining time was modified from 10 minutes to 3 minutes because of the excessive saltiness experienced during pre-conduct.

Microbial Analysis

Microbial examinations of the most preferred powder were performed to assess the total plate count. The pour plate technique and serial dilution were methods used to count the bacteria. The pour plate technique was done by transferring 0.1 mL (100 ml) of diluted bacteria samples have been added to the petri dish. Once the diluted bacteria samples have been added to the petri dishes, pour a melted nutrient agar into each petri dish. Gently swirl the nutrient agar and diluted bacteria samples together, and let the petri plate solidify. While serial dilution was performed, one 1mL of the bacterial sample was added to 9 mL distilled water, and it was mixed together (creating a 10-1 dilution). Then, 1 mL from that mixture is added to 9 mL of distilled water, and it is mixed (a 10-2 dilution) (Fankhauser, 2000).

Proximate Analysis

The collected samples of bottle rice eel were submitted to the Department of Agriculture- Regional Feed and Chemical Analysis Laboratory Services (DA-RFCALS) for proximate analysis and were determined according to the AOAC method (2000). The moisture content was determined by oven-drying and the crude protein content of the finished product was determined through Kjedahl method. The determination of ash was oven-burned at 600°C to constant weight and ashes were determined by weighing. The crude lipid content was determined by the soxhlet method (AOAC, 2000).

The Procedure of the Taste Test

The product was prepared in bite-sized form for sensory evaluation. There were fifty (50) panelists in this study. The panelists were asked to observe the color, savor the aroma, and assess the texture and taste. Each panelist was provided with water after tasting each product to differentiate the taste of each treatment very well and they were immediately asked to provide the rating for the treatment group before proceeding to the next. The acceptability of the product was evaluated according to color, aroma, texture, and taste, using the sensory evaluation form.

Data Gathering Procedure

The panelists rated the color, aroma, texture, and taste of the product through sensory evaluation using the hedonic scale wherein 1 is the lowest rate and 9 will be the highest rate of the product.

Data Gathering Instruments

Hedonic Scale

The 9-point hedonic scale has shown itself to be a simple and effective measuring device for determining the hedonic differences between foods, beverages, and consumer products and predicting their acceptance (Lim, 2011). The table below was used to measure the acceptability of the product with its corresponding scale.

Table 3. Hedonic Scale Used to Assess the Bottled Rice eel with Different Fruit Flavorings

Scale	Range	Description	Abbreviation
1	1.00-1.88	Dislike Extremely	DE
2	1.89-2.77	Dislike Very Much	DVM
3	2.78-3.66	Dislike Moderately	DM
4	3.67-4.55	Dislike Slightly	DS
5	4.56-5.44	Neither Like nor Dislike	NLND
6	5.45-6.33	Like Slightly	LS
7	6.34-7.22	Like Moderately	LM
8	7.23-8.11	Like Very Much	LVM
9	8.12-9.00	Like Extremely	LE

Labelling and Packaging

Nowadays, almost all food products must have standardized nutritional labels. This is to ensure that consumers are well aware of the nutritional composition of foods so that they can make informed and knowledgeable decisions about their diet. Additionally, packaging serves as a means to create suitable conditions for fair market competition between food companies. The packaging of the product was an autoclavable bottle jar ordered online and printed with sticker paper for the label.

Data Analysis

The data were analyzed using one-way Analysis of Variance (ANOVA) and Tukey Honestly Significant Difference (HSD) test to determine if the treatments significantly affect the product in terms of color, aroma, texture, and taste. All statistical tests were run in Statistical Package for Social Sciences (SPSS) software version 16. The total plate count was determined using a logarithm number. A descriptive analysis was also used to determine the frequencies of each treatment as per criteria of evaluation based on the hedonic scale.

Results and Discussion

Microbiological Analysis

Total Plate Count (TPC) is a method of estimating the total number of microorganisms. Ten grams of samples were collected from all the treatments and analyzed in triplicate. The result of bottled rice eel with different fruit flavorings was counted from day 1, 8, 16, 24, and 32, as shown in Figure 1. The population of TPC recorded varies from 10^3 to 10^6 samples. All treatments showed that there was no development of bacteria on day 1. However, treatments from day 8 to day 32 had an increasing number of TPCs. Day 16 recorded the lowest TPC, while day 32 got the highest TPC. The bacterial growth in each treatment slightly decreases in 16 days but increases after T1. However, in T2-T5, an obvious decreasing trend in TPC was observed on day 16 from an increase on day 8. (Figure 1-5).

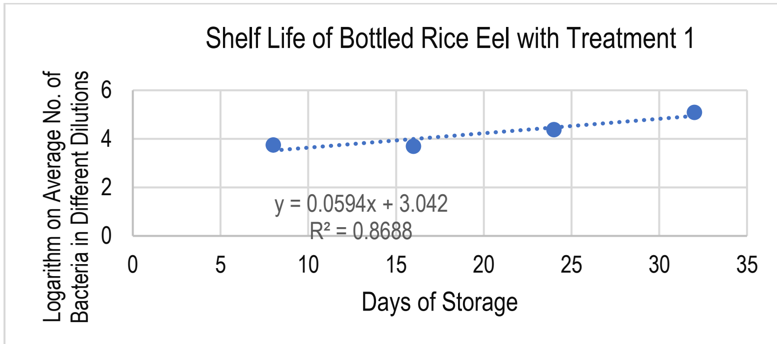

Figure 1. *Total Plate Count of Bottled Spanish Oil Style Rice Eel in Treatment 1 in 18, 16, 24 and 32 Days of Storage*

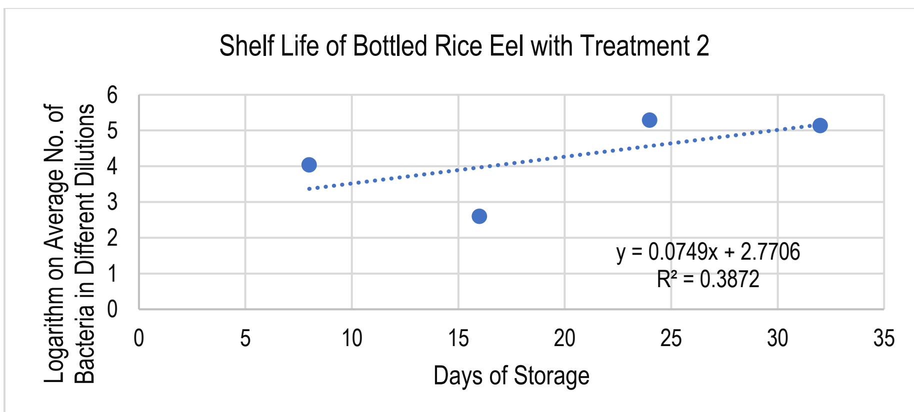

Figure 2. *Total Plate Count of Bottled Spanish Oil Style Rice Eel in Treatment 2 in 8, 16, 24 and 32 Days of Storage*

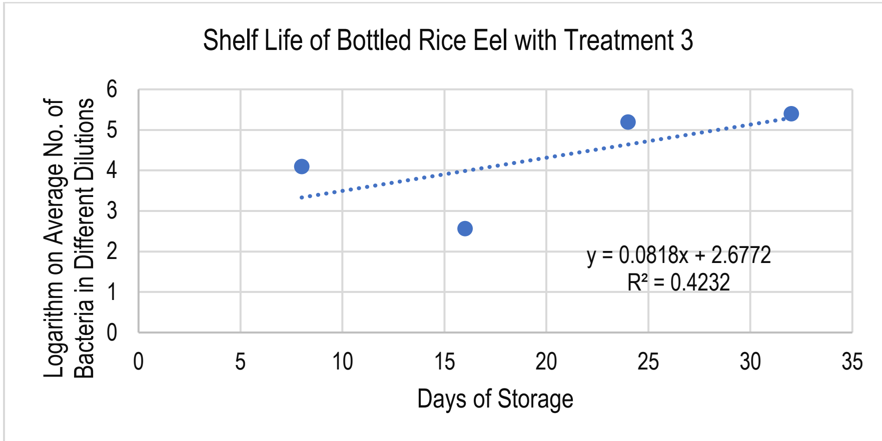

Figure 3. *Total Plate Count of Bottled Spanish Oil Style Rice Eel in Treatment 3 in 8, 16, 24, and 32 Days of Storage*

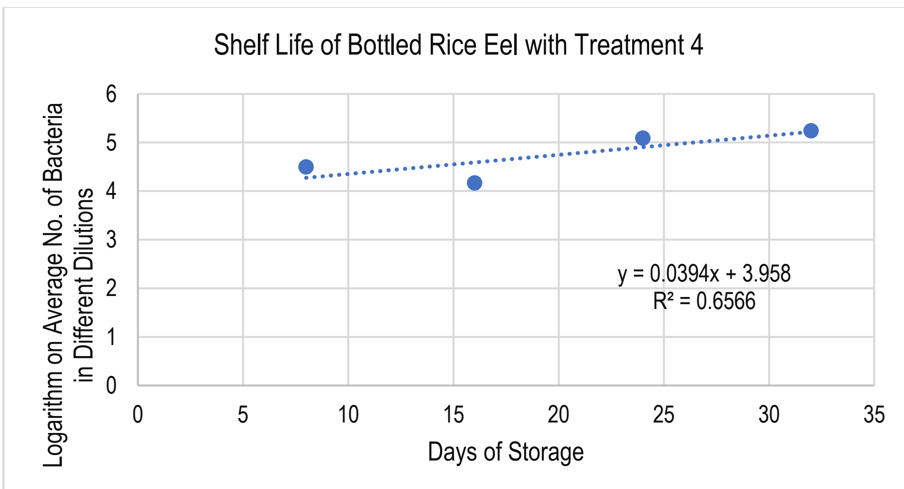

Figure 4. *Total Plate Count of Bottled Spanish Oil Style Rice Eel in Treatment 4 in 8, 16, 24, and 32 Days of Storage*

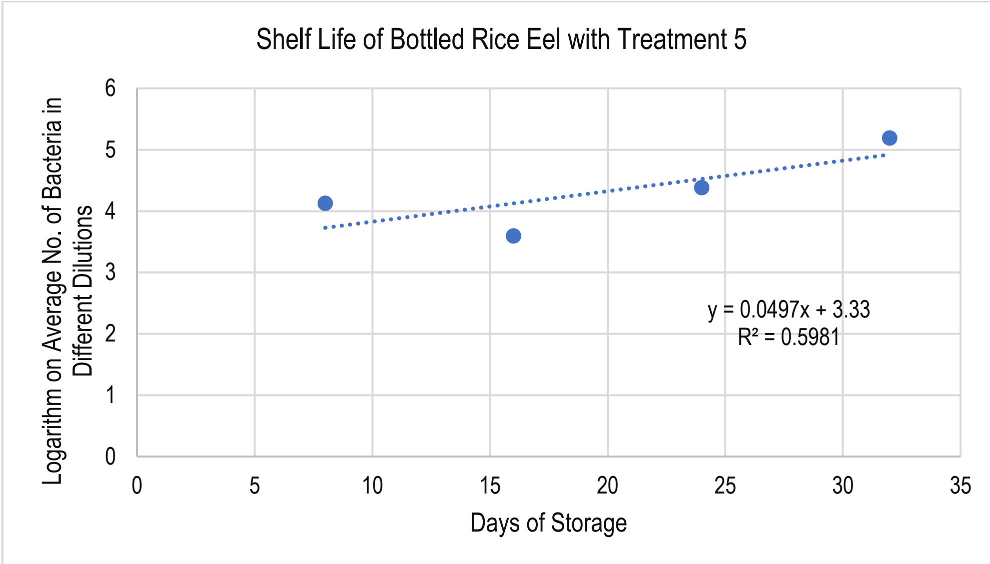

Figure 5. *Total Plate Count of Bottled Spanish Oil Style Rice Eel in Treatment 5 in 8, 16, 24, and 32 Days of Storage*

The presence of microbes in processed and unprocessed foods leads to food-borne diseases that can harm human health and trigger death. Unhygienic conditions, improper handling of equipment, and poor cleaning conditions are just some of the factors wherein bacteria and microorganisms may multiply and grow (Bigueja, 2016). Thus, safety assessment of foods is prominent to meet quality standards.

Based on the results of the TPC analysis, it was observed that there was no development of bacteria on day 1. The product was pressure-cooked for two hours at 10 psi/115°C to kill the microorganisms. Commercial sterility refers to the absence of microorganisms capable of growing in the food at normal non-refrigerated conditions at which the food is likely to be held during distribution and storage (Codex Alimentarius Commission, 1983). The purpose of bottling is to use heat alone or in combination with other means of preservation to kill or inactivate all the microbial contaminants (Warne, 1998).

However, all treatments from day 8 to day 32 were detectable and had an increasing number of TPCs. Bacteria increase their numbers by geometric progression, whereby their population doubles every generation. In some studies, the bacteria contained in fish will increase with the length of storage (Leksono, 2001). This is in agreement with the result in 24 to 32 days of storage, and this could be attributed to many factors including the temperature of storage and factors related to environment. The environment has the greatest influence on the production of bacteria. However, the TPC in all treatments was acceptable since the standard bacterial colonies ranged from 30-300 (Breed & Dotterrer, 1916).

However, it can be seen in the result that despite a detectable increase of TPC on days 8 and 32, it somehow decreased on day 16 due to contamination during the conduct of the microbiological analysis and the increasing temperature during storage.

Proximate Analysis

The result of the proximate analysis of bottled rice eel in Spanish style was analyzed by the Department of Agriculture-Regional Feed and Chemical Analysis Laboratory Services (DA-RFCALS) following the AOAC method (2000). The result of the proximate composition of Bottled rice eel samples is shown in Table 4.

The crude protein content ranged from 18.72 to 21.05% in T1 to T5. The highest value (21.05%) was observed in T4 with camias extract, and T1 (control) got the lowest protein content. The crude fiber ranged from 0.82 to 2.01% in T1 to T5. The highest value was observed in T5 with tamarind extracts at 2.01%, and T2 with guava extracts got the lowest value at 2.0%**.** The crude fat ranged from 7.95 to 12.72% in T1 to T5. The highest value was observed in T1 (Control) at 12.72% and T4 with camias extracts got the lowest value at 7.95%.

On the other hand, the moisture content of the samples ranged from 53.28 to 64.40% in T1 to T5. T2 with guava extracts got the highest moisture content, and T3 with calamansi got the lowest moisture content at 53.28%. The ash content of the product ranged from 3.85 to 5.49% in T1 to T5. Treatment 5 with tamarind extracts got the highest ash content, and T3 with calamansi extracts got the lowest ash content.

Table 4. Proximate Analysis of Bottled Rice Eel with Different Fruit Flavorings

Sensory Attributes	Treatment 1	Treatment 2	Treatment 3	Treatment 4	Treatment 5
Crude Protein (%)	18.72	20.33	19.93	21.05	20.61
Crude Fiber (%)	1.48	0.82	1.59	1.94	2.01
Crude Fat (%)	12.72	8.10	9.92	7.95	9.14
Moisture (%)	61.18	64.40	53.28	61.76	56.62
Ash (%)	4.44	4.07	3.85	4.23	5.49

Note: *Treatment 1 (Control); Treatment 2 (Guava Extract); Treatment 3 (Calamansi Extract); Treatment 4 (Camias Extract); T5 (Tamarind Extract)*

Based on the proximate result, the highest value in terms of crude protein was observed at T4 with camias extracts (21.05%). During the extraction of camias, heat was used to boil the fruit for 30 minutes. The use of heat in food processing such as boiling, steaming, and frying can affect the nutritional value of food, especially protein content (Winarno, 2008). This process shows that the flavorings added to the product increase the protein content.

The highest value of crude fiber was observed in T5 with tamarind extracts (2.01%). The tamarind seeds were included during the boiling of the fruits; therefore, the flavorings added to the product increase the crude fiber. The tamarind fruit pulp contains tartaric acid, responsible for providing typical fruit acidity, while seeds are good sources of crude fiber, carbohydrates, and phytochemicals (Akajiaku et al., 2014). Fiber is an important part of the diet, which decreases serum cholesterol levels, and the risk of coronary heart disease, hypertension, diabetes, colon, and breast cancer (Ishola et al., 1990).

The highest value of crude fat content was observed in T1 (control) with 12.72%. Treatment 1 had no inclusion of fruit flavorings except for the corn oil that serves as the ingredient of the product. Corn oil can play a major role in the human diet. It is a concentrated source of energy (calories), is very digestible, provides essential fatty acids and Vitamin E, and is a rich source of polyunsaturated fatty acids, which help regulate blood cholesterol levels and lower elevated blood pressure. Corn oil is a rich source of linoleic acid, an essential fatty acid that the body cannot make (Hauman, 1985; Dupont, 1990).

The highest value for the moisture content was observed in T2 with guava extracts. The guava fruit has low carbohydrate, fat, and protein content and high-water content, as well as vitamins A, B, and C (Abu-Goukh & Bashir, 2003). Moisture contents significantly affect the overall compositional fraction of biochemical attributes and serve as an important index of freshness and storage stability. This reveals that higher moisture levels spoil the fruit earlier and vice versa (Ahmed et al., 2020).

On the other hand, the highest value for ash content was observed in T5 with Tamarind extracts at 5.49%. The ash represents the total content of minerals in a food. Tamarind had the highest ash content; however, it had the lowest moisture content (Untalan et al., 2015). Ash content ensures the safety of foods, making sure there are no toxic minerals present. The ash content in food can also impact the taste, texture, and stability of foods.

Color Acceptability

Based on the hedonic score in terms of color, T1 got the highest score of 7.02, followed by T5 with a score of 6.96, T3 and T4, which both have an average score of 6.92, and T2 got the lowest score of 6.76. All treatments were described as “Like Much” by the panelists as shown in Table 5.

Table 5. Color Acceptability

Treatment	Description	Hedonic Color	Interpretation
1	Control	7.02 ± 1.253	LM
2	Guava Flavor	6.76 ± 1.379	LM
3	Calamansi Flavor	6.92 ± 1.175	LM
4	Camias Flavor	6.92 ± 1.192	LM
5	Tamarind Flavor	6.96 ± 1.370	LM
	Grand Mean	**6.92 ± 1.269**	

In this study, the color of the bottled rice eel without flavorings (T1) got the highest acceptability among all treatments. Color is the most outstanding parameter by which the quality of foods is judged that can stimulate or suppress one’s appetite. Food colorants make food more attractive, appetizing, and recognizable. Natural colorants have become more popular worldwide due to their therapeutic and medical effects and the high toxicity of synthetic colors (Jurić et al., 2020; Lu et al., 2021). Corn oil is sold in a crude, intermediate-refined, or fully refined state. It has a pale-yellow color which darkens during frying (Jayadeep, 1996) and this would be attributed to the vibrant coloration of the product.

Aroma Acceptability

Based on the hedonic score in terms of aroma, T4 got the highest score of 7.22, followed by T3 with a rating of 7.20, followed by T5 with a rating of 7.06, and T1 and the T2 got the lowest score of 6.86 and 6.70, respectively. All treatments were described as "Like Much" by the panelists as shown in Table 6.

Table 6. Aroma Acceptability

Treatment	Description	Hedonic Aroma	Interpretation
1	Control	6.86 ± 1.443	LM
2	Guava Flavor	6.70 ± 1.403	LM
3	Calamansi Flavor	7.20 ± 1.178	LM
4	Camias Flavor	7.22 ± 1.516	LM
5	Tamarind Flavor	7.06 ± 1.406	LM
	Grand Mean	**7.01 ± 1.397**	

With regards to the aroma, T4 got the highest acceptability among all treatments. Bilimbi locally known as "kamias" can be made into wine. Sterilized kamias wine maybe pale in color but in terms of aroma, it is powerful in wine because when bilimbi is exposed to heat before fermentation, it produces a powerful aroma, therefore reducing its fruity scent (Caoli et al., 2017). This justification would apply to the product since during bottling, a heating process was employed.

Texture Acceptability

Based on the hedonic score in terms of texture, T5 got the highest score of 7.40, followed by T4 with a rating of 7.30, followed by T1 and T3 with a rating of 7.24, and T2 got the lowest score of 7.08. The texture of T1, T3, T4, and T5 was described as "Like Very Much" and T2 as "Like Much" by the panelists as shown in Table 7.

Table 7. Texture Acceptability

Treatment	Description	Hedonic Texture	Interpretation
1	Control	7.24 ± 1.318	LVM
2	Guava Flavor	7.08 ± 1.226	LM
3	Calamansi Flavor	7.24 ± 1.188	LVM
4	Camias Flavor	7.30 ± 1.266	LVM
5	Tamarind Flavor	7.40 ± 1.565	LVM
	Grand Mean	**7.25 ± 1.313**	

In terms of texture, T5 had the highest acceptability among all treatments. Extracting the tamarind pulp concentrates the juice. Bottled rice eel can be slightly softer and moister, which some people may find appealing. The edible bones in sardines also contribute to their overall texture. The oral texture is the perception that arises when food interacts with teeth, saliva, and tactile receptors in oral activity. During mastication, the texture of the food changes, the palatability of the food is assessed, and the food is converted into a form suitable for swallowing (Mishellany et al., 2006).

Taste Acceptability

Based on the hedonic score for taste, T5 received the highest rating of 7.86, with T4 close behind at 7.80. Treatment 3 scored 7.14, T2 received 6.68, and T1 had the lowest rating at 6.30. The taste of T5 and T4 was described as "Like Very Much", T3, and T2 were described as "Like Much", and T1 was described as "Like Slightly" by the panelists as shown in Table 8.

Table 8. Taste Acceptability

Treatment	Description	Hedonic Taste	Interpretation
1	Control	6.30 ± 1.581	LS
2	Guava Flavor	6.68 ± 1.659	LM
3	Calamansi Flavor	7.14 ± 1.325	LM
4	Camias Flavor	7.80 ± 1.125	LVM
5	Tamarind Flavor	7.86 ± 1.161	LVM
	Grand Mean	**7.16 ± 1.506**	

In terms of taste, T5 got the highest acceptability among all treatments. Taste is mostly assessed in terms of sweetness, saltiness, bitterness, and sourness (Iatridi et al., 2019). The tamarind fruit pulp is used for seasoning, as a food component, to flavor confections, curries, and sauces, and is a main component in juices and certain beverages. (El-Siddig et al., 1999; El-Siddig et al., 2006). The addition of spices, fruits, and herbs to oils had an important impact on their sensory characteristics, giving strong flavors and tastes (Krist et al., 2006; Navas, 2013).

ANOVA for Hedonic Color

Based on the hedonic analysis in terms of color, it was found that all the treatments have no significant differences in the hedonic color of the product. It signifies that the product was not significantly affected by the treatments.

Table 9. ANOVA for Hedonic Color

Treatment	n	M	SD	F (2, 245)	p	Interpretation
Treatment 1	50	7.02	1.253	.285	.888	Not Significant
Treatment 2	50	6.76	1.379			
Treatment 3	50	6.92	1.175			
Treatment 4	50	6.92	1.192			
Treatment 5	50	6.96	1.370			

ANOVA for Hedonic Aroma

Based on the hedonic analysis in terms of aroma, it was found that all the treatments have no significant differences in the hedonic aroma of the product. It signifies that the product was not significantly affected by the treatments.

Table 10. ANOVA for Hedonic Aroma

Treatment	n	M	SD	F (2, 245)	p	Interpretation
Treatment 1	50	6.86	1.443	1.295	.272	Not Significant
Treatment 2	50	6.70	1.403			
Treatment 3	50	7.20	1.178			
Treatment 4	50	7.22	1.516			
Treatment 5	50	7.06	1.406			

ANOVA for Hedonic Texture

Based on the hedonic analysis in terms of texture, it was found that all the treatments have no significant differences in the hedonic texture of the product. It signifies that the product was not significantly affected by the treatments.

Table 11. ANOVA for Hedonic Texture

Treatment	n	M	SD	F (2, 245)	p	Interpretation
Treatment 1	50	7.24	1.318	.388	.817	Not Significant
Treatment 2	50	7.08	1.226			
Treatment 3	50	7.24	1.188			
Treatment 4	50	7.30	1.266			
Treatment 5	50	7.40	1.565			

ANOVA for Hedonic Taste

Based on the hedonic analysis in terms of taste, there is a significant difference in the hedonic taste of the product for the five treatments: $F(2,245) = 12.148$, $p < .01$. The difference in the mean score between the groups was very large ($\eta^2 = 0.16$). Hence, there is a large effect size in the mean difference. A post-hoc comparison using the Tukey HSD procedure indicated that the mean scores of Treatments 3, 4, and 5 are significantly different from Treatments 1 and 2. Since Treatment 5 has the highest mean score ($M = 7.86$, $SD = 1.161$), it can be concluded then that Treatment 5 is the best treatment for the hedonic taste of the product.

Table 12. ANOVA for Hedonic Taste

Treatment	n	M	SD	F (2, 245)	p	Interpretation
Treatment 1	50	6.30	1.581	12.148	.000	Significant
Treatment 2	50	6.68	1.659			
Treatment 3	50	7.14	1.325			
Treatment 4	50	7.80	1.125			
Treatment 5	50	7.86	1.161			

Significant at .01

Table 13. Tukey HSD for Hedonic Taste

Treatment	n	Subset for alpha = 0.05		
		1	2	3
1	50	6.30		
2	50	6.68	6.68	
3	50		7.14	7.14
4	50			7.80
5	50			7.86
Sig.		.648	.462	.074

Acceptability Composite Index (ACI)

The hedonic Acceptability Composite Index (ACI) is the grand mean rating of four criteria (color, aroma, texture, and taste) known as general acceptability. The ranking per treatment was also determined based on the grand mean score. The result below confirms that Treatment 5 (with tamarind flavor) is the most acceptable among all treatments (Table 14).

Table 14. Acceptability Composite Index (ACI) of Bottled Rice Eel with Different Fruit Flavorings

Trt	Hedo-nic Color	Color 17.64 %	Hedo-nic Aroma	Aroma 22.62%	Hedonic Texture	Texture 19.26%	Hedo-nic Taste	Taste 40.48%	Total ACI	Rank
1	7.02	1.24	6.86	1.55	7.24	1.39	6.30	2.55	6.73	**4**
2	6.76	1.19	6.70	1.52	7.08	1.36	6.68	2.70	6.78	**5**
3	6.92	1.22	7.20	1.63	7.24	1.39	7.14	2.89	7.13	**3**
4	6.92	1.22	7.22	1.63	7.30	1.41	7.80	3.16	7.42	**2**
5	6.96	1.23	7.06	1.60	7.40	1.43	7.86	3.18	7.44	**1**

The overall acceptability composite index showed that bottled rice eel with tamarind extract got the highest mean average (Table 14). Considering that the majority of respondents used tamarind as a flavor for food enhancement which is also widely practiced elsewhere (Khurana & Ho, 1989; Lakshmi et al., 2005).

In addition, nutritional labels show information about the total calorific value of the food product and also state total and saturated fat, cholesterol, sodium, carbohydrate dietary fiber, sugars, proteins, vitamins, calcium, and iron. Additional information related to other nutrient content claims such as low fat, high fiber, or fat-free might also be stated on the food product labels.

Packaging must keep the product safe during shipment between the manufacturing facility and the retailer and must prevent damage while the product sits on the shelf. Therefore, product packaging must be sturdy and reliable.

Cost and Return Analysis of Bottled Rice Eel with Different Fruit Flavorings

Return on investment (ROI) is generally defined as the ratio of net profit over the total cost of the investments. ROI can be used to identify the investment's gain and financial returns. Table 15 shows that T1 has a 42% estimated ROI, T2 and 4 have a 49% estimated ROI, and T3 and 5 have 45% estimated ROI.

Table 15. Cost and Return Analysis of Bottled Rice Eel with Different Fruit Flavorings

Ingredients	Treatment 1	Treatment 2	Treatment 3	Treatment 4	Treatment 5
Rice Eel	160g@100	160g@100	160g@100	160g@100	160g@100
Corn oil	40 ml@10	40 ml@10	40 ml@10	40 ml@10	40 ml@10
Carrots (sliced traversely)	3 pcs@5	3 pcs@5	3 pcs@5	3 pcs@5	3 pcs@5
Sweet pickles (sliced traversely)	2 pcs@5	2 pcs@5	2 pcs@5	2 pcs@5	2 pcs@5
Whole black peppercorn	6 pcs@1	6 pcs@1	6 pcs@1	6 pcs@1	6 pcs@1
3 Siling labuyo	3 pcs@5	3 pcs@5	3 pcs@5	3 pcs@5	3 pcs@5
Bayleaf or laurel	1 pc@2	1 pc@2	1 pc@2	1 pc@2	1 pc@2
Guava extract	0 ml	10 ml @ 20	0 ml	0 ml	0 ml
Calamansi extract	0 ml	0 ml	10 ml @10	0 ml	0 ml
Camias extract	0 ml	0 ml	0 ml	10 ml @ 20	0 ml
Tamarind extract	0 ml	0 ml	0 ml	0 ml	10 ml @10
Bottle	50	50	50	50	50
Total Expenses	178	198	188	198	188
Unit Price	50	100	100	100	100
Retail Price	50 x 10 bottle	50 x 10 bottle	50 x 10 bottle	50 x 10 bottle	50 x 10 bottle
Total Selling	60.00/bottle x10 bottle	60.00/bottle x10 bottle	60.00/bottle x10 bottle	60.00/bottle x10 bottle	60.00/bottle x10 bottle
Profit = total Selling – total Expenses	600-178	600-198	600-188	600-198	600-188
Net Income	422	402	412	402	412
ROI	178x100 422	198x100 402	338x100 412	198x100 402	338x100 412
ROI	**42%**	**49%**	**45%**	**49%**	**45%**

With regard to the cost and return analysis of the product, profitability can be determined based on the computation of the ROI. It denotes that the acceptability level of rice eel Spanish oil style with different flavorings has the capability for commercialization and will demand good marketing in terms of business ventures.

Conclusion and Future Works

This study was conducted to determine the acceptability of bottled rice eel flavored with different fruit extracts such as guava, calamansi, camias, and tamarind in Spanish oil style in terms of color, aroma, texture, and taste using a hedonic scale and ACI. The acceptability of the product was based on a 9-point hedonic scale as described in the following conclusions.

1. In terms of the microbiological test, all treatments showed that there was no development of bacteria on day 1. However, all treatments from day 8 to day 32 had an increasing number of TPCs. The bacterial growth in each treatment decreases in 16 days but increases after.
2. In terms of the sensory acceptability of the product, there were no significant differences in the sensory acceptability of the product for T1, T2, T3, and T4; however, for T5, there was a significant difference. In terms of hedonic color, T1 got the highest score, T4 got the highest score in terms of aroma, and T4 and T5 got the highest score in terms of hedonic texture and taste. The general acceptability of the product was determined, and bottled rice eel with tamarind flavoring was the most accepted by the panelists based on the ACI total ranking.
3. The bottled rice eel with different fruit flavorings was found to have the highest proximate composition attributes: 21.05% crude protein in camias extracts, 2.01% crude fiber in tamarind extracts, 12.72% crude fat without flavorings (control), 64.40% moisture content in guava extracts, and 5.49% ash content in tamarind extracts.
4. Based on the computation of the ROI, it was computed that T1 has 42%, T2 and T4 have 49%, and T3 and T5% have 45% of the estimated ROI.

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Conflict of Interest

The authors declare that there are no conflicts of interest regarding the publication of this paper.