Optimization of Jackfruit (*Artocarpus heterophyllus* Lam) rags and salt levels in the development of corned milkfish (*Chanos chanos*)

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Abstract. Corning is a preservation method that involves soaking the raw material with salt to add flavor and extend shelf life. Milkfish, which is abundant in the Philippines, was developed into a corned product incorporated with a by-product of jackfruit which is the rags. The levels of salt and jackfruit rags were optimized using a 3 by 3 full factorial design with three (3) levels of jackfruit rags (15 g, 20 g, and 25 g) and salt (7.5 g, 15 g and 22.5 g). The result of sensory evaluation revealed that color, odor, taste, and general acceptability were significantly affected by salt, while texture and general acceptability were significantly affected by varying levels of jackfruit rags. The acceptability for all the attributes was moving towards high jackfruit rags and middle level of salt. Treatment 8 consisting of 15 grams salt and 25 grams jackfruit rags with a total cost of 1.74 USD/250 grams fell on the optimum region and was preferred by 55% of the consumers over the commercial brand. This formulation is light brown, moderately salty, slightly tender, has a well-blended fishy odor & jackfruit, liked very much by the panelist, and has a pH of 5.79.

1. Introduction

Milkfish (*Chanos chanos*), locally known as Bangus in the Philippines, is the most important farmed species in the country. It provides a nutritious source of protein to millions of people in the Indo-Pacific region at a reasonable price [1]. Its average annual production since 1990 is reported to be 206 850 metric tons, with an annual per capita consumption of 7.5% of the total fish consumed by every Filipino [2].

Milkfish are often processed and preserved through drying, smoking, fermentation, and canning. The most popular value-added milkfish product is the “boneless bangus” or deboned milkfish, which are either sold as fresh-chilled, smoked, or marinated. There are also other value-added products produced, such as fishball, lumpia, kikiham, and embutido [1], meatballs [3], and pandesal bread [4]. With the growing population and the changing consumption patterns and need for convenience foods, there is a need to keep up with them through the continuous development of value-added products with enhanced acceptability, especially to younger generations.

Corned foods are preserved products in canned form [5], which is part of the Philippines' meal and is usually made up of beef. Corned means using large, grained rock salt which looks like a wheat kernel known as corn of salt [6]. Corned products have an extended shelf life brought by the hurdle processes employed. It involves curing with salt and nitrite, which possesses antimicrobial activities. Following this are washing, stirring with spices and emulsion, steaming, packaging, and sterilization.
Corned beef and tuna are common products that are commercially available in the market. It contains a considerable amount of protein but is lacking in carbohydrate content. Additionally, using pure meat can be costly. To address this, and to further add variation to the corned beef while also producing sustainable meat product, incorporating fruit byproducts can be used as an ingredient. The use of fruit and fruit byproducts as meat extenders however are yet to be explored with only a few literatures available [7]. Extenders are usually added to the formulation to improve textural properties [8] and reduce cost formulation [9]. It also aims to partially replace meat due to concerns in production sustainability. There have been continued exploration on the use of extenders from different sources to help address one of the main pillars of the Sustainable Development goals which is the sustainable production. Reported meat extenders are pulses, cereals, tubers, fruits, mushroom and insects [7].

Jackfruit rags, a latex-like filaments found outside the jackfruit bulb, is a by-product in jackfruit processing. It comprises 25.3% of the fruit weight [10] that has 19.77% carbohydrates [11], cellulose (20.5%), protein (0.3-0.6%), reduced sugar (1.76-4.50%), total sugar (1.3-6.8%), pectin (1.10-1.63%) [10]. This can therefore provide additional benefits to the corned milkfish. In addition, its utilization can help in addressing wastage for sustainability purposes. This too can add variation to corned tuna products wherein usage of jackfruit rags is not yet available.

In the development of corned products, the salt level needs to be considered so that it will not negatively affect the product's sensory properties. Salt helps improve the flavor by influencing some enzyme activity responsible for flavor development [12], aids in development of taste, texture and aroma [13] and in protecting from microorganisms [14], however, too much salt can negatively influence the product's taste. Whereas too little may not provide a preservative effect. Salt has been widely used and is a known ingredient in preserving meat products [15]. On the other hand, the level of jackfruit rags to be incorporated in the corned product also needs to be optimized such that the overall quality will not be compensated. Hence, this research study's objective is to optimize the levels of salt and jackfruit rags in the production of corned milkfish through sensory evaluation. The total cost of production is also used in obtaining the optimum formulation of the product. Further, to test the market potential of the optimum formulation, a consumer preference test was also undertaken.

2. Materials and Methods

2.1. Sources and selection of raw materials
The boneless milkfish (Bangus) was purchased at the BSK (Bureau of Fisheries and Aquatic Resources Cooperative), and jackfruit rags were bought at Panabo City, Davao del Norte local market. Other ingredients were purchased at the Gaisano Mall, Panabo City. All ingredients were fresh and clean and were from reliable sources to achieve good quality for the product. The glass bottles as packaging material were also bought at Panabo City, Davao del Norte.

2.2. Experimental design
A 3 by 3 full factorial design was used with nine treatments for experimental combinations. Three levels of jackfruit rags (15 g, 20 g, and 25 g) and salt (7.5 g, 15 g, and 22.5 g) were considered in the study. The treatment combination is shown in table 1. Variable levels were based on the preliminary study that was conducted.

| Treatment | Jackfruit rags (g) | Salt (g) |
|-----------|-------------------|---------|
| T1        | 15                | 7.5     |
| T2        | 15                | 15      |
| T3        | 15                | 22.5    |
| T4        | 20                | 7.5     |
| T5        | 20                | 15      |
| T6        | 20                | 22.5    |
2.3. Preparation of raw materials

2.3.1. Jackfruit rags. Jackfruit rags were washed with tap water to remove adhering dirt. After which, it was drained through a strainer at room temperature. The rags were cut up uniformly, approximately 1 inch, similar to the size of corned milkfish. To remove any adhering flavor from the jackfruit rags, it was soaked in 50% brine solution for at least 3 hours. Then, the rags were precooked in boiling water for 2 minutes. It was then drained and incorporated in the corned milkfish.

2.3.2. Milkfish. Deboned milkfish were washed with tap water to remove adhering dirt. After which, it was sliced into 1-inch cubes and precooked in boiling water for 5 minutes. Then, the skin was removed from the flesh. Curing of corned milkfish followed which was patterned from the procedure of Industrial Technology Development Institute- Department of Science and Technology [16].

2.3.3. Curing of Milkfish. Curing ingredients such as sugar (2%), salt (3%, 6%, 9%), curing salt (0.5%), vitamin C (0.1%), monosodium glutamate (1%), and bay leaves were mixed with the cubed milkfish. It was cured in the refrigerator for 3-4 days. Salt levels used varied based on table 1. Other ingredient levels were based on preliminary trials. The basis for the percentage was the deboned milkfish.

2.4. Processing of corned milkfish with jackfruit rags
Milkfish that was cured was washed with water and precooked with 1/3 water from its volume for 5 minutes. The meat was then drained and cooled. After which, it was flaked manually using a fork. The jackfruit rags (6%, 8%, 10%), flaked milkfish, and other spices (0.3% chili powder, and 0.2% powdered pepper) were mixed. It was then packed in sterilized glass bottles containing 90 mL of corn oil, leaving ¼ inch headspace. The bottles were slightly sealed and undergone exhausting through boiling at 82°C for 15 minutes to eliminate air. After which, the bottles were fully and tightly sealed and autoclaved at 121°C at 15 lbs pressure for 15 minutes. It was then chilled at room temperature.

2.5. Sensory profiling
Conventional sensory profiling was done to determine the characteristics describing the color, odor, taste, and texture of the corned milkfish with jackfruit rags. Forty-eight laboratory panelists from the Bachelor of Science in Food Technology who have a background on sensory evaluation was considered. Each of them was given an orientation on how to evaluate the product. They were provided with randomly coded six different treatments from table 1. Following [17], panelists made descriptive terms for each sensory attributes based on their perceptions. After which, a group discussion to come up with a descriptive term for each attributes containing quantified values indicating its intensity was done.

2.6. Sensory evaluation
Sensory acceptability using 9-point hedonic scale, in combination with descriptive scoring developed during conventional profiling were determined by forty-eight laboratory panelists from the Bachelor of Science in Food Technology students. Sensory attributes evaluated were color, odor, texture, taste, and general acceptability. An Incomplete Block Design (IBD) was used during the presentation of the treatments. The set plan of t=9, k=6, r=8, b=12, E=.94, Type II where t refers to the number of treatments, k the number of samples presented to the panelist, r to the number of replications based on
the plan IBD, b the number of blocks and E the efficiency factor [18]. The plan was repeated four times to get 32 evaluations per treatment which required 48 panelists. Another set of the evaluation was carried out for replication two following the same procedure as stated above. Along with the samples, panelists were also given water that served as palate cleanser.

2.7. pH determination
The pH of the corned milkfish with jackfruit rags was determined using a benchtop pH meter. The sample was blended to create a paste. A maximum of 20 mL of water was added per 100 grams of the sample. The pH electrode was dipped into the paste, and the reading was obtained as soon as the reading stabilized.

2.8. Data analysis
The result from the descriptive scoring was analyzed using frequency to determine the description of the product’s sensory attributes. Acceptability results were analysed using Response Surface Regression (RSREG) analysis using STATISTICA software. A response surface plot was generated to visualize the effects of the factor variables on the responses that were studied.

2.9. Optimization
Contour plots generated for all attributes evaluated were superimposed, and a cut-off acceptability score within the experimental range was set to establish the region above which the product is considered optimum.

2.10. Consumer’s paired preference test
To verify the optimum formulation and determine it has a market potential, a consumer paired preference test was undertaken. One hundred random consumers who are frequent eaters of milkfish or fish were chosen as evaluators. They were asked to choose which of the two formulations they preferred [19]. The result was analysed using chi-square test.

2.11. Cost of production
The total relative cost in the production of corned milkfish with jackfruit rags was calculated by adding the prevailing market price of all the ingredients depending on the amount used. The contour plot for the production cost was included in the determination of the optimum region.

3. Results and Discussion

3.1. Color
The color is the first attribute of the product that catches the attention of the consumer. The color description of the different treatments of corned milkfish is shown in Table 3. Pinkish light brown is observed for treatments with low jackfruit rags (15 g to 20 g), whereas light brown color for treatments having the highest levels of jackfruit rags (25 g) regardless of the salt levels. The pinkish color observed is due to the curing salt added, which is known for developing a characteristic pink color [20]. In contrast, the light brown color is from the cooked milkfish and jackfruit rags. The acceptability of the product ranged from 7.60 to 8.04, with an overall response mean of 7.90 (Table 3). This value falls on the like very much category on the 9-point Hedonic scale. Table 2 shows that salt significantly influenced the color acceptability of the corned milkfish linearly and quadratically. This means that increasing the salt levels increases the acceptability of the product but only up to a certain level because further increases can lead to a decline in its acceptability. This is depicted in figure 1 with the bending of the response surface plot. High acceptability is leaning towards increasing jackfruit levels and middle salt levels. Other studies have also shown the direct effect of salt concentration on fish color [21].
Table 2. Parameter estimates for the color acceptability of the corned milkfish with jackfruit rags (g)

| Parameter | Color          | Odor            | Texture         | Taste           | General acceptability |
|-----------|----------------|-----------------|-----------------|-----------------|------------------------|
| Jackfruit Rags (g) | 0.042014ns | 0.144097ns | 0.281250* | 0.141319ns | 0.467014* |
| Jackfruit Rags (g)^2 | -0.000139ns | -0.002222ns | -0.005486* | -0.002917ns | -0.007847* |
| Salt (g) | 0.098380* | 0.089583* | 0.020833 | 0.074537ns | 0.229167* |
| Salt (g)^2 | -0.002191* | -0.001821ns | -0.000247ns | -0.002407* | -0.003025* |
| Jackfruit Rags (g)*Salt (g) | -0.001319ns | -0.001875ns | -0.001736ns | -0.001042ns | -0.007083* |

ns: Not significant
*Significant

Table 3. Descriptive score and acceptability of the color of corned milkfish with jackfruit rags (g)

| Treatment | Salt (g) | Jackfruit rags (g) | Color Description | Acceptability | Odor Description | Acceptability |
|-----------|----------|--------------------|-------------------|---------------|-----------------|---------------|
| 1         | 7.5      | 15                 | Pinkish light brown | 7.60          | Very perceptible fishy odor & no Jackfruit odor | 7.64          |
| 2         | 15       | 15                 | Pinkish light brown | 7.98          | Perceptible fishy odor with a hint of jackfruit | 7.83          |
| 3         | 22.5     | 15                 | Pinkish light brown | 7.91          | Perceptible fishy odor with a hint of jackfruit | 7.76          |
| 4         | 7.5      | 20                 | Pinkish light brown | 7.94          | Well blended fishy odor & jackfruit | 7.97          |
| 5         | 15       | 20                 | Pinkish light brown | 8.00          | Well blended fishy odor & jackfruit | 7.95          |
| 6         | 22.5     | 20                 | Golden Brown       | 7.81          | Perceptible fishy odor with a hint of jackfruit | 7.89          |
| 7         | 7.5      | 25                 | Light brown        | 7.94          | Well blended fishy odor & jackfruit | 8.04          |
| 8         | 15       | 25                 | Light brown        | 8.01          | Well blended fishy odor & jackfruit | 8.11          |
| 9         | 22.5     | 25                 | Light brown        | 8.04          | Well blended fishy odor & jackfruit | 7.89          |
| Mean      |          |                    |                   | 7.91          |                  | 7.90          |

3.2. Odor

The odor of corned milkfish was dominated by the milkfish and jackfruit rags. It was observed that as the jackfruit rags level increased, the intensity of fishy odor is somehow reduced. Table 3 shows the odor description, which ranged from “slight fishy odor with a trace of jackfruit” to “well blended fishy odor & jackfruit. Despite the detectable fishy aroma, the acceptability of the product was not rejected. It has an acceptability ranging from 7.64 to 8.11, which falls on the like very much category on the 9-point Hedonic scale. Figure 2 shows that the odor acceptability of the product is moving towards high levels of jackfruit rags and medium salt levels. Based on the parameter estimates in Table 2, only salt significantly affects the odor acceptability of the product linearly. This means that increasing its level increases the odor acceptability of the product. Salt has been shown to also affect moderately and largely to the odor of salted fish [21].
3.3. Texture

The textural quality of the product is based on its tenderness. The description of the product varied from “just right” to “slightly tender” (table 4). Generally, low jackfruit rags have just the right tenderness, whereas adding high levels reduces its tenderness. This can be due to its natural rubbery and bouncy texture that can be felt by the panelists when high levels are incorporated in the corned milkfish. Despite this, the product had an acceptability rating ranging from 7.81 to 8.37 which falls on the like very much category on the 9-point Hedonic scale. Based on the parameter estimates in Table 2, only jackfruit rags significantly affected the texture acceptability of the product linearly and quadratically. Despite its rubbery texture, the response surface plot in figure 3 shows that using it at higher levels leads to higher acceptability. This means that its addition in corned milkfish is effective as it does not cause any rejection from the panelist.

Figure 1. Response Surface Plot for the color acceptability of corned milkfish with jackfruit rags (g)

Figure 2. Response surface plot for the odor acceptability of Corned milkfish with jackfruit rags (g)
Figure 3. Response surface plot for the texture acceptability of Corned milkfish with jackfruit rags (g)

Table 4. Description and acceptability of the texture, taste, and general acceptability of corned milkfish with jackfruit rags (g)

| Treatment | Salt (g) | Jackfruit rags (g) | Texture | Acceptability | Description | Acceptability | Taste | Acceptability | General Acceptability |
|-----------|---------|--------------------|---------|---------------|-------------|---------------|-------|---------------|-----------------------|
| 1         | 7.5     | 15                 | Just right | 7.81 | Slightly Salty | 7.91 | Moderately Salty | 7.20 |
| 2         | 15      | 15                 | Just right | 7.90 | Salty | 7.95 | Very Salty | 8.02 |
| 3         | 22.5    | 15                 | Just right | 7.89 | Moderately Salty | 7.84 | Salty | 7.85 |
| 4         | 7.5     | 20                 | Slightly tender | 8.24 | Salty | 8.22 | Salty | 8.28 |
| 5         | 15      | 20                 | Slightly tender | 8.24 | Moderately Salty | 8.17 | Very Salty | 8.20 |
| 6         | 22.5    | 20                 | Just right | 8.06 | Very Salty | 7.67 | Very Salty | 7.89 |
| 7         | 7.5     | 25                 | Slightly tender | 8.38 | Salty | 8.06 | Salty | 8.40 |
| 8         | 15      | 25                 | Slightly tender | 8.10 | Moderately Salty | 8.06 | Salty | 8.09 |
| 9         | 22.5    | 25                 | Just right | 8.19 | Moderately Salty | 7.84 | Moderately Salty | 7.99 |
| Mean      |         |                    |          | 8.09 |         | 7.10 |         | 7.99 |

3.4. Taste
The taste of the product varied from slightly salty to very salty considering that varying salt levels were used during the curing process of milkfish. The saltiness’ acceptability ranged from 7.67 to 8.22, which falls on the like very much category in the 9-point hedonic scale. Parameter estimate in table 2 shows that it significantly affected the taste acceptability of the product quadratically, given that it is the main contributor to the salty taste of the corned milkfish. The surface plot (figure 4) shows that increasing acceptability is leaning towards medium to low salt levels and jackfruit rags. Using high
Salt levels lead to a significant decrease in its acceptability, as depicted by the bending of the graph and the negative parameter estimate value in Table 2. This can be because high salt level is associated as unhealthy and can be too much for their taste buds considering that it was eaten solely without its usual pair of rice. Additionally, high sodium is reported to be positively correlated to off-flavor in corned beef [6] and frankfurters [22,23]. Literatures however, noted complicated relationship between liking and saltiness as affective response to varying salt concentration may be food specific [24].

3.5. General acceptability
The general acceptability of the different treatments ranged from 7.20 to 8.40, which falls on the “like moderately” and “like very much” category in the 9-point hedonic scale (Table 4). The lowest mean general acceptability (7.19) is obtained from corned milkfish with the lowest levels of salt (7.5 g) and jackfruit rags (15 g). The highest mean general acceptability is from the lowest salt (7.5 g) and highest jackfruit rags (25 g) levels. Considering the high acceptability of using high jackfruit rags, it denotes that the addition of jackfruit rags as an extender is practical as it does not compensate for the quality of the corned milkfish.

Response surface plot in Figure 5 shows the same trend for the rest of the attributes in which higher acceptability is obtained using high levels of jackfruit rags and low to medium salt levels. Based on the parameter estimates in Table 2, both the salt and jackfruit rags significantly affected the general acceptability of the product in terms of linear, quadratic, and interaction. This means that changing their levels can cause a marked decrease or increase in the general acceptability of the corned milkfish.

![Figure 4. Response surface plot for the taste acceptability of corned milkfish with jackfruit rags (g)](image-url)
Figure 5. Response surface plot for the General acceptability of Corned milkfish with jackfruit rags (g)

3.6. pH
The pH of the product ranged from 5.33 to 5.95 (Table 5) indicating that it is a low acidic product [25]. This pH is attributed to the fish which is reported to be within 6-6.5 after post mortem [26, 27] and the jackfruit rags having a pH value ranging from 5.61 to 6.45 during the fully ripen stage [28]. Based on table 6, only the salt levels have a significant effect linearly to the pH of the product, whereas no significant effect for the different levels of jackfruit rags. Increasing salt levels are shown to increase the pH value or decrease its acidity based on the response surface plot. This trend is however contrary to reported literatures, wherein increase in salt content in sausages caused a minor shift to lower pH values [29].

Table 5. Mean pH values of corned milkfish with jackfruit rags (g)

| Treatment | Salt (g) | Jackfruit rags (g) | pH     |
|-----------|----------|-------------------|--------|
| 1         | 7.5      | 15                | 5.33   |
| 2         | 15       | 15                | 5.95   |
| 3         | 22.5     | 15                | 5.82   |
| 4         | 7.5      | 20                | 5.84   |
| 5         | 15       | 20                | 5.85   |
| 6         | 22.5     | 20                | 5.66   |
| 7         | 7.5      | 25                | 5.80   |
| 8         | 15       | 25                | 5.79   |
| 9         | 22.5     | 25                | 5.81   |

Table 6. Parameter estimates of the pH of corned milkfish with jackfruit rags (g)

| Parameter                          | Parameter estimates |
|------------------------------------|---------------------|
| Jackfruit Rags (g)                 | 0.106833ns          |
| Jackfruit Rags (g)^2               | -0.001213ns         |
| Salt (g)                           | 0.153126*           |
| Salt (g)^2                         | -0.002726ns         |
| Jackfruit Rags (g)*Salt (g)        | -0.003211ns         |

ns Not significant, *Significant
3.7. Cost of production

The production cost is the sum of the expenses incurred during the production of the product. The total cost for producing 250 g of bottled corned milkfish is shown in table 7. The cost for preparing 250 g corned milkfish ranges from Php 85.86 to Php 91.19 or 1.70 to 1.81 USD. The price is higher than commercial products at retail prices because glass bottles are used, and commercial products are mass produced. The cost was used as a factor for obtaining the optimum formulation. The response surface plot of the price is shown in Figure 7, which shows that using high levels of jackfruit rags and salt provides a lower cost as this combination also produces a high yield as compared to the rest of the treatment combination. This indicates that the addition of jackfruit rags will make it cheaper without compromising the quality of the corned milkfish, evident from the higher acceptability at high jackfruit rags.

Table 7. Summary of cost incurred in the production of corned milkfish with jackfruit rags (g)

| Treatment | Salt (g) | Jackfruit rags (g) | Cost (PHP)/ 250 g | Cost (USD)/ 250 g |
|-----------|----------|--------------------|------------------|------------------|
| 1         | 7.5      | 15                 | 91.19            | 1.81             |
| 2         | 15       | 15                 | 89.45            | 1.78             |
| 3         | 22.5     | 15                 | 87.77            | 1.74             |
| 4         | 7.5      | 20                 | 90.14            | 1.79             |
| 5         | 15       | 20                 | 88.44            | 1.76             |
| 6         | 22.5     | 20                 | 86.80            | 1.72             |
| 7         | 7.5      | 25                 | 89.11            | 1.77             |
| 8         | 15       | 25                 | 87.46            | 1.74             |
| 9         | 22.5     | 25                 | 85.86            | 1.70             |

Php to USD conversion rate ≅ 0.02
Figure 7. Response surface plot for the break-even price of corned milkfish with jackfruit rags (g)

3.8. Determination of optimum region

Optimum formulation refers to the best possible and most favorable formulation for a food product as affected by several attributes. All the sensory attributes were superimposed, and an acceptability rating of greater than or equal to 8 was set as the cut-off score. The shaded region in Figure 8 shows the optimum region with \( \pm 21.2-25 \) g of jackfruit rags and middle level of salt at \( \pm 15.4 \) to 18 g. It was cut off to a production cost of \( \pm 87.5 \) PHP or \( \pm 1.74 \) USD. The optimum A is bounded by the cost and texture, and optimum B by texture and taste. Among the treatments that were produced, treatment 8 with 15 g of salt and 25 g of jackfruit rags fell on the optimum region. The corresponding jackfruit rags and salt combination of the obtained optimum is presented in table 8.

The acceptability in all the attributes was predicted using the general equation shown in Table 9. Table 8 shows that treatment 8 has the highest acceptability in all the attributes among the three. Although it is expected that all combinations falling inside the optimum region are not significantly different from each other, treatment eight was used for the consumer preference test.

Table 8. Predicted Values of the acceptability rating for the two optimum points

| Optimum | Jackfruit Rags (g) | Salt (g) | Color | Odor | Taste | Texture | General Acceptability | Cost per 250g (Php) |
|---------|-------------------|---------|-------|------|-------|---------|----------------------|---------------------|
| A       | 21.4              | 18.2    | 8.01  | 8.00 | 8.18  | 8.02    | 8.21                 | 87.47               |
| B       | 22.2              | 18.8    | 8.01  | 7.99 | 8.18  | 7.99    | 8.18                 | 87.18               |
| T8      | 25                | 15      | 8.07  | 8.08 | 8.21  | 8.07    | 8.27                 | 87.46               |

Table 9. Model equation and predicted values for the acceptability of corned milkfish with jackfruit rags (g)

| Attributes | Model equation                                      |
|------------|-----------------------------------------------------|
| Color      | \( 6.6273 + 0.042x + 0.0984y - 0.0001x^2 - 0.0003xy - 0.0022y^2 \) |
| Odor       | \( 5.6377 + 0.1441x + 0.0896y - 0.0022x^2 - 0.0019xy - 0.0018y^2 \) |
| Texture    | \( 4.8935 + 0.2812x + 0.0208y - 0.0055x^2 - 0.0017xy + 0.0002y^2 \) |
| Taste      | \( 6.184 + 0.1413x + 0.0745y - 0.0029x^2 - 0.001x^3 - 0.0024y^2 \) |
1.4016 + 0.467x + 0.2292y - 0.0078x^2 - 0.0071xy - 0.003y^2

x is the level of Jackfruit rags (g)
y is the level of salt (g)

**Figure 8.** Superimposed plot for the acceptability of the corned milkfish with jackfruit rags with an acceptability value of ≥8

3.9. Consumer preference test
Treatment 8, which is the optimum formulation, and a commercial corned tuna as control were subjected to consumer evaluation. This was done for verification and check the marketing potential of the corned milkfish with jackfruit rags. The two samples were labelled with random three-digit numbers and were placed in uniform containers. The result showed a high preference in all age brackets for the optimum formulation over the commercial brand. However, there is no significant difference. Most of the consumers preferred it due to the unique flavor as contributed by the jackfruit rags. The result implies that the formulated corned milkfish has market potential and can be produced commercially.

| Age        | Corned milkfish | Commercial |
|------------|----------------|------------|
| 18 to 25ns | 27             | 23         |
| 26 abovens | 28             | 22         |
| Totalns    | 55             | 45         |

*ns no significance (p>0.05)

4. Conclusions
Acceptability in terms of color, odor, taste, and general acceptability were significantly affected by the varying salt levels, while texture and general acceptability were affected by the different levels of jackfruit rags. The optimum levels of jackfruit rags and salt were found to be at ≈21.2-25 grams and ≈15.4 to 18 grams, respectively. Treatment 8 with 25 g of jackfruit rags and 15 g of salt fell within the optimum region and was subjected to a consumer preference test. Fifty-five consumers preferred it out of 100. The cost in producing the optimum was Php 87.46 or 1.74 USD per 250 g. This
formulation is light brown, moderately salty, slightly tender, has a well-blended fishy odor & jackfruit, and is liked very much by the panelist. It has a pH value of 5.79.

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