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## Nutritional Evaluation of Boiled and Smoked Catfish (*Clarias gariepinus*) using Different Parts (Bone, Skin and flesh)

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**ABSTRACT:** A comparative nutritional estimation of the proximate and profile of boiled and smoked Catfish (*Clarias gariepinus*) using different parts (Skin, Flesh and Bone) were investigated so as to determine which nutritive value of the two had a higher nutritive value. 20 experimental fishes were separated differently into skin, flesh and bone parts respectively. Major nutrient compositions like protein, carbohydrate, Ash, Lipid, and moisture content were determined in the two different conditions, boiled and smoked. The result of this study revealed the mean percentages of protein, moisture content, Ash, Carbohydrate, and Lipid, in each, of these fish parts. For the skin parts result from smoked to boiled fish ranged between 38.25-47.70; 8.30-20.10; 17.32-21.82; 23.25-32.78; 3.75-4.95%. And for fish flesh parts ranged between 51.53-61.82; 14.31-23.11; 16.37-24.15; 27.50-45.47; 4.59-5.32%. Lastly for fish bone parts: (16.25-25.30; 5.38-11.21; 18.38-26.58; 11.75-20.80; 1.95-2.11%). Protein in each of the three conditions, above ranged higher, while the lipid is least. This study showed that there was significant difference in smoking and boiling in the nutritive value of catfish used and there were variations in the nutritive value of the different part of the fishes. Boiling showed higher retention of nutritive values. While smoking will keep the fish product free from spoilage and keep the shelf life of fish and give it attractive appearance to the consumer.

**KEYWORDS:** Smoking, Boiling Protein, Carbohydrate, Ash, Lipid, Moisture content.

### I. INTRODUCTION

Fish is an important favorite food item across the globe. The demand for fish is on the increase as a result of increasing world population, higher living standard and its overall image among its diverse consumers, Cahu, et al(5). It is also a low cost dietary protein source of food and used as a substitute to meat protein. The fish products contain most important nutritional component and this serve as a source of energy for human beings Koffi-Nevry et al (9); Suth arhiny and Sivashanthini (15). Fish has a whole lot of food potential and provide relief from malnutrition, especially in developing countries Ashratt et al (1). This is because fish and its products provide a superior quality protein to that of meat, milk, eggs, well balanced essential amino acids profile, necessary minerals and fatty acids. Hossain (7).

The flesh part of fish is tasty, highly dispersible and minimize the risk of heart diseases and increase life expectancy Murray (11). Fish processing is mainly concerned with the technology of processing fish in such a way that they retain their nutritive value and acceptability to consumers. The aim of the preservation is to reduce the operation of bacteria and enzymes activities. Spoilage bacteria and enzyme activities can be killed by heat treatment (i.e. pasteurization and sterilization etc) or freezing, smoking, drying, boiling and use of chemical component e.g. salting.

In Nigeria; the fishery sector is estimated to contribute 3.5% of Nigeria's Gross Domestic Product (GDP); and provides a direct and indirect employment to well over six million people. (Trade Invest Nigeria 2010). Smoked or dried fish is a traditional part of the diet of a large section of the world's population. The problem encountered is how to handle successfully the post harvest processing and long storage facilities and utilization of the fish and its products. Ayuba and Dimeji (3).

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Fish is highly perishable and it needs to be processed immediately; if, refrigerated to avoid wastages and its economic loss. The aim of this study is to compare boiled and smoking processing methods of Catfish to know which one will retain the nutritional quality more than the other.

## II. MATERIALS AND METHODS

**Sampling:** Twenty catfishes (*Clarias gariepinus*) aged 7 months were obtained from Kunlex fish farm at Olomore, Abeokuta, Ogun State in March 2015. The fishes *Clarias gariepinus* (catfish) were separated into two (10) groups each: - for boiling and smoking. They were then processed accordingly and their different parts separated for laboratory analysis.

### Fish Processing

All the fishes were killed, beheaded and eviscerated and washed thoroughly. They were brined using teaspoon of salt per fish. The first 10 were boiled in a gas cooker to 100<sup>o</sup>c while, the other 10 were placed on a tray with local stove charcoal and covered to allow smoking take place. During smoking temperature and ambient conditions were monitored. The smoking was terminated after they were properly dried. The boiled and smoked fishes parts via: - skin, flesh and bone were prepared separated at the Nigeria Institute of Science Laboratory Technology Ibadan for analysis to determine Protein, Moisture content, Ash, Carbohydrate and Lipid in them.

### Proximate analysis

The proximate composition were assayed as describe by AOAC (2). All chemical used were of analytical grade and supplied by Sigma Co (St. Louis U.S.A). Each analysis was carried out in triplicate.

1. **Estimation of protein:** The usual Kjeldahl method was followed to determine the amount of protein in the smoked fish separately and dried boiled muscle of the body. For this analysis, then the content of the flask was digested until the color becomes greenish blue or blue. The digested materials were then diluted by adding distilled water which in turn distilled over by slowly adding of 40% NaOH solution. The end point is indicated by previously added phenolphthalein. Ammonia was distilled with 4% boric acid solution which was finally titrated with standard HCl (0.1 N). the percentage of gross proteinous nitrogen was nitrogen which was calculated out by the following formula:

$$N (\%) = (\text{volume HCL} \times \text{Normality HCl} \times 0.014 \times 100) / \text{Weight of sample (g)}$$
$$\text{protein}(\%) = \% \text{ of nitrogen} \times 6.25 (\text{conversion factor})$$

2. **Estimation of moisture:** Content. Moisture content was determined by drying the sample at +105<sup>o</sup>c in an oven. By subtraction, the moisture was calculated. To determine moisture, Aluminum dish was cleaned dried and then the constant weight of the dish was taken. Sample was placed in the dish and weight was taken. Difference between two weights, weight of the sample was ascertained. Then the dish with sample was put in a controlled oven and was dried at 105<sup>o</sup>c until the constant weight was achieved. The following equation was used to determine the moisture content of the dry fish sample:

3.

$$\text{Moisture} (\%) = \frac{\text{weight of the sample} - \text{weight of the dried sample}}{\text{weight of the sample}} \times 100$$

4. **Estimation of ash content:** Ash was determined by muffle the sample at 6000-7000<sup>o</sup>c to dry ash. By subtraction ash was determine. Firstly clean porcelain crucibles were heated in a muffle furnace at 6000<sup>o</sup>c and crucible were then weighted until a constant weight was obtained. The sample with the crucible was weighted and recorded. The sample were ignited at 6000<sup>o</sup>c for 6 h, until the residue was uniformly grayish to white. Afterwards crucibles were transferred to the desiccator to cool them at room temperature for few minutes. After heating, desiccations were weighted, desiccator repeated till a constant weight was obtained. Final constant weights of the crucibles were recorded. The following equation was used to determine the ash content of the dry fish samples

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$$\text{Ash (\%)} = \frac{\text{weight of ash} \times 100}{\text{weight of the sample}}$$

5. **Estimation of carbohydrate:** The percentage of carbohydrate was calculated by simply subtracting the total percentage of protein, fat moisture and ash, from 100. The following equation used to determine the amount of lipid content in the dry fish sample:

$$\text{Carbohydrate (\%)} = 100 - \% \text{ of (Protein + Fat + Moisture + Ash)}$$

6. **Estimation of lipid:** lipid content was estimated by the soxhlet method. First of all weight of the empty tumbler was taken. Then it was weighted with the sample. Difference of these two weights gives the weight of sample. Then the sample was placed in a Soxhlet extractor previously set. Fats were extracted with petroleum ether. After ensuring complete extraction, petroleum ether was evaporated and the residue was dried to a constant weight at 105°C. The following calculation was used to determine the amount of lipid content in the dry fish sample:

$$\text{Lipid (\%)} = \frac{\text{weight for the extracted lipid content} \times 100}{\text{Weight of sample}}$$

**Data analysis:** To find out the mean percentage, standard deviation and correlation matrix, Statistical Package for Social Science (SPSS Version 19.0) was used in this study.

### III. RESULTS AND DISCUSSION

**Proximate composition:** The proximate composition of the comparison between the values of boiled and smoked catfish (*Clarias gariepinus*) using different parts of fish skin, its flesh and fish bone were obtained, in the laboratory to investigate the mean percentages of protein, moisture content, Ash content, carbohydrate and lipid.

The mean percentages of *Clarias gariepinus* (Catfish) boiled and smoked (using fish skin) are presented in table I. The result showed that the mean percentage of protein, moisture content, Ash, carbohydrate and lipid for the boiled fish skin are: 47.70, 20.10, 21.82, 32.78, 4.95% while that of smoked fish are 38.25; 8.30; 17.32; 23.25; 3.75%.

**Table I proximate composition of the comparison between nutritional values of boiled and smoked cat fish using fish skin**

Nutritional composition (%)	Boiled fish	Smoked Fish
Protein	47.70±1.15	38.25±1.65
Moisture	20.10±0.55	8.30±0.95
Ash	21.82±0.38	17.32±0.37
Carbohydrate	32.78 ± 1.28	23.25±1.37
Lipid	4.95±0.41	3.75±0.45

The protein value and other nutritional parameters are higher in boiled fish than smoked fish; showing the higher nutritive value in boiled fish.

Table 2 and 3 showed the values obtained for boiled and smoked Catfish (*Clarias gariepinus*) using fish skin flesh and fish bone respectively. When the three conditions were compared to each other. The protein value in the Fish Flesh is the highest in both conditions 6.82% (boiled) and 51.53% (smoked) Table 2 This is followed by the mean protein in the fish skin 47.70% (boiled) and 38.25% (smoked) Table 1 While the value in the fish bone is least 23.50% (boiled fish) and 16.25% (smoked fish) Table 3.

Flesh is highest in both cases except the value for Ash which is highest in fish bone 26.58% (boiled fish) and 18.38% (smoked) Table 3 respectively. Others had lower values. Ash value is least in fish skin 21.82% (boiled) and 17.32% in (smoked) Table 1.

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**Table 2: Proximate composition of the comparison between nutritional values of boiled and smoked cat fish (Clarias gariepinus) using fish flesh**

Nutritional composition (%)	Boiled fish	Smoked Fish
Protein	61.82±0.88	51.53±1.77
Moisture	23.11±0.65	14.31±0.69
Ash	24.15±0.43	16.37±0.24
Carbohydrate	45.47 ± 1.77	27.50±1.19
Lipid	5.32±0.41	4.591±0.62

The protein value in fish flesh is higher in value in both boiled and smoked. They are still higher than fish in skin in Table 1

**Table 3: Proximate composition of the comparison between nutritional values of boiled and smoked cat fish (Clarias gariepinus)**

Nutritional composition (%)	Boiled fish	Smoked Fish
Protein	25.30±0.34	16.25±0.85
Moisture	11.21 ± 0.79	5.38 ± 0.35
Ash	26.58 ± 0.46	18.38 ± 0.72
Carbohydrate	20.80 ± 0.45	11.75 ± 1.25
Lipid	2.11 ± 0.34	1.95 ± 0.56

Protein value is least in the bones of both boiled and smoked fish. Compared to Table 1. But the Ash value is highest in boiled and smoked fish than the others (fish skin and fish fresh)

#### IV. DISCUSSION

##### **Protein:**

The mean proximate value of 61.82% were obtained from *Clarias gariepinus* (boiled) in this study (Table 2) for the fish flesh of *Clarias gariepinus* which is slightly less than 68.4% mean proximate value obtained by Olayemi et al (13) using drying method. The value of smoked fish too was 51.53%. The significant increase in protein with this result is in accordance with the findings of Puwastein et al (14) Tao and Linchin (17).

This showed that drying, boiling and smoking can retain the protein values.

##### **Moisture Content:**

The value of the moisture content obtained in this study varied significantly; Table 1, 2, and 3, respectively.

The value is highest in boiled fish 23.11% (Table 2), and least in smoked fish bone 5.38%. (Table 3). The least value of smoked fish bone is slightly less than the value 7.30% obtained for dried Catfish by Olayemi et al (13). It agrees with other researchers such as Effiong and Mohammed (6). M. Munba and Fose (10).

The moisture content of the dried Catfish by Olayemi et al (13) was 7.3%. This work had 5.38% least for smoked fish bone part (Table 3) 11.21% boiled (Table 3). The flesh had 14.31% smoked, boiled 23.11% Table 2. This is of great importance in storage and is still at safe level of 5.38% which is below the recommended safe moisture content of dried fish 6-8%.

##### **Ash**

The value of the ash content obtained in this work ranged from 16.37- 18.38% for smoked fish skin, flesh and bone. While the value for boiled range from 21.82%-26.58%. The value of obtained by Olayemi et al (13) is relatively lower for dried Catfish 6.40% this showed that ash is relatively lower in dried fish.

##### **Carbohydrate**

In the present study; Carbohydrate level in the analysis ranged from 1.95% - 27.50% in fish bone to fish flesh (Table 3, 1, 2) respectively; Bhuiyan (4) observed 0.2 – 0.88% in dried Bambay Duck and in Croaker Samples, In India, Olayemi (13) obtained 6.40%. The results obtained by other workers are relatively similar to this work.

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### Lipids

The mean percentage of lipid in the two samples varied from 1.95 – 4.59% for smoked fish Catfish, bone, skin, flesh. While that of boiled Catfish ranged from 2.11 to 5.32%.

Bhuiyan (4) observed 6.84 – 9.21% lipid in dried Bombay duck and Sin croaker samples. Rubbi et al (15) reported the lipid content ranging from 0.45 – 15.51% in dried mean Catfish (*Clarias gariepinus*) fishes Olayemi et al (13) obtained 12.50%. Their results are very close with the present investigation.

### V. CONCLUSION

The present study revealed that catfish (*Clarias gariepinus*) have a very good nutritional value. The protein value in both conditions are much higher and compared relatively well with other workers confirmed that all the parts of the fish can supply the much needed protein and other nutritive foods. The boiling condition can keep the retention of nutritive value. While smoking will keep the fish production free from spoilage and extend the shelf life of fish and give them an attractive appearance to the customers.

### VI. RECOMMENDATION

Since this study focus is on boiled and smoked parts of different fish parts; Further research will be encouraged to compare marine fishes with fresh water under different conditions via dried, smoked, boiled and fried.

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