Acceptability and Sensory Evaluation of Bottled Spanish-Style Rice Eel with Natural Flavorings

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Abstract:- Rice eel's acceptability as a table food has been tarnished due to its distinct fishy smell. Hence, most Filipinos considered it as the least preferred viand resulting in the least capture for food that hastened its invasiveness. To lessen the impact of rice eel's presence in rice farms and encourage its utilization, a post-harvest processing technology with emphasis on bottling was conducted. Three falvorings were tested such as pandan (*Pandanus amaryllifolius),* lemon grass (*Cymbopogon citratus)* and guava (*Psidium guajava)* and were evaluated in terms of appearance, texture, aroma and taste by fifty (50) panelist using a 9-point hedonic scale and determined its general acceptability using the acceptability composite index. Four treatments were prepared following the ingredients and procedure of the Industrial Technology Development Institute – Department of Science and Technology (DOST-ITDI). Sensory evaluation shows that Treatment 1 (control), 2 (pandan) and 4 (guava) were statistically not significant in terms of appearance, texture, aroma and taste while Treatment 3 (lemon grass) is significantly lower among treatments. Based on acceptability composite index, Treatment 2 (pandan) rated as rank 1 followed by the Treatment 1 (control), Treatment 4 (guava) and Treatment 3 (lemon grass). It was noted, that the texture and aroma of bottled Spanish-style rice eel with *pandan* got the highest acceptable rating among the treatments while appearance and taste had the highest acceptability in Treatment 1 (or control). A separate study on the shelf-life and waste utilization of rice eel is highly recommended.

Keywords:- Rice eel; Natural Flavorings; Sensory Evaluation; Bottled Spanish-style.

I. INTRODUCTION

Rice eel was considered a pest in Cagayan Valley Region due to its invasiveness and the great degree of potential damages it brought to the rice farmers as it dwells on rice farms to feed for habitation (Ame, 2021). They burrow in rice paddies to live when the weather is hot and stays there until the rainy season where they come out to reproduce (Davidson, 1975). Their ability to breathe atmospheric air help them survive underground for several months without food and water. Also, eel can pass through wet soil for migration (Hill and Watson, 2007). Rice eel was introduced in the Philippines for aquaculture in 1905 without considering its impact on the environment; thus, it has become invasive (Juliano *et al.,* 1989; Guerrero, 2014). Its

invasiveness has been manifested in the damages and economic loss it has inflicted on rice farming in the region (Ame, 2021). To address this problem, the development and processing of rice eel into a value-added product such as longganisa, nuggets, and smoked rice eel was initiated by the DA-Bureau of Fisheries and Aquatic Resources Region 2 (DA-BFAR 2) (Official Gazette, 2013).

Despite the negative impacts of *M. albus* invasiveness in rice areas in Region 2, the fish has positively contributed to the economy. At present, local fisherfolk earn a livelihood from harvesting and trading live eel. As of 2023, the DA-BFAR 2- Regional Fisheries Inspection and Quarantine Unit recorded a total of 6,120.085 metric tons of live eel transported to Bulacan and Metro Manila (BFAR, 2023). The fish is sold in local and international markets in Singapore, China, Japan, Taiwan and other Asian countries (Domingo, 2013).

To take advantage of the potential of this fish in addressing the need for food and income of farmers and fisherfolk and introduce the rice eel as a potential dish on every table, a need to develop improved products should be undertaken as an initial step towards its utilization. However, fish is a very perishable product, hence processing techniques are being employed to prolong its shelf-life. Value-added products are becoming increasingly important in satisfying consumer demands for safe, high-quality convenient, healthy, and nutritious food throughout the world (Boziaris, 2014). Value addition is one of the most prominent approaches among the other processing techniques in the fish and seafood industry with tremendous market values as well as employment opportunities. Besides the profitable utilization of low-valued fish, it can fulfill the consumers' demands for convenient foods with quality assurance and longer shelf-life (Ikbal *et al.,* 2021).

Canning or bottling is a method of preservation for fish and fishery products providing food that is stable at ambient temperatures for a long period (Bigueja *et al.,* 2020). Spices and herbs have long been utilized for culinary and medicinal purposes. They are used in cooking as flavor enhancers, colorants, preservatives (antioxidants or antimicrobials), as well as ingredient replacements for salt and sugar.

The addition of locally abundant natural flavorings such as pandan, lemon grass, and guava as an off-odor remover and flavor enhancer is being considered to better understand its effects to fish and fishery products in addressing the needs of the consumers. The development of bottled Spanish-style rice eel added with natural flavorings will maximize the utilization of abundant supply of rice eel in the region thereby promoting more nutritious food options while paving the way to livelihood opportunities to local fisherfolk in the region.

II. MATERIALS AND METHODS

A. Initial processing of experimental organisms

A total of 20 kilograms rice eels weighing 150-200g each were bought from the fisherfolk of Cagayan Province, Philippines to be utilized in the study. The purchased rice eel was packed in insulated container and transported to the Integrated Fish Processing Laboratory of DA-BFAR 2, Tuguegarao City, Cagayan and immediately used in the experiment upon arrival.

B. Experimental Plants as Natural Flavorings

Fresh leaves of pandan *Pandanus amaryllifolius*, lemon grass *Cymbopogon citratus*, and guava *Psidium guajava*, from Gattaran, Cagayan wee utilized as the natural flavorings for the developed Bottled Spanish-style rice eel. It was sun dried and packed in plastic bags and delivered to the Integrated Fish Processing Laboratory of the DA-BFAR 2, Tuguegarao City prior to its processing.

C. Experimental Treatments

There were four experimental treatments used with three (3) replicates in the study (Table 1). The bottled Spanish-style rice eel was prepared following the ingredients listed by the Industrial Technology Development Institute – Department of Science and Technology. The flavorings served as the variables to improve the taste and its acceptability to the consumers.

**Table 1**. Experimental Treatments and List of Ingredients for 8 oz. glass jars

Ingredients	Treatment 1	Treatment 2	Treatment 3	Treatment 4
Fried rice eel	160 grams (±10 grams)	160 grams (±10 grams)	160 grams (±10 grams)	160 grams (±10 grams)
Corn oil	60-80 grams	60-80 grams	60-80 grams	60-80 grams
Carrots, sliced traversely	3 pcs	3 pcs	3 pcs	3 pcs
Sweet pickles sliced traversely	2 pcs	2 pcs	2 pcs	2 pcs
Whole black peppercorn	6 pcs	6 pcs	6 pcs	6 pcs
Birds eye chilli	2 pcs	2 pcs	2 pcs	2 pcs
Flavorings added	2 grams dried bay leaves	2 grams dried pandan leaves	2 grams dried lemon grass leaves	2 grams dried guava leaves

D. Methods in Making Bottled Spanish-Style Rice eel

The bottled Spanish-style rice eel was prepared following the procedure of Industrial Technology Development Institute – Department of Science and Technology with the slight modification.

- Hit the eel head with a large knife and apply salt to scrub the entire outer surface of the eel until the slime is gone and rinse the eel with running water.
- Cut the head, eviscerate, and wash the fish thoroughly to remove blood and remaining internal organs.
- Cut the fish that fit the size of the glass jar.
- Soak in 15% salt solution (brine) for 3 minutes. To prepare brine: dissolve 1 part salt to 4 parts waters. Drain.
- Dry the fish under the sun for about 1 ½ to 2 hours or until dry to touch.

- Deep fry in pre-heated hot cooking oil for about 30 seconds to 1 minute. Drain then cool to room temperature.
- Pack fish in 8-ounce glass jars at 160 g (±10 g) per jar then add other ingredients (arrange properly).
- Fill jars with pre-heated corn oil leaving 1/6 to ¼ inch headspace then exhaust to an internal temperature of about 85°C. Close jars tightly.
- Process in a pressure cooker for 2 hours at 10 psi (115.6 °C)
- Allow to cool at room temperature (28-30°C)
- Wash glass jars to remove adhering oil and dry.
- Code, label and store at room temperature (28-30°C).
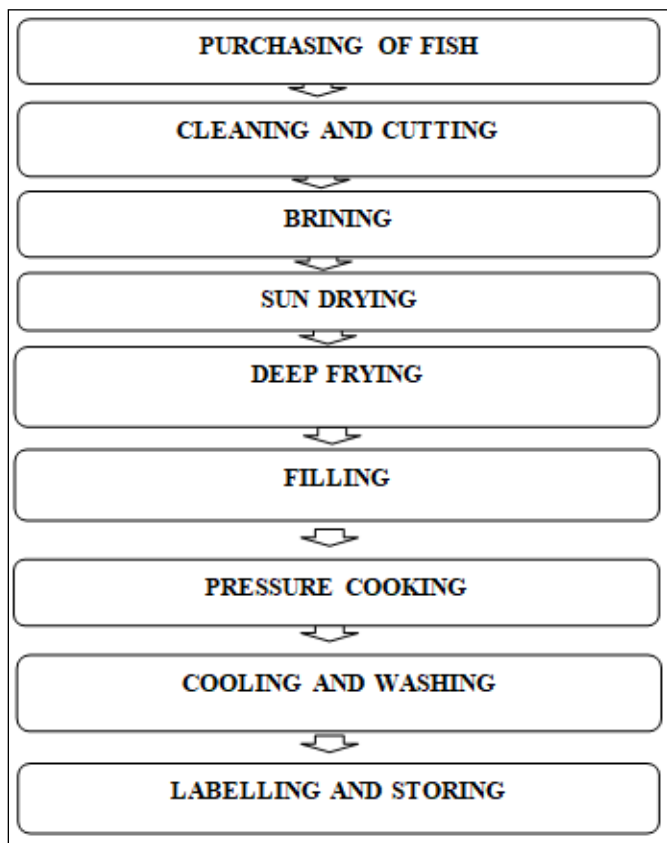
Fig 1. Process Flow of making Bottled Spanish-style Rice eel

E. Sensory Evaluation

Taste test procedure was carried out with the aid of fifty (50) semi-trained panelist wherein they had all been experienced in using sensory methods used in this evaluation to determine the acceptability of the finished product. Acceptability composite index and Hedonic scale were used during taste test. Each panelist was provided with a rating sheet to evaluate each treatment. After taste test of every treatment, they were required to drink water. Rating sheets were collected after the taste test and rating procedure.

➤ *Hedonic Scale*

The following scale was used to measure the acceptability of the product.

Table 2. Hedonic Scale used to Assess the Bottled Spanish-style Rice Eel with Natural Flavorings

Scale	Range	Description	Abbreviation
1	1.00-1.49	Dislike extremely	DE
2	1.50-2.49	Dislike Very Much	DVM
3	2.50-3.49	Dislike Moderately	DM
4	3.50-4.49	Dislike slightly	DS
5	4.50-5.49	Nor Like Nor Dislike	NLND
6	5.50-6.49	Like slightly	LS
7	6.50-7.49	Like Moderately	LM
8	7.50-8.49	Like Very Much	LVM
9	8.50-9.00	Like extremely	LE

(*Hedonic Scale by Peryam and Pilgrim, 1957*)

F. Acceptability Composite Index

Acceptability composite index is a procedure to follow and to determine the general acceptability of the product by ranking each treatment. The percentage in each criterion was computed through receiving the panels' recommended allotted percentage. The ACI will be the average percentage of each criterion among treatment.

G. Statistical Analyses

The weighted means of each treatment was calculated using Statistica Software version 7.0. Acceptability in terms of appearance, aroma, taste and texture was analyzed using the One-way Analysis of Variance (ANOVA) at $p<0.05$ level of significance. Tukey Honestly Significant Difference (HSD) was used in the comparison of treatment means.

III. RESULTS AND DISCUSSION

A. Quality Attributes and Acceptability of Bottled Spanish-Style Rice eel with Natural Flavorings

Sensory characteristics of Bottled Spanish-style rice eel with natural flavorings were carried out using 9-point hedonic scale.

Tables 3 to 6 show the mean score of the four different treatments from sensory evaluation of the different quality attributes (appearance, texture, aroma and taste).

➤ *Appearance Acceptability*

The average mean score of bottled Spanish-style rice eel with natural flavorings in terms of appearance was shown in Table 3. T_1 (control) obtained the highest mean score of 7.4

followed by T_2 (Pandan leaves) with 7.38, T_4 (Guava leaves) with 7.32 and T_3 (lemon grass) obtained the lowest mean of 6.80. Furthermore, all treatments were described as "Like Moderately" LM by the panelists. For the ANOVA, results showed that Treatment 3 was significantly lower from the other treatments in terms of appearance. However, no significant difference was observed between Treatment 1, Treatment 2 and Treatment

Table 3. Appearance Acceptability of Bottled Spanish-style Rice Eel based on Hedonic Scale

Treatment	Description of the Treatment	Mean Hedonic of Appearance	Interpretation
1	Bottled Rice Eel with Bayleaf (control)	7.4[a]	LM
2	Bottled Rice Eel with dried pandan leaves	7.38[a]	LM
3	Bottled Rice with dried lemon grass leaves	6.80[b]	LM
4	Bottled Rice Eel with dried guava leaves	7.32[a]	LM

Note: Means with different superscript letters represent significant difference between groups at $p<0.05$.

➢ *Texture Acceptability*

Based on the result, Table 4 shows the average mean score of bottled Spanish-style rice eel with natural flavorings in terms of texture wherein T_2 (Pandan leaves) obtained the highest mean score of 7.58 characterized as "Like Very Much" LVM followed by T_1 (control) with 7.46, T_4 (Guava leaves) with 7.42 and T_3 (lemon grass) which has the lowest mean of 6.84 characterized as "Like Moderately" LM. Statistical analysis showed that Treatment 3 is significantly lower among treatments. However, no significant difference was observed between Treatment 1, Treatment 2, and Treatment 4.

Table 4. Texture Acceptability of Bottled Spanish-style Rice Eel based on Hedonic Scale

Treatment	Description of the Treatment	Mean Hedonic of Texture	Interpretation
1	Bottled Rice Eel with Bayleaf (control)	7.46[a]	LM
2	Bottled Rice Eel with dried pandan leaves	7.58[a]	LVM
3	Bottled Rice Eel with dried lemon grass leaves	6.84[b]	LM
4	Bottled Rice Eel with dried guava leaves	7.42[a]	LM

Note: Means with different superscript letters represent significant difference between groups at $p<0.05$.

➢ *Aroma Acceptability*

In terms of aroma (Table 5), T_2 (Pandan leaves) obtained the highest mean score of 7.64 followed by T_1 (Control) with 7.50, T_4 (Guava leaves) with 7.34 and T_3 (lemon grass) obtained the lowest mean score of 6.72. Based on the mean scores, T_2 (pandan) and T_1 (control) were described as "Like Very Much" LVM while T_4 (guava) and T_3 (lemon grass) were described as "Like Moderately" LM. Statistical analysis showed that Treatment 3 is significantly lower among treatments. However, no significant difference was observed between Treatment 1, Treatment 2 and Treatment 4.

Table 5. Aroma Acceptability of Bottled Spanish-style Rice Eel based on Hedonic Scale

Treatment	Description of the Treatment	Mean Hedonic of Aroma	Interpretation
1	Bottled Rice Eel with Bayleaf (control)	7.50[a]	LVM
2	Bottled Rice Eel with dried pandan leaves	7.64[a]	LVM
3	Bottled Rice Eel with dried lemon grass leaves	6.72[b]	LM
4	Bottled Rice Eel with dried guava leaves	7.34[a]	LM

Note: Means with different superscript letters represent significant difference between groups at $p<0.05$.

➢ *Taste Acceptability*

In terms of taste (Table 6), T_1 (control) has the highest mean score of 7.52 characterized as "Like Very Much" LVM followed by T_2 (pandan) with 7.46, T_4 (guava) with 7.28 and the least was T_3 (lemon grass) with 6.46. T_3 (lemon grass) was described as "Like Slightly" LS while Treatments 2 and 4 were described as "Like Moderately" LM in terms of taste. Statistical analysis showed that Treatment 3 is significantly lower among treatments. However, no significant difference was observed between Treatment 1, Treatment 2 and Treatment 4.

Table 6. Taste Acceptability of Bottled Spanish-style Rice Eel based on Hedonic Scale

Treatment	Description of the Treatment	Mean Hedonic of Taste	Interpretation
1	Bottled Rice Eel with Bayleaf (control)	7.52[a]	LVM
2	Bottled Rice Eel with dried pandan leaves	7.46[a]	LM
3	Bottled Rice Eel with dried lemon grass leaves	6.46[b]	LS
4	Bottled Rice Eel with dried guava leaves	7.28[a]	LM

Note: Means with different superscript letters represent significant difference between groups at $p<0.05$.

B. Acceptability Composite Index

The general acceptability of the product was determined using the acceptability composite index (ACI). Table 8 shows the mean acceptability of each treatment based on the score sheets rated by fifty (50) panelist.

T2 (with pandan leaves) obtained the highest ACI of 7.51 followed by T1 (control) with 7.48, T4 (with dried guava leaves) with 7.34 and T3 (with lemon grass leaves) obtained the lowest ACI of 6.7.

Table 8. Acceptability Composite Index (ACI) of Bottled Spanish-Style Rice Eel with Natural Flavorings

Treatments*	Appearance 23.35%	Texture 23.58%	Aroma 24.2%	Taste 28.87%	Total ACI	Rank
Treatment 1	1.73	1.76	1.82	2.17	7.48 LM	2
Treatment 2	1.72	1.79	1.85	2.15	7.51 LVM	1
Treatment 3	1.59	1.61	1.63	1.87	6.7 LM	4
Treatment 4	1.71	1.75	1.78	2.10	7.34 LM	3

T_1-Control T_2-Pandan T_3-Lemon grass T_4-Guava

Based on the result presented, Treatment 3 or the Bottled Spanish-style Rice Eel with lemongrass is significantly lower among treatments in terms of appearance, texture, aroma, and taste. However, Treatment 1, 2 and 4 were statistically found not significant in terms of appearance, texture, aroma, and taste which means that the dried pandan and guava leaves are comparable with the bay leaf currently used in making the commercial bottled Spanish-style sardine and bangus. This was further validated using Tukey HSD comparison test. Based on ACI, Bottled Spanish-style Rice Eel with pandan rated as rank 1 followed by the control as rank 2, Bottled Spanish-style Rice Eel with guava as rank 3 and the least is the Bottled Spanish-style Rice Eel with lemongrass as rank 4. It was also noted in the results that the texture and aroma of Bottled Spanish-style Rice Eel with pandan got the highest acceptable rating among the treatments while appearance and taste had the highest acceptability in Control.

Pandan and guava leaves as flavoring in bottled Spanish-style rice eel are preferred by the panelist. The result of the present study showed that lemongrass is less preferred by the panelist which was described as moderately unlike in the study of Reyes, 2019 which was described as like very much.

In the study conducted by Reyes and Bulan, 2017 on bottled flying fish in spanish style with organic plants as natural flavor enhancer such as oregano (*Oreganum vulgare)*, lemongrass and turmeric (C*urcuma longa)* wherein bottled flying fish without flavoring and with lemongrass received

the highest acceptability over other treatment and both are not comparable with each other.

The Acceptability composite index was used to determine the general acceptability of the product by ranking each treatment. The percentage in each criterion was computed through receiving the panels' recommended allotted percentage. The given percentage in each criterion is the following: Appearance 23.35%, Texture 23.58%, Aroma 24.2%, and Taste 28.87%.

Bottled Spanish style rice eel with pandan leaves rated as the highest ACI of 7.51, the result may be due to the sweet and delightful flavor of pandan leaves, which is well-known as a source of natural flavoring commonly used in culinary arts such as food coloring, flavor-enhancing and aromatic flavor into the dishes for its fragrant leaves. This characteristic of pandan makes the respondents rated the pandan higher than the other natural flavorings used in this study.

In South-East Asia, guava leaf has been used as a conventional spice in fermented meat processing (Tran et al., 2020). The guava leaves possess high antioxidant and antibacterial properties which makes it a potential natural preservative to extend the shelf-life of food (GFAR Blog, 2016).

On the other hand, bottled Spanish-style rice eel with lemongrass leaves recorded the lowest ACI. This was due to the intense lemony fragrance of lemongrass. Lemongrass is

known for its smoky, sweet, herbaceous, and lemony fragrance. It is used extensively in Thai cuisine in both fresh and dried forms in dishes including soup, grilled chicken, and curries. It adds a citrus taste to the food (Farkhanda *et al.,* 2013).

IV. CONCLUSION

The present study reveals that Bottled Spanish-Style Rice Eel with dried pandan leaves got the highest acceptable rating in terms of texture and aroma characterized as "Like Very Much". Moreover, it is also ranked 1 with a mean acceptability of 7.51 based on the Acceptability Composite Index while the control had the highest acceptability in terms of taste and appearance. Value-adding and processing rice eel may increase its consumer's acceptability and its potential to increase the income of farmers and fisherfolk vis a vis minimizing the negative impact of its inavasiveness. However, a separate study on the waste utilization of rice eel is highly recommended and a storage study of the developed product must be done to determine the maximum storage of the product to include physico-chemical changes and detailed sensory analysis.

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