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Determination of the Protein Content of Smoked Fish Sold in the Markets of the Town of Mbuji-Mayi (Democratic Republic of the Congo)

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Abstract

Our study on the determination of the protein content of smoked fish sold in the markets of the city of Mbuji-Mayi followed a scientific approach based on empirical methods and led to the results set out below. This aims to identify the types of smoked fish sold in the market in the city of Mbuji-Mayi and measure their protein content. The sample for this study was composed of 60 types of fish smoked on 6 varieties. 10 for each are as follows: Makoki, VODO, Milongo Kashinga, KABOBU and KASHA. At the end of this study by the prospective experimental method based on the chemical determination of proteins in the smoked fish consumed in the city of Mbuji-Mayi, our results show that most of the smoked fish sampled were well preserved and the average content protein in the past was of 16.08% ± 2.12%. Taking into account the variety of fish, we found that the protein content of smoked fish consumed in the city of Mbuji-Mayi was high in the variety of smoked fish Kashinga with 19.92% ± 1.33%, followed respectively by the Kabobu variety with 16.66% ± 0.69%, the Kasha variety with 16.02% ± 0.42%, followed by the Milongo variety with 15.68% ± 0.67%, the Makoki variety with 14.53% ± 0.69% and finally the variety Vodo which occupied the last place in protein with 13.68% ± 0.32%. So, we are led to conclude that fish contains proteins in a proportion of 16.08% ± 2.12% which varies according to the varieties.

Subject Areas

Biological Chemistry

Keywords

Determination, Content, Smoked Fish Sold, Mbuji-Mayi

1. Introduction

Hunger and malnutrition remain scourges in the world and affect nearly 800 million people, the majority of whom are in developing countries. In the latter, the notion of food security remains a luxury [1].

The FAO estimates that fish constitutes 22% of the protein intake in sub-Saharan Africa. However, in the poorest countries, this rate can exceed 50%, especially when other sources of animal protein are scarce or expensive. In the coastal states of West Africa, where fish has been central to the local economy for centuries, the proportion of animal protein from fish is extremely high: 47% in Senegal, 62% in The Gambia and 63% in Sierra Leone and Ghana. The caloric contribution of fish is of equal importance. In the absence of other proteins from local production and/or when the population has acquired a preference for fish, the caloric intake of fish can reach 180 calories per capita per day [2].

To contribute to the fight against food insecurity, we should increase aquaculture production and promote local products through the judicious use of technical knowledge [3].

Fish is an important source of protein of good biological value, minerals and essential fatty acids. Its consumption is beneficial for protection against cardiovascular disease and other nutritional diseases [4].

It is a unique source, accessible to low-income households, especially in developing countries where the price of meat remains beyond the reach of the average consumer [5].

Several techniques including salting, drying and smoking are used for its transformation and conservation [6].

Smoking is a processing operation that has been practiced for generations in many regions of the world, for the preservation of products (meat, fish or cheese) and for food diversification [7].

It is often associated with cooking, drying and/or salting. Particularly in West Africa, smoking makes it possible to stabilize perishable foodstuffs before transporting them from capture or rearing sites to consumption areas. The preservative, aromatizing and coloring functions are well correlated with the supply of smoke, but we also know that smoke carries polycyclic aromatic hydrocarbons (PAHs), known for several decades for their carcinogenic power in humans [8].

Since fish constitutes the main component of the animal source diet of the majority of the population in our environment, we were led to carry out a study

on the determination of their protein content in order to assess their contribution in the food ration of our populations.

This is how we asked ourselves the question of what is the protein content of smoked fish sold in the markets of the city of Mbuji-Mayi.

2. Methodology

In carrying out this work, we opted for the prospective survey method supported by the experimental technique based on the chemical assay of proteins. For our work, we used the following laboratory materials:

- DENVER brand precision balance;
- Pyrex beaker of 250 ml capacity;
- Erlen Meyer in pyrex with a capacity of 250 ml;
- Pyrex distillation flask with a capacity of 250 ml;
- Watch glass;
- Timer.

Our sample consists of 60 samples of 6 varieties of smoked fish, 10 of which are for each. The 6 varieties of fish sampled are as follows: MAKOKI, VODO, MILONGO, KASHINGA, KABOBU and KASHA.

The study variables are as follows: the organoleptic analysis and the different varieties of smoked fish found in the Bakwadianga and Tukunyema markets, of which each of these varieties has undergone protein analysis.

We proceeded as follows to do the analysis:

The protein content in smoked fish was determined by the KJELDAHL method.

- **KJELDAHL method**

Principle

Total nitrogen is assayed by the KJELDAHL method where the mineralization of the latter first consisted of mineralizing the sample in acid. Condition such that all Nitrogen (except nitrous and nitric Nitrogen) is transformed into ammonia. The latter is then distilled from the alkalinized and titrated mixture (LAVOISIER, 1963).

Reagents

- ✓ K_2SO_4;
- ✓ Copper sulphate;
- ✓ Magnesium sulfate;
- ✓ Sulfuric acid;
- ✓ Distilled water;
- ✓ 1% phenolphthalein;
- ✓ 0.1 N caustic soda;
- ✓ Methyl orange.

- **Mineralization**

- ✓ Operate on a test sample of one gram of smoked fish which is introduced into a flask;

- ✓ Add 2 grams of K_2SO_4, 0.2 grams of copper sulfate, 0.2 grams of mercury sulfate and 20 ml of concentrated sulfuric acid, place a matras on a plate of a stable green color.

- **Distillation**

- ✓ Take up the residue in 30 ml of distilled water to dissolve the insoluble matters which have formed;
- ✓ Pour the mineralized sample into a 250 ml volumetric flask and make up to the mark with distilled water after cooling;
- ✓ Take 100 ml, place them in a distillation flask;
- ✓ Add 300 ml of distilled water, 3 drops of phenolphthalein and slowly pour into a flask of sodium hydroxide solution until it turns pink. Shake the flask, on the other hand, in a 250 ml Erlene Meyer, place 50 ml of the 0.1 N HCl solution and 20 drops of orange methyl;
- ✓ Heat at the boil for one hour and collect approximately 150 ml of distillate, titrate the excess 0.1 N HCl with 0.1 N NaOH until it turns from pink to yellow.

- **Titration**

Titrate the uncombined acid with 0.1 N NaOH, the assay indicates the amount of NH_3 coming from the decomposition of the weight of the smoked fish analyzed and by the same amount of nitrogen, the protein content is obtained by multiplying the percentage of N_2 by a coefficient 6.25.

➢ **Expression of results**

Either at the test portion (PE)

N: the number of 0.1 N HCl

1 ml of 0.1 N HCl corresponds to 0.00014 grams of Nitrogen

N_2 in grams for 100 grams of sample then corresponds:

$$N_2 = \frac{V \times 0.00014 \times m \times 100}{a} = \frac{0.14 \times m}{a}$$

We applied the statistical test of "Student's T", based on the calculation of the arithmetic mean, the standard deviation and the variance.

3. Results

Our analyses have provided us with the results which we have presented in the form of averages in the successive statistical tables which follow for convenience.

We recall that our study focused on 60 samples of smoked fish divided into 6 varieties, including 10 determinations per variety. The analysis of these results required the consideration of the variety parameter of the smoked fish and the comparison with the theoretical reference value.

In the light of this Table 1, it should be noted that most of the varieties subjected to the organoleptic test were well preserved.

With regard to this Table 2, we find that the protein content of smoked fish consumed in the city of Mbuji-Mayi varies between 13.98% to 18.2% (minimum and maximum), *i.e.* on average standard deviation 16.08 ± 2.12.

Table 1. Organoleptic characteristics of smoked fish varieties.

Varieties	Couleur	Odour	Taste
KABOBU n = 10	Black (8 cases) Blackish (2 cases)	Pleasant (8 cases) Nauseabond (2 cases)	Very good (5 cases) Good (3 cases) Bad (2 cases)
KASHA n = 10	Dark chocolate (10 cases)	Pleasant (9 cases) Odorless (1 case)	Very good (6 cases) Good (3 cases) Bad (1 case)
KASHINGA n = 10	Black (10 cases)	Pleasant (6 cases) Odorless (1 case) Nauseabond (3 cases)	Very good (7 cases) Good (2 cases) Bad (1 case)
MAKOKI n = 10	Black (8 cases) Blackish (2 cases)	Pleasant (8 cases) Odorless (1 case) Nauseabond (1 case)	Very good (2 cases) Good (6 cases) Bad (2 cases)
MILONGO n = 10	Black (9 cases) Blackish (1 case)	Pleasant (8 cases) Nauseabond (2 cases)	Good (8 cases) Bad (2 cases)
VODO n = 10	Chocolate (10 cases)	Pleasant (4 cases) Odorless (3 cases) Nauseabond (3 cases)	Very good (4 cases) Good (3 cases) Bad (3 cases)

Table 2. Mean variation of the protein content (in %) in the smoked fish.

	Teneur moyenne en protéine
N	60
$\sum x$	964.964
$\bar{X}$	16.08
$\bar{X} \pm \tilde{o}$	16.08% ± 2.12%
Theoretical value	16.5% ± 3.5% (13% à 20%)

According to statistical analysis by comparing this result against the theoretical reference value which is 16.5% ± 3.5%. The difference observed between the average of the contents found in the smoked fish and the theoretical value is significant at the significance level of 5% at the degree of freedom 58 because the calculated "£" which is equal to 8.96 is greater than tabular Z which is 1.96, so we infer that the protein content of smoked fish eaten in Mbuji-Mayi town is the same as that found elsewhere.

Examination of the averages in this Table 3 shows that the protein content of smoked fish consumed in the city of Mbuji-Mayi is high in the variety of smoked fish KASHINGA (19.92% ± 1.33%) followed respectively by the variety of KABOBU (16.66% ± 0.69%), the variety of KASHA (16.02% ± 0.42%), followed by the variety of MILONGO (15.68% ± 0.67%), the variety of MAKOKI (14.53% ± 0.69%) and finally the variety of VODO occupies the last place in protein with (13.68% ± 0.32%).

Table 3. Respective protein content (in %) according to the varieties of smoked fish.

No.	MAKOKI	VODO	MILONGO	KASHINGA	KABOBU	KASHA
01	14.38	13.92	14.48	20.32	17.72	15.68
02	15.76	13.73	15.54	19.02	16.22	15.18
03	14.71	13.98	16.32	18.34	16.17	16.64
04	13.68	13.16	16.02	22.08	17.93	16.00
05	13.98	13.92	15.99	20.06	15.99	16.71
06	14.502	13.542	14.48	19.964	16.80	16.01
07	15.76	13.98	16.32	18.34	16.17	15.68
08	13.68	13.92	15.99	22.08	15.99	16.48
09	14.38	13.54	16.02	19.09	16.80	16.00
10	14.502	13.12	15.59	19.964	16.79	16.01
not	10	10	10	10	10	10
	145.334	136.812	156.75	199.258	166.58	160.23
	14.53	13.68	15.68	19.92	16.66	16.02
δ	0.69	0.32	0.67	1.33	0.69	0.45

4. Discussion

The results that we have just presented require, for their importance, an interpretation which will allow their understanding.

Concerning the organoleptic analysis of the smoked fish varieties sampled, we note that most of these were well preserved or in good condition (Table 1). This ties in with Goueu BB's observation. According to which smoking and drying are among the techniques used for processing and preserving smoked fish [6]. What would dictate to these last the black color and the bad odor for the majority because being smoked with the heated wood and the pleasant taste following the loss of water which generates the concertation in macronutrients.

If we take into account the parameter "protein content in fish", our results show that the average protein of all the fish is 16.08, 2.12% or (13.98 minimum to 22.08 maximum) against 16.5 for the theoretical value and that the observed difference is not significant at the sole significance of 0.05% (Table 2). This amounts to saying that the results obtained are the same as the theoretical value. These results are reminiscent of those reported on some previous work. Indeed, the work of Pierre DUKAN has revealed that the proteins of meat and fish are equivalent. They are of excellent quality and of very high biological value because they are complete, they contain all the essential amino acids, in a proportion close to the ideal. Quantitatively, the content is between 15% and 22% and often exceeds that of meats [9].

According to Table 3, compared to the variety, there emerges a difference in the level of protein in the different varieties of fish, *i.e.* the KASHINGA variety (19.92% ± 1.33%) followed respectively by the KABOBU variety (16.66% ±

0.69%), the variety of KASHA (16.02% ± 0.42%), followed by the variety of MILONGO (15.68% ± 0.67%) [10], the variety of MAKOKI (14.53% ± 0.69%) and finally the variety of VODO occupies the last place in protein with (13.68% ± 0.32%). This is in line with Pierre DUKAN's idea according to which the protein content differs from one variety of fish to another and that this rate varies between 15% to 22% and the most protein-rich fish are bluefin tuna, 27 g/100, mackerel and dogfish [9].

Finally, our results show that actually the fish proteins whose content ranges from 13.98% to 22.08% and that these tenures protein vary their varieties.

5. Conclusion

At the end of this study by the prospective experimental method based on the chemical determination of proteins in the smoked fish consumed in the city of Mbuji-Mayi, our results denote that most of the smoked fish sampled were well preserved and the average content protein in smoked fish is 16.08% ± 2.12%. Taking into account the variety of fish, we found that the protein content of smoked fish consumed in the city of Mbuji-Mayi is high in the variety of smoked fish KASHINGA (19.92% ± 1.33%) followed respectively by the variety KABOBU (16.66% ± 0.69%), the KASHA variety (16.02% ± 0.42%), followed by the MILONGO variety (15.68% ± 0.67%), the MAKOKI variety (14.53% ± 0.69%) and finally the variety of VODO occupies the last place in protein with (13.68% ± 0.32%). So we are led to conclude that fish contain proteins in a ratio of 16.08% ± 2.12% which vary with varieties.

Conflicts of Interest

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

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