Original Article

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Nutrient Composition of *Tilapia zilli, Hemisynodontis membranacea, Clupea harengus* and *Scomber scombrus Consumed in Zaria*

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ABSTRACT [ENGLISH/ANGLAIS]

This study was conducted to determine the proximate composition of some selected fish species. Four fish species; Tilapia (*Tilapia zilli*), Catfish (*Hemisynodontis membranacea*), Atlantic herring (*Clupea harengus*) and Mackerel (*Scomber scombrus*) were collected from markets around the Nigerian northern city of Zaria and analyzed for their nutrient composition. Nutrient composition of the four fish species revealed higher content of lipid(12.33 % and 11.14 %) and lower moisture (65.0 % and 68.6 %) in Mackerel and Herring respectively while the carbohydrate with maximum percentage of 0.63 %, Ash (1.79 %) were statistically insignificant in the four species. Protein content of Atlantic herring was significantly lower (18.45 %) compared to the other species. This study clearly indicate that the proximate values obtained would be useful to help the consumers in choosing fish based on their nutritional values besides providing an update to food composition database.

Keywords: Proximate composition, protein, lipid, carbohydrate, moisture, ash, Zaria market

RÉSUMÉ [FRANÇAIS/FRENCH]

Cette étude a été menée afin de déterminer la composition immédiate de certaines espèces de poissons sélectionnés. Quatre espèces de poissons; tilapia (Tilapia zilli), Catfish (Hemisynodontis membranacea), hareng de l'Atlantique (Clupea harengus) et le maquereau (Scomber scombrus) ont été recueillies sur les marchés autour de la ville nigériane de Zaria du Nord et analysées pour leur composition en éléments nutritifs. La composition en nutriments des quatre espèces de poissons ont révélé une teneur plus élevée de lipides (12,33% et 11,14%) et faible taux d'humidité (65,0% et 68,6%) dans le maquereau et le hareng respectivement, tandis que l'hydrate de carbone avec un pourcentage maximum de 0,63%, Cendres (1,79%) étaient statistiquement significatif au cours des quatre espèces. La teneur en protéines du hareng de l'Atlantique était significativement plus faible (18,45%) par rapport aux autres espèces. Cette étude indiquent clairement que les valeurs obtenues proches serait utile pour aider les consommateurs à choisir des poissons en fonction de leurs valeurs nutritionnelles en plus de fournir une mise à jour base de données de composition des aliments.

Mots-clés: Composition globale, protéines, lipides, glucides, humidité, cendres, le marché Zaria

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INTRODUCTION

Fish constitute the cheapest source of animal protein in Africa [1]. Fish is generally appreciated as one of the healthiest and cheapest source of protein and it has amino acid compositions that are higher in cysteine than most other source of protein [2]. Fish meat contains significantly low lipids and higher water than beef or chicken and is favored over other white or red meats [3, 4]. The nutritional value of fish meat comprises the contents of moisture, dry matter, protein, lipids, vitamins and minerals plus the caloric value of the fish [5, 6]. Fish has lower cholesterol content when compared with meat [7] and thus often recommended for consumption especially among the adult population. The marine fish is generally cheaper and more abundant when compared with fresh water fishes, which are relatively more expensive in Nigeria. The major constituents of fish are moisture, protein and fat with minerals occurring in trace amount [8]. Generally fish contains very little carbohydrate, while the moisture content is very high. In most fish species the moisture content is between 60 – 80 %, protein between 15 – 26 % and 2 – 13 % for fat [9]. The fat content of fishes varies with species, age, size and season. Therefore, this study was undertaken to determine the proximate composition of Tilapia (*Tilapia zilli*), Catfish (*Hemisynodontis membranacea*), Atlantic

herring (*Clupea harengus*) and Mackerel (*Scomber scombrus*) in an attempt to enlighten the populace the nutritive values of these fish species.

MATERIALS AND METHODS

Sample Collection

The fish samples used for this study were collected from two different major markets in Zaria town, Kaduna State, Nigeria.

Sample Preparation

The fish samples were thoroughly washed with tap water and distilled water to remove any adhering contaminants and drained under folds of filter paper. The fish sample was dissected with a knife and the intestines, guts and bones were removed. The head was also discarded. The samples were then homogenized into a fine mesh with an electric food blender and thereafter, stored in a deep freezer (- 18 ^{0}C) prior to analysis.

Moisture Content Analysis

Moisture content of fish fillets was determined according to Association of Official Analytical Chemists [10]. The samples were dried in moisture dish in an oven at 105 ˚C until constant weights was obtained.

Ash Content Analysis

Ash content of fish fillets was determined according to Association of Official Analytical Chemists [10]. Pre-dried samples obtained from moisture content analysis were ashed in furnace at 550˚C overnight.

Crude Protein Analysis

Crude protein content of fish fillets was determined according to Association of Official Analytical Chemists [10]. Briefly, one gram of sample was weighed into digestion tubes. Two Kjeltabs Cu 3.5 (catalyst salts) were added into each tube. About 20 ml of concentrated sulphuric acid (H_2SO_4) was carefully added into the tube and then shaken gently. Digestion procedure was carried out. Digested samples were cooled for 10-20 minutes. Distillation procedure was then performed using distillation unit and the distillate was titrated with 0.025N sulphuric acid (H_2SO_4) until the end point changes from green to pink. Volume of acid required in the titration was recorded. Blank was prepared with the exclusion of sample. The percentage of protein content was calculated according to the equation below.

$$\% \text{ Nitrogen} = \frac{0.014 \times VD \times N \times 100 \times TV}{\text{Weight of sample} \times AD}$$

% Protein =% N x F

Where,

VD= Volume of digest, N= Normality of acid, TV= Titre value, AD= Aliquot of digest

F = Conversion factor for nitrogen to protein (6.25)

Fat Content Analysis

Crude fat was obtained by exhaustively extracting 2.0 g of each sample in a Soxhlet apparatus using petroleum ether (b.p. 40-60^{0}C) as the extractant.

Carbohydrate Content

Carbohydrate content was calculated based on difference calculation [Carbohydrate =100% - (% moisture + % ash + % crude protein + % fat)].

Statistical Analysis

Data was subjected to one-way analysis of variance (ANOVA) and least of significant difference (LSD) at 0.05 probability level. All statistical analyses of data were performed using SPSS 17.0 software and the data were reported as mean values± standard deviation (SD).

RESULTS

Table 1 represents the concentration and percentage of proximate composition (protein, ash, carbohydrate, moisture and lipid contents of the selected species analyzed. The varied values of their presence in the body tissues of the fishes analyzed were recorded. Subjection of the result to statistical analysis showed a significant difference in moisture, protein and lipid content ($p < 0.05$) though there was no significant difference ($p < 0.05$) in the ash and carbohydrate content of the different fresh fishes.

DISCUSSION

Moisture of a given sample simply refers to the water content of that sample. Results obtained from the proximate analysis of the various fish species showed that of all the fish samples, Tilapia which is locally harvested has the highest percentage of moisture, 75.8 ± 0.40 % while Mackerel has the lowest moisture content, 65.0 ± 2.19 %. The fishes had moisture ranging from 65.0 to 75.8 % indicating that the percentage moisture in fish muscles was within the acceptable level (60-80 %) in all the

samples which could be due to the stable water levels in the environmental location where the fish were collected. The percentage of water is also a good indicator of its relative content of energy, protein and lipid. There was no significant difference ($p < 0.05$) between catfish and mackerel as was seen in mackerel and herring. The high moisture content is a disadvantage in that it increases the fishes' susceptibility to microbial spoilage, oxidative degradation of polyunsaturated fatty acids and consequently decreases in the quality of the fishes for longer preservation time [11].

Table 1: This table shows the proximate compositions are triplicate determination of each fish sample

	Catfish	Tilapia	Mackerel	Herring
Moisture (%)	74.9±1.21^{c,d}	75.8±0.40^{c,d}	65.0±2.19^{a,b,d}	68.6±1.14^{a,b,c}
Protein (%)	20.26±1.47^{d}	18.80±0.17	20.20±0.66^{d}	18.45±0.47^{a,c}
Lipid (%)	3.13±0.06^{c,d}	3.29±0.33^{c,d}	12.33±1.08^{a,b,d}	11.14±0.47^{a,b,c}
Ash (%)	1.26±0.14	1.17±0.06	1.79±0.89	1.51±0.96
Carbohydrate (%)	0.41±0.45	0.41±0.04	0.63±0.14	0.54±0.36

Values are shown as mean ± standard deviation of triplicates. a= statistically significant ($p < 0.05$) when compared with catfish; b =statistically significant ($p < 0.05$) when compared with tilapia; c = statistically significant ($p < 0.05$) when compared with mackerel; d= statistically significant ($p < 0.05$) when compared with herring.

The results in table 1 shows that all the fish species are good sources of protein with catfish having the highest protein content (20.26 ± 1.47 %) and herring with a significantly lower ($p < 0.05$) protein content (18.45 ± 0.47 %). The protein content of the fish samples ranged from 18.45 to 20.26 %. The relatively high to moderate percentage crude protein may be attributed to the fact that fishes are good source of pure protein, but the differences observed in values obtained could also be as a result of fish consumption or absorption capability and conversion potentials of essential nutrients from their diets or their local environment into such biochemical attributes needed by the organisms body [12, 13].

Generally, lipids are soluble in ether hence they are ether extractable. They serve as source of energy during starvation and fasting. The mean oil content (3.13 ± 0.06 %) of Catfish was relatively low compared to the oil content of the other three fishes. Mackerel had the highest mean oil content (12.33 ± 1.08 %). According to Ackman [14], generally fish can be grouped into four categories according to their fat content: lean fish (< 2 %), low fat (2 to 4 %), medium fat (4 to 8%), and high fat (> 8%). There was no significant difference ($p < 0.05$) between catfish and tilapia as was seen in mackerel and herring. The marine fishes (mackerel and herring) had a higher lipid content than the fresh water fishes hence their classification as high fat fishes. This indicates that the marine fishes are better sources of lipid in the body when consumed. The low concentrations of lipid in the muscles of the fresh water species could be due to poor storage mechanism and the use of fat reserves during spawning activities [15].

The ash content in marine fish species was generally higher (Mackerel1.79 ± 0.89 %; Herring 1.51 ± 0.96 %) than that of the fresh water samples (Catfish 1.26 ± 0.14 %; Tilapia 1.17 ± 0.06 %). There was no significant difference ($p < 0.05$) between the values. The observed range of ash content (1.17 to 1.79 %) in the fishes indicates that the species is a good source of minerals such as calcium, potassium, zinc, iron and magnesium. Ash is a measure of the mineral content of food item. It is the inorganic residue that remains after the organic matter has been burnt off. A good source of instant energy that comes to the mind is carbohydrate. It also helps in the body's development and growth. The carbohydrate content in fish is generally very low and practically considered zero [16]. The result in Table 1 shows that the various fish species are poor sources of carbohydrate. Mackerel has a high mean carbohydrate content of 0.63 ± 0.14 % while the fresh water fishes (Catfish and Tilapia) had a low mean carbohydrate content of 0.41 ± 0.45 % and 0.41 ± 0.04 % respectively. There was no significant difference ($p < 0.05$) between the values. The relatively low values of carbohydrate could be due to higher values of moisture and a relatively high value of protein content.

CONCLUSION

This study clearly indicates that the proximate values obtained would be useful to help the consumers in choosing fish based on their nutritional values besides providing an update to food composition database.

REFERENCES

[1] Claucas IJ, Ward AR, Post-harvest Fisheries Development. A Guide to Handling, Preservation, Processing and Quality. Charthan Maritime, Kent ME4 4TB, United Kingdom 1996.
[2] Duffus JH. Environmental Toxicology. Resource and Environmental Science series, Edward Arnold Publishers London, England. 1980. 164.
[3] Neil JS. Fish consumption, fish oil, lipids, and coronary heart disease, Circulation. 1996;94:2337-40.
[4] Nestel PJN. Fish oil and cardiovascular disease: lipids and arterial function. Am. J. Clin. Nutr. 2000;71: 228-31.
[5] Evangelos SL, Aggelousis G, Alexakis A, "Metal and proximate composition of the edible portion of 11 freshwater fish species". J. Food Comp. Anal, 1989. 2: 377-81.
[6] Steffens W. Freshwater fish- wholesome foodstuffs". Bulg. J. Agric. Sc. 2006;12: 320-8.
[7] Harris WS, "n-3 fatty acids and serum lipoproteins: human studies". American Journal of Clinical Nutrition 1997;65:1645S-54S.
[8] Holland B, Brown J, and Buss DH, Fish and fish products; the third supplement to McCance & Widdowson's "The composition of foods" 5th edition, HMSO, London 1993.
[9] Pearson D, and Cox, HE, "The Chemical Analysis of Foods" (7th edition) Churchill Livingstone 1976. 575.
[10] AOAC, In: Helrich K (Ed.). Official Methods of Analysis of the Association of Official Analytical Chemists (15th edition)". Airlington: Association of Official Analytical Chemists 1990. Section 969: 33.
[11] Omolara OO, Omotayo, OD. Preliminary Studies on the effect of processing methods on the quality of three commonly consumed marine fishes in Nigeria. Biokemistri Journal 2008;21:1-7.
[12] Burgress GH, "Increasing the direct consumption of fish". In: W Pirie (Edu). Food Protein Sources. International Biological Programme 4. Cambridge, 1975. p.187- 200.
[13] Adewoye SO, and Omotosho, JS. Nutrient Composition of some freshwater Fishes in Nigeria. BioSci. Res. Commun. 1997;11(4):333-6.
[14] Ackman RG. Nutritional composition of fats in seafoods. Prog. Food Nutr Sci. 1989;13:161-241.
[15] Osibona AO, Kusemiju K, Akande GR. Proximate composition and fatty acids profile of the African Catfish Clarias gariepinus. Acta SATECH 2009;3(1):85–9.
[16] Payne SA, Johnson BA, and Otto RS. Proximate composition of some north-eastern Pacific forage fish species. Fish Oceanography 1999;8(3):159-77.

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CONFLICT OF INTEREST

No conflict of interests was declared by authors