

Kjeldahl Method and Sensory Analyses of a Thornback Ray (*Raja clavata*), Eel (*Anguilla* spp), and Tilapia (*Oreochromis mossambicus*) Meat; As a Nutritious Product Alternative

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Abstract

According to data from the Center for the Development of Fisheries and Aquaculture (CENDEPESCA), El Salvador ranks sixth in fish consumption in Central America followed by Belize. Salvadoran population, in recent years has increased the consumption of fish meat. This is why the great restaurants have increased the dishes based on the marine product, in terms of the hamburger industry, the multinational restaurant chain Burger King® has implemented fish meat for their burgers and has apparently been accepted by consumers.

For this investigation three formulations of hamburgers were elaborated with different percentages of Raya, Eel and Tilapia meats as well as beef burgers, which were subjected to a sensory evaluation, searching for the most accepted formula in these products, a bromatological analysis was also made, which included the determination of humidity percentage (by drying in a stove), crude fat percentage (by Soxtec method) and total protein percentage (by Micro-Kjeldahl) in a protocol known as proximal analysis.

The results of the bromatological analysis shows that the fish meat burger has a higher percentage of proteins compared to the beef burger, as well as the moisture content; as for fat, the fish burger obtained a lower percentage than the beef burger.

Keywords: Hamburger/ Ray (*Raja Clavata*)/ Tilapia (*Oreochromis Mossambicus*)/ Eel (*Anguilla* spp.)

1. Introduction

The following research paper is an innovative subject, non-studied before and can be used for further research. According to 2013 data from the Center for the Development of Fisheries and Aquaculture (Cendepesca), El Salvador ranks sixth in fish consumption in Central America followed by Belize. In the data of Cendepesca, based on the statistics of production, imports and exports of fishery products for human consumption (including the production of fishmeal and other products of industrial use) it is estimated that in Central America the country that consumes the most fish products and aquaculture is Panama, with 45.7%, followed by Costa Rica and Honduras with 18% and 10.4%, respectively.

The research is aimed at developing three formulations of hamburgers with different percentages of Ray, Eel and Tilapia meats as well as beef burgers, and submit them to a sensory

evaluation process with a panel of judges. The bromatological comparison of these hamburgers with a conventional beef burger will be done. The main objective of this research is to know if this new product can become an alternative for a more nutritious burger than the one that is usually consumed.

2. Methodology

2.1 Method

The research was correlational, with the purpose of knowing the relationship between the nature of hamburgers, nutritional value through analytical methods and sensory acceptance by panelists. It was started by gathering bibliographic information related with the topic. A material collection was compiled and then the product was ready to be elaborated.

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A compilation of quantitative and qualitative data was made at the Dr. José Matías Delgado University in the Faculty of Agriculture and Agricultural Research through a sensory analysis with the use of the hedonic scale in which a group of panelists participated.

Later the statistical method was applied, the program used was the Statistical Package for the Social Sciences (SPSS). The coding of frequencies and the analysis of variance (ANOVA) was implemented to determine which formulation differed significantly from each other. We also used a Duncan multiple comparison test; this program was used to calculate the acceptability and variation of the formulations and then the most accepted formulation was determined.

The bromatological analysis was realized in the quality laboratory of the Faculty of Agriculture and Agricultural Research of the Dr. José Matías Delgado University with a sample of beef burger and a burger made of ray, eel and tilapia meat that had the highest acceptance by the panelists.

In this analysis, three determinations were done: humidity percentage (by oven drying), crude fat percentage (by Soxhlet method) and total protein percentage (by Micro-Kjeldahl) this was included in a protocol known as proximal analysis.

The research was experimental in nature, since it aims to obtain a functional food through ingredients or snack that can combat the undernourishment, therefore, three formulations were chosen, of which the most accepted through the results of a sensory analysis; in which to sample winner will be carried out its subsequent bromatological study to determine if the formulations met the stated objectives. The study populations was staff and students of the Dr. José Matías Delgado University, from the Agricultural Research Faculty "Julia Hill de O'Sullivan". The population were of both sexes, i.e., male and female. Almost 15 steps are involved in the production process starting from reception of raw material to packaging, and those are explained in detail in the results and discussion section. A bromatological analysis was performed to the winning sample to further determine moisture, ashes, and proteins.

For the determination of the samples, a sensory analysis was carried out in the laboratory mobile sensorial analysis located within the Faculty of Agriculture and Research Julia Hill of O'Sullivan,

taking into account the opinion of 50 judges whose data were tabulated and then an ANOVA analysis of variance was performed to determine Significant differences between the two samples. Finally, bromatological and sensory analysis of the product of the sample was carried out a winner at the Industrial Quality Control Center (CCCI) located in the city of San Salvador. To investigate the results, Analysis of variance, Friedman Test, Correction factor, and ANOVA, and econometric functions were used. Detail of these models/tests is given below.

Correction factor:

$$CF = T^2/N$$

Sum of squares for sample=SSF (Sum of Squares Formula)

$$SSF = (\sum MA)^2 + (\sum MB)^2 + (\sum MC)^2 - FCn$$

Mean square samples MSs:

$$MSs \text{ samples} = SCm/glm$$

Variation ratio for samples:

$$Fm = MS \text{ sample} / MS \text{ error}$$

Hypothesis test process

Hypothesis:

H0: Sample A is superior to Sample B in all terms.

H1: Sample B is superior to Sample A, B in all terms.

H2: Sample C is superior to Sample A, B, C in all terms.

2.2 Meat preparation

The three different meats were mixed and minced, for the ray, the edible part is its fins, so the edible portion of this fish represents approximately 55% (of 100 grams of fish are actually consumed 55). It is a white fish (low in fat) that has few thorns but the most comfortable if we want to consume it, is to buy it already clean. The minced meat was handled with extreme care because it can have bacteria that contaminate the meat and cause food poisoning, as can be caused by Escherichia coli O157: H7. To the meat were added spices such as oregano and cumin to finally cook it at temperature of 90°C. This mixture of fish meat contributes with some vitamins of the B group such as B1 (thiamin), B2 (riboflavin), B3 (niacin) necessary for the



conversion of food into energy and also for the correct functioning of the skin, muscles and nerves. It also has small amounts of vitamin A and retinol.

3. Results

3.1 Formulation

Three different formulations were used that vary the amount of meat eel, ray and tilapia. The formula he presents now is the largest significant difference; it is thus the most accepted by the judges.

Table 1. Fish meat formulation

| Ingredients | Percentage |
|-------------------|------------|
| Ray meat | 14.4 |
| Eel meat | 7.2 |
| Tilapia meat | 14.4 |
| Fat | 24 |
| Water | 25.2 |
| Protein | 8.21 |
| Salt | 1 |
| Egg | 5 |
| Oregano | 0.05 |
| Pepper | 0.10 |
| Cumin | 0.03 |
| Dehydrated garlic | 0.30 |
| Onion powder | 0.10 |
| Liquid smoke | 0.10 |
| Total | 100 |

3.2. Bromatological analysis results

The formulation A of the Ray (*Raja clavata*), Eel (*Anguilla* spp.) and Tilapia (*Oreochromis massambicus*) meat compared sensorially with a conventional beef burger, shows that the fish meat has 15.6 g protein/100g, 18.4 g fat/100g and 60.5 g humidity/100 g, in contrast to the beef burger that has 12.8 g protein/100 g, 29.1 g fat/100 g and humidity 52.1 g /100 g. The fish burger has 2.8% more protein than beef, and it also has a 10.7% less fat where theoretically unsaturated fatty acids predominate that bring more benefits and are more precious than the saturated ones like in the beef with 8.4% more water. Based on the bromatological evaluation of the fish burger of formulation A, it represents a food with high nutritional value of macronutrients (proteins and fat) and theoretically has a good supply of B vitamins, so it presents a

good innovative opening to the needs and also adds commercial value to resources of hydrobiological origin that are generally not sensory appreciated.

Table 2. Bromatological analysis results

| Analysis | Results | Replica | Method |
|-----------|-----------------|---------|--------------------|
| Total fat | 18.4g±0.5g/100g | 2 | Soxhlet Extraction |
| Humidity | 60.5±0.1g/100g | 3 | Gravimetric Method |
| Protein | 15.6g±0.3g/100g | 2 | Macro Kjeldahl |

3.3 Sensory analysis results

The appearance of the meat was accepted by the 50% of the judges and only 10% indicated that they “liked it moderately”. For the color, the 75% of the judges “like it very much”, being these the majority. For the smell category, the sample had an acceptance of 40%, which pleased the judges “very much”. In the case of the taste, 30% of judges “liked it very much” and just a 10% “disliked it slightly”. Half of the judges indicated that they liked the texture of the sample “very much” and the other half liked it “moderately”.

The formulation "A" had the results with greater acceptance according to the judges due to the balance in content of meat, protein and water; This formulation gave a better consistency, taste and better appearance to the product, compared to formulation "B" that had 10% more meat content and formulation "C" that had 10% more s protein.

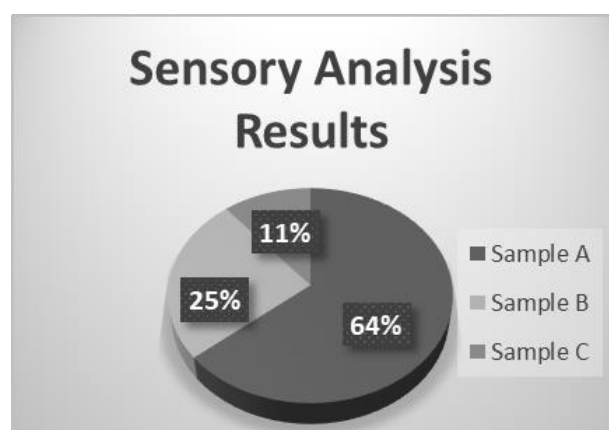


Figure 1. Percentage of acceptance graph

Sensorially both products were accepted by the evaluating judges, it was emphasized that the

characteristic fishy smell in these burgers was scarcely or not detected at all.

The discussion of the bromatological analysis was made based on a comparison of the beef burger with the fish meat burger, obtaining the following results:

The amount of protein present in the fish meat burger compared to the beef burger results in a higher protein content, which guarantees that the fish meat burger is a product with better nutritional value.

The total fat content of the fish meat burger is lower compared to the beef burger, which indicates that the fish meat burger is a low-fat burger

The fish meat burger has a higher humidity percentage than the beef burger, therefore this lengthen the shelf life of the product.

Despite the fact that the fish meat was more nutritious than beef there is a limitation, obtaining the raw material is complicated, the ray meat has a low level of commercialization in El Salvador.

4. Conclusions

The assessment of formula A of the Ray (*Raja clavata*), Eel (*Anguilla* spp.) and Tilapia (*Oreochromis massambicus*) meat compared sensorially with a conventional beef burger results in low accepted burger (average of 8.06 on the hedonic scale of 1-9) and the conventional beef burger had an average of 8.37 (on the hedonic scale of 1-9), both results are acceptable.

Fish is classified as a food with many nutritional properties and its use in other products is recommended to increase the nutritional value of a common and highly consumed food like hamburger.

The thornback ray is probably one of the commonest rays encountered by divers. The adult fish can grow to 1m in length although most are less than 85cm. According to WoRMS (World Register of Marine Species), Moreover the Wildlife Trusts Cornwall say is one of the most abundant ray species in Cornish waters, the thornback is a medium sized ray of the skate family growing to cm maximum length. Finally this Rays are not Endangered Species

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