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# Consumer Preferences: Sensory Attributes of Sea Urchin Chips

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## Abstract

Many new variations of products and ideas have been emerging in the business world lately, especially in the food market. One should consider the consumers' purchasing choices, which are influenced by sensory attributes. This study ought to assess the influence of consumers' attributes towards the acceptability of a new variation of Chips, mainly if it is made from Sea Urchins. Sea urchin is appreciated worldwide for the taste of their gonads. Thus, sensory analysis, particularly product characterization, was also used to measure, analyze and interpret the reaction to the characteristics of the chips. In terms of product characteristics, under the most favored product treatment, "taste" appeared as the most essential product attribute of sea urchin chips followed by "flavor," "texture," "odor," and lastly "color". Overall, among the four different treatments used in this study, treatment 2 turned out to be the most favorable.

## Keywords
Customers Attributes, Chips, Sea Urchin, Customer Preferences, Sensory Analysis

## 1. Introduction
Creating a product on the market might present an unusual number of difficulties for business owners. This position entails developing a product that can be sold on the market without putting the business in the loss column (Zaichenko 2021). This study proposes a new variation of chips on the market. Thus, the following are the problems seen by the researchers: 1.) The acceptance of this new variation of the product by the target market; 2.) Consumers' evaluation and their sensory preference for this new variation. The researchers' desire to investigate the viability or feasibility of Sea Urchin Chips is sparked by this notion. This will show off Chips' rebranding with a new variation.

### 1.1 Objectives
This paper aims to assess the sensory preferences and acceptability of Sea Urchin Chips in the market. The respondents will then be given a chance to evaluate four different mixtures of Sea Urchin chips and a questionnaire where they can put their evaluation of each mixture. This will then help the researchers assess which mixture the consumers prefer and what sensory attributes they consider to have affected their evaluation.

## 2. Literature Review
Sea Urchin Innovation
Sea urchins' classification was appreciated worldwide for the taste of its gonads. This species can be commonly located underwater and habituated below marine life worldwide. It was highly valued for its caviar-like appearance. The edible part is represented by the reproductive system, the gonads, commonly known as pulp or eggs, which are valuable

ingredient in seafood. The commercial value of the gonads is strictly associated with their organoleptic features, which consist of maintaining their granular surface without melting. Gonads can be commercialized fresh, frozen, and sterilized after packaging in tinplate boxes and glass jars (Delafield 2017). One of the essential parts to look for when it comes to Sea Urchin was the bright yellow to orange lobes, if it was large then it has an accumulated stock of the following: sugar, amino acids, salts, a trifecta of sweet and salty, and umami (Lu 2018). Good quality sea urchin eggs should be prominent in orange or yellow, have a distinctive sweet and salty taste, and have a proper firm texture. These eggs are a highly regarded specialty in the international market (Saetra 2019). The price at which an egg is fetched is greatly influenced by its appearance, color, texture, and taste, so it is essential to understand the factors that affect egg quality. Nonetheless, different species and food vary the taste of sea urchins, just like some other edible creatures found in the ocean (Lu 2018).

Thus, nourishment can be found in nutrients. Basically, the nutrient can be defined as any absorbed or ingested molecule, organic or inorganic, that is needed for an organism's physiological functions, specifically the following: survival, growth, maintenance, and reproduction (Watts et al. 2020). Mineral nutrients are inorganic molecules that can be intake with the appropriate amount that is sufficient to satisfy the body's essential and metabolic, and or structural functions in the body. Personalized nutrition has the potential to develop human health. It is rooted that one dimension is not fit for all: in biochemistry, metabolism, genetics, and microbiota give a contribution to the difference of each observed nutrition, nutrient status, dietary patterns, timing of eating, and environmental exposures (Bush et al. 2019). There should be structured research for daily dietary nutrient requirements determination of sea urchins in different environments and life history. As of now the daily dietary nutrient for sea urchins is not yet known (Watts et al. 2020).

Sea urchin is significant in the market due to high revenue achievements in the worldwide market. Besides, it also contributes to income in countries near the sea, especially in the pacific coastal location, specifically in Malaysia (Parvezet et al. 2016). Better food quality, such as increased food safety, nutritional value, freshness, and taste, is becoming increasingly crucial to health-conscious customers. Clean-label goods, which claim to be natural and fresh while also being free of chemical ingredients, have slowly acquired popularity among consumers (Huang et al. 2018). Future technology and systemic innovation are needed for the food system's significant development. These improvements cover everything from food production to better diets and waste management (Herero et al. 2020). Sea urchin production can observe that trade is rampant across the Asian continent, which leads to exportation in Indo-Pacific countries. However, abusive harvesting implemented nowadays can decrease sea urchins' lifespan. Included in the scope of this appealing situation is the breeding, larval rearing, seed production, and culture techniques in captivity is the appropriate tool in solving within an efficient manner. (Parvezet et al. 2016). Although there were several studies about innovating seafood reflective of the demands of the consumers, there were no innovative studies on the preceding subject, particularly the sea urchin chips.

Sea Urchin also has its background and history of innovations. One study shows the innovation of Sea Urchins by extracting collagen and using it to make a skin regenerative medicine (Ferrario et al. 2020). Another innovation shows that using the extract of Sea Urchin that contains Fructose and Vitamin C that was used in the pigments for diabetes 1 and 2 (Rubilar and Cardozo 2021). Then, another study discussed how Sea Urchin waste was turned into a new eco-friendly product (Zilia et al. 2021).

Sensory Attribute

An essential component of marketing is knowing the purchasing decision of the consumer. In the agricultural sector, knowledge of consumer preferences is necessary to create products that live up to consumer expectations. Quality, cost, packaging, and marketing can affect a customer's preference for particular goods and services. Each consumer has a preference for a product; thus, sensory evaluation can be used to assess this preference (Isaskar et al. 2021). Sensory evaluation is critical in determining acceptability of new food products and preferences for various cuisines. This procedure gives significant and valuable information on the sensory quality of food products to the food-processing industries and food scientists. Traditional sensory evaluation approaches can only have qualitative assessments and cannot perform precise quantitative assessments (Vivek et al. 2020).

Sensory analysis is used to determine consumer preferences. Thus, it is essential in the food industry because it helps to improve product quality (Limba et al. 2019). When combined with other branches of science in research, development, and marketing, sensory knowledge can provide a more holistic contribution to understanding product characteristics and developing products that match customer preferences (Talavera and Chambers 2017). On the other

hand, a study by (Nguyen et al. 2019) shows that five food image attributes, namely, taste, health issues, price, presentation style, and vendor/staff, have a positive relationship with satisfaction, resulting in positive word-of-mouth promotion and return to tourism.

## 3. Methods

This study used primary data gathering based on the observation of the 30 respondents since the evaluation of each recipe's attributes require expertise of the panelist and the experts' population size is relatively small, then the researchers utilize non-probability sampling method such as purposive sampling. Using the respondents following senses; taste, touch, and sight to determine and evaluate the four different formulations of sea urchin gonads to mixture proportions undergo sensory evaluation by them in determining which is the best formulation prior their preferences in sensory attributes such as taste, texture, color, odor, and flavor. To gather the data, the researchers utilized an adaptive questionnaire using a 5-point Likert scale technique for the convenience of the panelists to describe and evaluate each formulation's sensory attributes in terms of taste, color, texture, and general acceptability. To put it another way, respondents should rate sea urchin chips in four treatments based on the five sensory factors. In other words, the scoring employs adverbial scoring. The impact of sensory attributes to formulate a recipe for sea urchin chips was estimated using sensory analysis, particularly product characterization.

## 4. Data Collection

Product characterization is an analytical method that assists in determining which characteristics distinguish well among a set of products in a sensory evaluation. All computations are based on the Analysis of Variance (ANOVA). The data table must adhere to a specific format. Each row should concern a particular treatment and, eventually, a specific session and should collect judged scores for one or more descriptions linked with the specified product. The dataset must have the following columns: one identifying the judge, one identifying the product, and eventually one identifying the session, as well as many columns as there are descriptors or attributes. as shown in Table 1.

Table 1. Data Table

| Obs | Judges | Session | Product | Color | Texture | Taste | Flavor | Odor |
|---|---|---|---|---|---|---|---|---|
| 1 | 1 | 1 | Treatment 1 | 4 | 2 | 4 | 3 | 1 |
| 2 | 1 | 1 | Treatment 2 | 4 | 3 | 5 | 4 | 3 |
| 3 | 1 | 1 | Treatment 3 | 4 | 2 | 3 | 2 | 2 |
| 4 | 1 | 1 | Treatment 4 | 4 | 4 | 4 | 4 | 4 |
| 5 | 2 | 1 | Treatment 1 | 5 | 5 | 3 | 3 | 4 |
| 6 | 2 | 1 | Treatment 2 | 5 | 5 | 5 | 5 | 5 |
| 7 | 2 | 1 | Treatment 3 | 5 | 5 | 5 | 4 | 4 |
| 8 | 2 | 1 | Treatment 4 | 5 | 5 | 3 | 3 | 4 |
| 9 | 3 | 1 | Treatment 1 | 3 | 4 | 2 | 2 | 3 |
| 10 | 3 | 1 | Treatment 2 | 3 | 4 | 5 | 5 | 3 |
| 11 | 3 | 1 | Treatment 3 | 3 | 4 | 5 | 5 | 3 |
| 12 | 3 | 1 | Treatment 4 | 4 | 5 | 5 | 5 | 3 |
| 13 | 4 | 1 | Treatment 1 | 3 | 3 | 4 | 3 | 3 |
| 14 | 4 | 1 | Treatment 2 | 4 | 4 | 4 | 4 | 3 |
| 15 | 4 | 1 | Treatment 3 | 3 | 5 | 5 | 4 | 3 |
| 16 | 4 | 1 | Treatment 4 | 3 | 4 | 3 | 3 | 3 |
| 17 | 5 | 1 | Treatment 1 | 3 | 3 | 3 | 3 | 3 |
| 18 | 5 | 1 | Treatment 2 | 4 | 5 | 5 | 4 | 4 |
| 19 | 5 | 1 | Treatment 3 | 4 | 5 | 5 | 5 | 3 |
| 20 | 5 | 1 | Treatment 4 | 2 | 4 | 3 | 3 | 3 |
| 21 | 6 | 1 | Treatment 1 | 4 | 4 | 4 | 3 | 3 |
| 22 | 6 | 1 | Treatment 2 | 4 | 4 | 4 | 5 | 3 |
| 23 | 6 | 1 | Treatment 3 | 3 | 5 | 4 | 3 | 3 |

The questionnaire was created to assess consumer preferences for Sea Urchin Chips. It was created after conducting extensive research on sensory qualities. The first part of the questionnaire asked respondents about their sociodemographic characteristics (e.g., gender, age, marital status, education level, and income). These questions were

added to see if these characteristics influenced their sea urchin sensory attributes preferences. The questions in the second half of the questionnaire were included in determining consumers' value of various sensory aspects. The last part of the questionnaire is the sensory evaluation of the respondents based on the five sensory attributes and the overall acceptance of the respondents about their preferences.

## 5. Results and Discussion

### 5.1 Numerical Results

This part depicts the results and the discussion of the sensory analysis, particularly product characterization. Since many correlations between the variables are high, or some other variables might be redundant, product characterization was conducted to determine the few underlying factors. Four different treatments were evaluated. Thus, the variables considered were color, texture, taste, flavor, and odor.

Table 2. Summary of Statistics

| Variable | Observations | Observations with missing data | Observations without missing data | Minimum | Maximum | Mean | SD |
|---|---|---|---|---|---|---|---|
| Color | 120 | 0 | 120 | 2.00 | 5.00 | 3.667 | 0.748 |
| Texture | 120 | 0 | 120 | 2.00 | 5.00 | 3.692 | 0.807 |
| Taste | 120 | 0 | 120 | 2.00 | 5.00 | 3.875 | 0.805 |
| Flavor | 120 | 0 | 120 | 2.00 | 5.00 | 3.750 | 0.748 |
| Odor | 120 | 0 | 120 | 1.00 | 5.00 | 3.392 | 0.639 |

Table 2 shows the summary data of the selected variables and the correlation matrix between the variables. There were five variables: color, texture, taste, flavor, and odor. Each of these variables has 120 observations, where the thirty respondents observed the four treatments. Hence, there is no missing data upon observation. The minimum rating for the color, texture, taste, and flavor was set to 2.00, indicating that it is the lowest rating the consumer panelist gave, while the minimum score for the odor was set to 1.00.

On the other hand, the maximum for all five variables was set to 5.00, indicating the highest rating that the consumer panelist gave. As for the mean, the taste has the highest mean with 3.875, followed by flavor at 3.759, texture at 3.692, color at 3.667, and odor at 3.392. Lastly, the variation with the highest standard deviation or correlation magnitude was the texture with 0.807, followed by the taste with 0.805; the color and flavor have 0.748, and odor with 0.639. Since the correlation magnitude is 0.7 to 0.9, the variables will be considered highly correlated.

Table 3. Variable Correlations

| Variable | Categories | Frequencies | % |
|---|---|---|---|
| Products | TREATMENT 1 | 30 | 25 |
| | TREATMENT 2 | 30 | 25 |
| | TREATMENT 3 | 30 | 25 |
| | TREATMENT 4 | 30 | 25 |
| Assessors | 1 | 4 | 3.333 |
| | 2 | 4 | 3.333 |
| | 3 | 4 | 3.333 |
| | 4 | 4 | 3.333 |
| | 5 | 4 | 3.333 |
| | 6 | 4 | 3.333 |

| | | | |
|---|---|---|---|
| | 7 | 4 | 3.333 |
| | 8 | 4 | 3.333 |
| | 9 | 4 | 3.333 |
| | 10 | 4 | 3.333 |
| | 11 | 4 | 3.333 |
| | 12 | 4 | 3.333 |
| | 13 | 4 | 3.333 |
| | 14 | 4 | 3.333 |
| | 15 | 4 | 3.333 |
| | 16 | 4 | 3.333 |
| | 17 | 4 | 3.333 |
| | 18 | 4 | 3.333 |
| | 19 | 4 | 3.333 |
| | 20 | 4 | 3.333 |
| | 21 | 4 | 3.333 |
| | 22 | 4 | 3.333 |
| | 23 | 4 | 3.333 |
| | 24 | 4 | 3.333 |
| | 25 | 4 | 3.333 |
| | 26 | 4 | 3.333 |
| | 27 | 4 | 3.333 |
| | 28 | 4 | 3.333 |
| | 29 | 4 | 3.333 |
| | 30 | 4 | 3.333 |

The variables in Table 3 were the products and the assessors. The product variation was divided into four categories: the four different treatments, a frequency of 30, which is the number of respondents, and the percentage shows that the four treatments had 25% each. The second variable is the assessors, which has 30 categories. This category is the individuality of the respondents. Thus, they had a frequency of 4, the number of treatments. Thus, there is an equal percentage of 3.333% for the assessors. The results verified that the product characterization was nuanced.

Table 4. Discriminating power by descriptor

| Descriptors | Test values | p-values |
|---|---|---|
| TASTE | 5.486 | 0.000 |
| FLAVOR | 3.639 | 0.000 |
| TEXTURE | 3.210 | 0.001 |
| COLOR | 2.555 | 0.005 |
| ODOR | 1.459 | 0.072 |

Table 4 shows the characteristics of sea urchin chips in order of highest discriminating power to lowest discriminating power. Thus, the taste has the most discriminating capability, whereas odor has the least. The associated test values and p-values are also displayed. The taste of the sea urchin chips is the highest graded factor in this table, while the odor is the lowest, indicating that the product's taste is liked, and its odor is average.

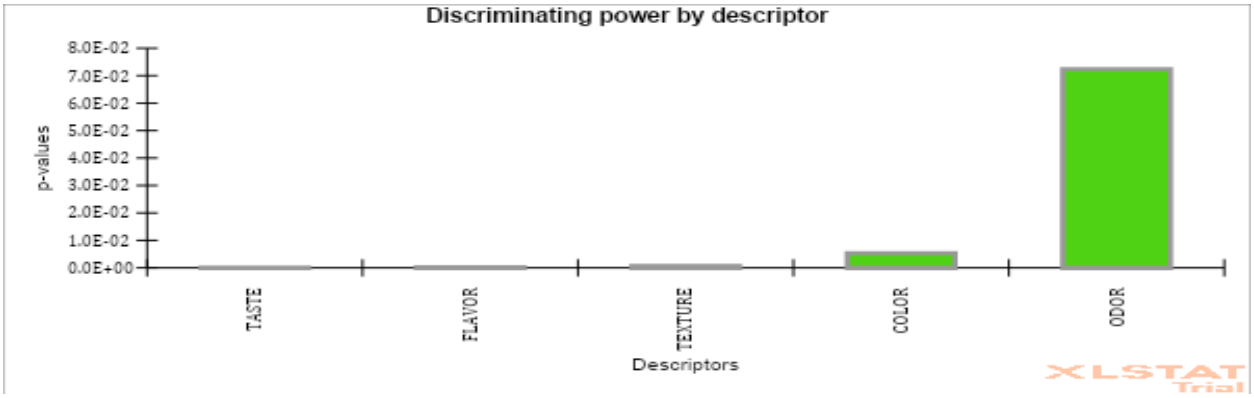


Figure 6. Discriminating power by descriptor

Figure 6 depicts the discriminating power by the descriptor. The higher the P-value, the lower its corresponding power by the descriptor. Therefore, taste has the highest power, followed by flavor, texture, color, and odor.

## 5.2 Graphical Results

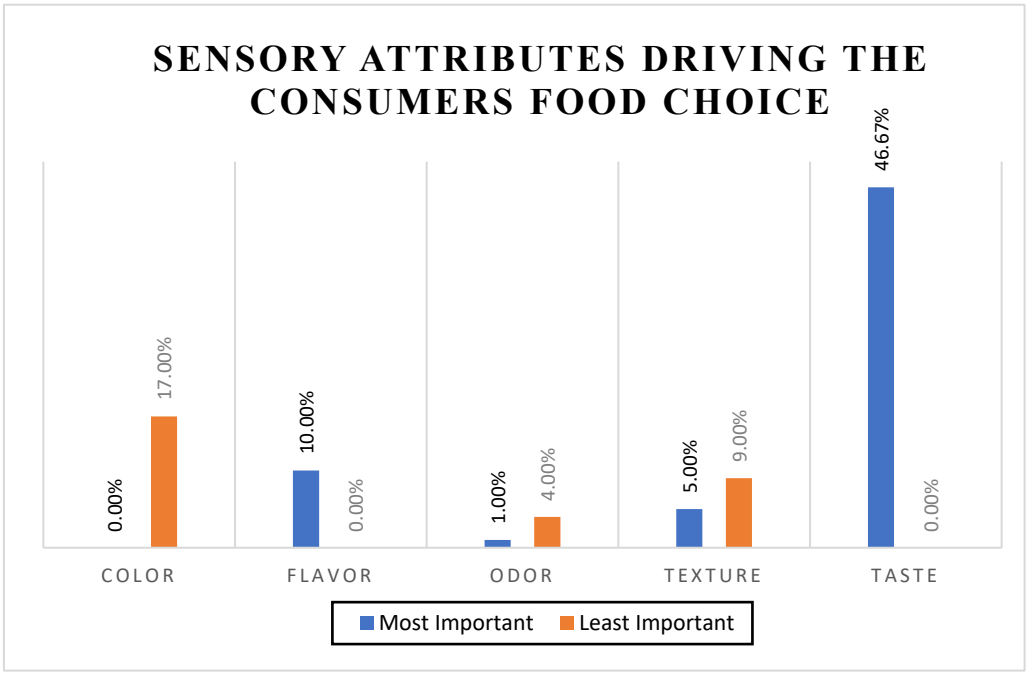


Figure 1. Sensory Attributes Driving the Consumers Food Choice

Figure 1 shows the consumers' preference for sensory attributes regarding food. A percentage of 46.67 chose to have a taste as the most important in picking food. It was followed by flavor and texture with a total percentage of 15% and odor with 1%. The least essential sensory attribute is color, with 17%, followed by texture and odor.

## 5.3 Proposed Improvements

Model coefficients:

The graphic below helps define the product. Blue is related to significant positive coefficients, whereas red relates to significant negative coefficients.

Table 5. Model Coefficients Treatment 1

| TREATMENT 1 | | | | | | |
|---|---|---|---|---|---|---|
| Descriptors | Coefficient | Estimated mean | p-value | Test value | Lower bound 95% | Upper bound 95% |
| COLOR | 0.000 | 3.667 | 1.000 | 0.000 | -0.188 | 0.188 |
| TEXTURE | -0.092 | 3.600 | 0.321 | -0.992 | -0.274 | 0.091 |
| TASTE | -0.142 | 3.733 | 0.174 | -1.360 | -0.347 | 0.064 |
| FLAVOR | -0.283 | 3.467 | 0.008 | -2.663 | -0.490 | -0.077 |
| ODOR | -0.025 | 3.367 | 0.769 | -0.293 | -0.194 | 0.144 |

Table 5 shows the model coefficients for treatment one, where color has the highest coefficient with 0.000, followed by -0.025 for the flavor, texture with -0.092, taste with -0.142, and flavor with -0.283.

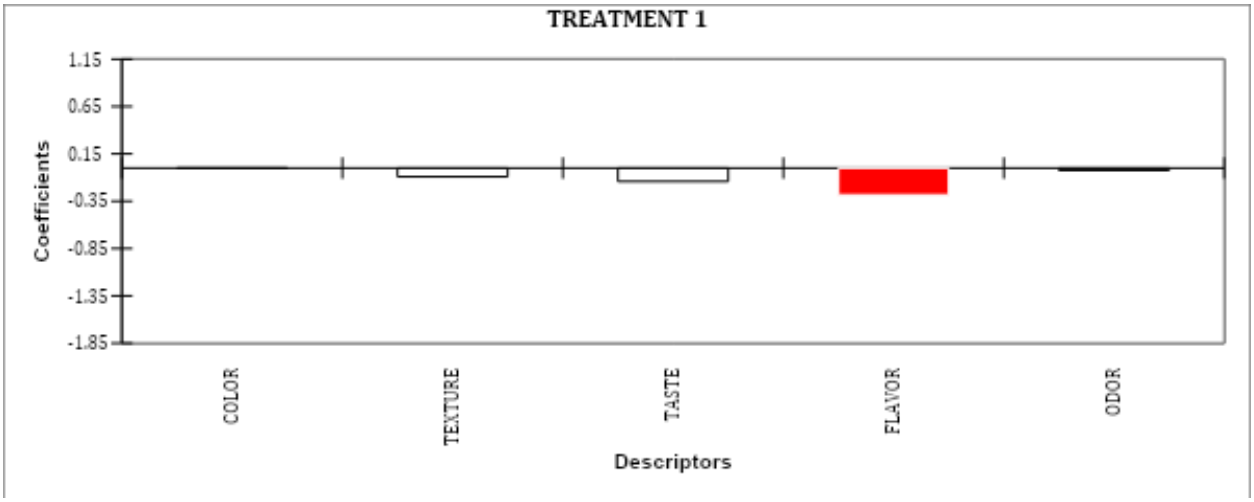


Figure 2. Model Coefficients Treatment 1

Figure 2 depicts that flavor was associated with a significant negative value coefficient.

Table 6. Model Coefficients Treatment 2

| TREATMENT 2 | | | | | | |
|---|---|---|---|---|---|---|
| Descriptors | Coefficient | Estimated mean | p-value | Test value | Lower bound 95% | Upper bound 95% |
| COLOR | 0.267 | 3.933 | 0.006 | 2.750 | 0.079 | 0.455 |
| TEXTURE | 0.342 | 4.033 | 0.000 | 3.571 | 0.159 | 0.524 |
| TASTE | 0.558 | 4.433 | < 0.0001 | 5.005 | 0.353 | 0.764 |

| | | | | | | |
|---|---|---|---|---|---|---|
| FLAVOR | 0.350 | 4.100 | 0.001 | 3.255 | 0.143 | 0.557 |
| ODOR | 0.208 | 3.600 | 0.016 | 2.403 | 0.039 | 0.377 |

Table 6 or Treatment 2 shows a higher coefficient than Table 5. The variable with the higher coefficient for Table 6 is the taste with 0.558, followed by the flavor with 0.350, texture with 0.342, color with 0.267, and odor with 0.208.

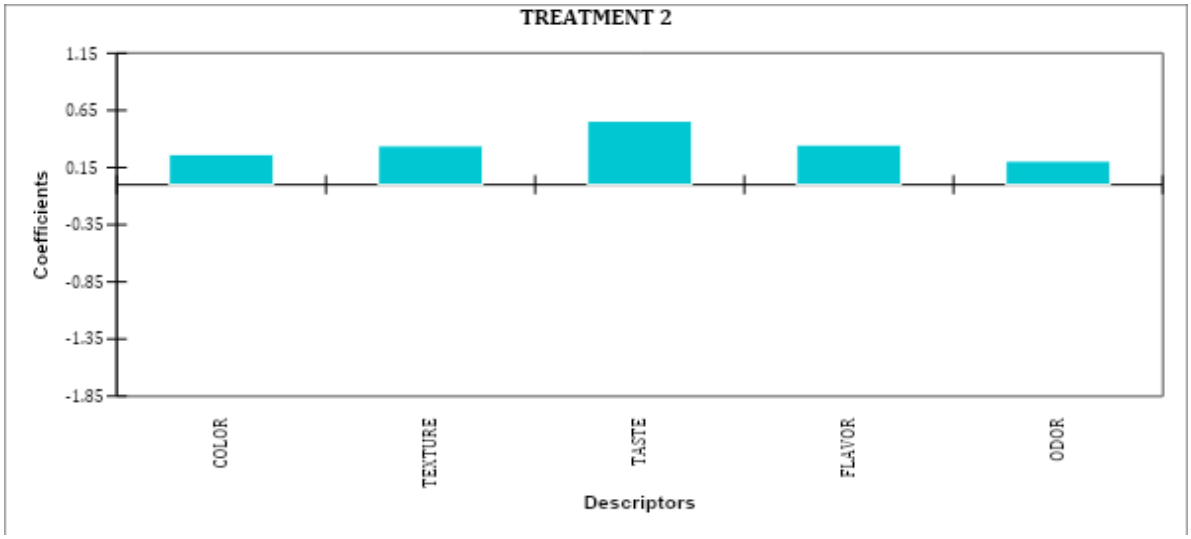


Figure 3. Model Coefficients Treatment 2

Figure 3 depicts that all five descriptors were associated with coefficients that have a significant positive value. This treatment focused on the taste; therefore, it has the highest coefficient.

Table 7. Model Coefficients Treatment 3

| TREATMENT 3 | | | | | | |
|---|---|---|---|---|---|---|
| Descriptors | Coefficient | Estimated mean | p-value | Test value | Lower bound 95% | Upper bound 95% |
| COLOR | 0.033 | 3.700 | 0.725 | 0.351 | -0.155 | 0.221 |
| TEXTURE | 0.042 | 3.733 | 0.651 | 0.452 | -0.141 | 0.224 |
| TASTE | 0.158 | 4.033 | 0.129 | 1.518 | -0.047 | 0.364 |
| FLAVOR | 0.217 | 3.967 | 0.040 | 2.053 | 0.010 | 0.423 |
| ODOR | -0.025 | 3.367 | 0.769 | -0.293 | -0.194 | 0.144 |

Table 7 shows that in treatment 3, the descriptor with the highest coefficient is the flavor with 0.217, followed by the taste with 0.158, texture with 0.042, color with 0.033, and odor with -0.025.

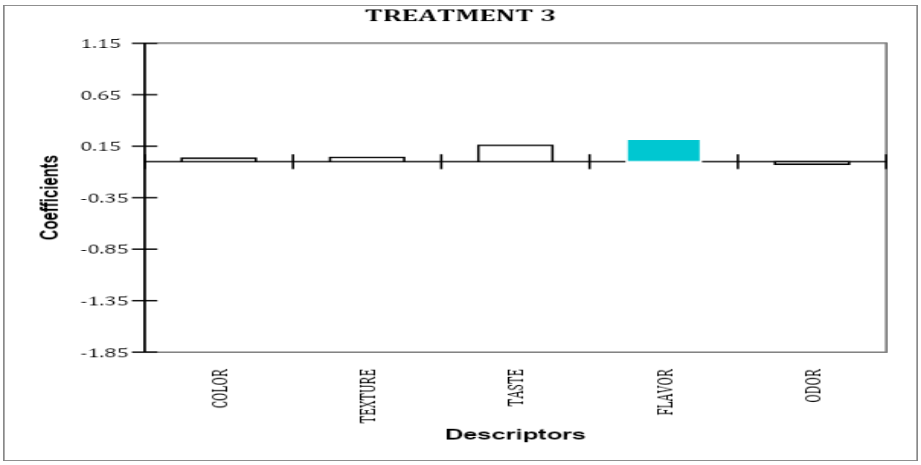


Figure 4. Model Coefficients Treatment 3

Figure 4 depicts that for Treatment 3, only the flavor is associated with coefficients with a significant positive value.

Table 8. Model Coefficients Treatment 4

| TREATMENT 4 | | | | | | |
|---|---|---|---|---|---|---|
| Descriptors | Coefficient | Estimated mean | p-value | Test value | Lower bound 95% | Upper bound 95% |
| COLOR | -0.300 | 3.367 | 0.002 | -3.077 | -0.488 | -0.112 |
| TEXTURE | -0.292 | 3.400 | 0.002 | -3.078 | -0.474 | -0.109 |
| TASTE | -0.575 | 3.300 | < 0.0001 | -5.134 | -0.780 | -0.370 |
| FLAVOR | -0.283 | 3.467 | 0.008 | -2.663 | -0.490 | -0.077 |
| ODOR | -0.158 | 3.233 | 0.066 | -1.839 | -0.327 | 0.011 |

Table 8 shows the model coefficients for Treatment 4, where odor has the highest coefficient with -0.158, followed by the flavor with -0.283, -0.292 for the texture, -0.300 for the color, and -0.575 for the taste.

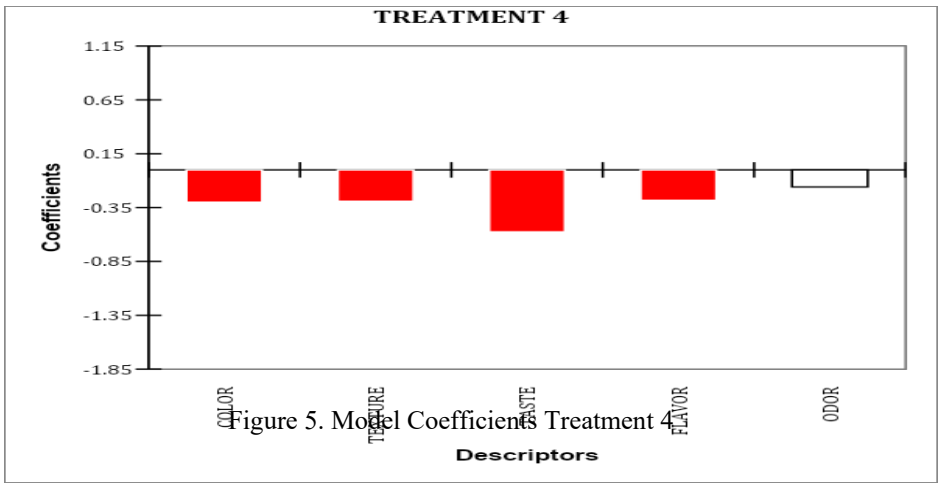


Figure 5. Model Coefficients Treatment 4

Figure 5 depicts that Treatment 4 focused on the odor; however, the four other descriptors have been associated with coefficients that have a significant negative value.

### 5.4 Validation

Adjusted means by product:

Table 9. Adjusted Means

| | TEXTURE | TASTE | COLOR | ODOR | FLAVOR |
|---|---|---|---|---|---|
| TREATMENT 2 | 4.033 | 4.433 | 3.933 | 3.600 | 4.100 |
| TREATMENT 3 | 3.733 | 4.033 | 3.700 | 3.367 | 3.967 |
| TREATMENT 1 | 3.600 | 3.733 | 3.667 | 3.367 | 3.467 |
| TREATMENT 4 | 3.400 | 3.300 | 3.367 | 3.233 | 3.467 |

Table 9 corresponds to the adjusted means for each product characteristic. The blue color corresponds to means significantly more significant than the global mean. We can see quickly that treatment 2 is a variable associated with taste and flavor characteristics. On the other hand, treatment 4 is a variable associated with flavor and texture characteristics, which signifies that the results are lower than the global mean. It can then be assumed that treatment 2 is the preferred choice among the other descriptors.

## 6. Conclusion

The study assessed the consumers' general acceptability towards sea urchin food chips through sensory evaluation. The researchers suggested four (4) recipe formulations that differ in the number of product ingredients. The different proposed recipes undergo sensory evaluation in terms of taste, color, texture, flavor, and odor by various potential consumers. The experimental technique and procedures were utilized in this study and consisted of experimentation concerning variables and quantitative adverbial scoring of different treatments.

Based on the findings and interpretation drawn from the data gathered, the most preferred product formulation of sea urchin food chips is treatment two (2), with the highest overall product characteristics ratings. Treatment three (3) closely garnered the second most acceptable product treatment, followed by treatment one (1) with ratings above general acceptability. Finally, treatment four (4) was obtained below the global mean of all four product attributes except for the odor.

According to the survey results, treatment two (2) was the most favored recipe formulation among the four suggested recipes. In terms of product characteristics, under the most favored product treatment, "taste" appeared as the essential product attribute of sea urchin chips, followed by "flavor," "texture," and "odor," with "color" being the least significant feature. The socio-demographic segmentation of the respondents might have influenced the results. The majority of the respondents are young adults (ages 18-24), which mostly goes for practicality and prioritizing taste other than other factors. The educational background was also seen to have affected the results since most of the respondents are at college level and in high school, indicating that the results gathered are directly from the consumers and not from the food experts.

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