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PROXIMATE AND MINERAL COMPOSITION OF FRESH AND DRIED AFRICAN CATFISH (*Clarias gariepinus*) FROM NSIDUNG BEACH, CALABAR, NIGERIA

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ABSTRACT

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The proximate and mineral composition of fresh and oven-dried catfish (Clarias gariepinus) from Nsidung beach, Calabar River, Nigeria were determined using standard methods. Purchased quantities of African catfish was shared into two parts: one part was used to determine the proximate composition of the raw fish and the other part was oven dried at a temperature of 120°C for 30 minute and proximate composition determined. Results showed mean moisture, protein, fat, ash, fibre and carbohydrate composition of raw fish to be 87.50±0.1%, 44.29±0.01%, 8.20±0.02%, 7.67±0.02%, 0.32±0.02% and 39.35±0.01% respectively, while the oven dried was 10.50±0.1%, 38.32±0.01%, 9.40±0.1%, 8.50±0.1%, 0.29±0.01% and 43.24±0.01% respectively. The elemental minerals detected were in the order Na>Ca>K>Mg>Zn>Fe. Consumers can now know the benefit to derive when these fishes are consumed. The study has provided an insight into the mineral content of these fish species in line with food and safety when consumed. More intake of these fish should be encouraged due to its high nutritional efficiency.

INTRODUCTION

In developing countries, fish is one of the potential sources of animal protein and essential nutrients for the maintenance of a healthy body compared to other sources of protein (Fawole *et al*., 2007). In recent years, fish has become favourite food stuff for the majority of societies because of several health reasons (Ali and Kiumars, 2010). The principal component of fish are water, protein, lipids and carbohydrate (Waterman, 2000) while the following minerals are commonly found in fish, sodium, potassium, calcium, magnesium, phosphorus, sulphur, Iron, chlorine, silicon, manganese, zinc, copper, arsenic and iodine (Dana *et al*., 1985). The knowledge of fish composition is essential for its maximum utilization. The nutritional composition of fish varies greatly from one species and individual to another, depending on age, feed intake, sex and sexual changes connected with spawning, the environment and season (Silva and Chamul, 2000). Processors have direct interest in the proximate composition of fish in order to know the nature of the raw materials before chilling, freezing, smoking and canning can be correctly applied (FAO, 2004). Moreover, the measurement of some proximate profile such as protein contents, carbohydrates, lipids, moisture content and ash percentage is often necessary to ensure that they meet the requirements of food regulations and commercials specifications (Waterman, 2000).

Nigerians are large consumers of fish and it remains one of the main products consumed in term of animal protein. It is cheap and highly acceptable with little or no religious bias, which gives it an advantage over pork or beef (Eyo, 2001). The fishery sector is estimated to contribute 3.5% of Nigeria's Gross Domestic Product (GDP) and provides direct and indirect employment to over six million people (FAO, 2004). Fish is a very important source of animal protein in the diets of man. Smoked or dried fish is a traditional part of the diet of a large section of the world's population. However, the gap between the demand and supply of fish is widening due to increase in population, poor post-harvest handling, lack of processing and storage facilities and utilization of unconventional fish species (Ayuba and Omeji, 2006). Spoilage is a metabolic process that causes food to be undesirable or unacceptable for human consumption due to changes in sensory and nutritional characteristics (Doyle, 2007). The processing and preservation of fresh fish were of utmost importance since fish is highly susceptible to deterioration immediately after harvest and also to prevent economic losses (Okonta and Ekelemu, 2005). If fish is not sold fresh preservation methods should be applied to extend the shelf life. These include freezing, smoking, drying and heat treatment (sterilization, pasteurization, etc). Among the several methods of long term preservation of fish, smoking is perhaps the simplest method as it does not require sophisticated equipment or highly skilled workers. In an attempt to reduce the problems often encountered during smoking, Nigeria Stored Products Research Institute (NSPRI) Fish smoking kiln was developed.

Studies on the proximate composition of catfish (*Clarias gariepinus*) smoked in Nigerians Stored Products Research Institute (NSPRI) was investigated by Olayemi *et al*. (2012). The general acceptances as shown by sensory evaluation were high, thus, they concluded that drying does have a positive effect on fish since there was an increase in embedded nutritional parameters. Therefore, considering the various health risk and the nutritional benefits associated with fish consumption; it is therefore important that fish mineral and proximate composition be assessed in order to establish the safety level of the table sized species prior to their consumption. These led to

the reason for determination of the proximate and mineral composition of *Claris gariepinus* (African catfish) from Nsidung Beach, Calabar South, Cross River State, Nigeria.

MATERIALS AND METHODS

Study area and sample collection

Fish samples were purchased from the fish mongers at Nsidung beach, Calabar, Cross River State, Nigeria. Nsidung beach is one of the fish landing ports along the Calabar River, Nigeria. Only freshly caught fish was bought and stored in an ice-chest and transported to the Department of Biochemistry, University of Calabar, for proximate analysis. Purchased samples of *C. gariepinus* from the study area were removed from ice-chest and prepared for smoking by eviscerating and degutting, thereafter washed and placed on trays to be smoked (Eyo, 2001). This was smoked using a Fish smoking kiln at a temperature of 100 °C for 5 hours. The samples consist of both sexes with sizes ranging from 800 g to 1.2 kg. Fish samples were purchased once during the rainy season.

Chemical analysis

Three (3) samples each of both raw and oven dried African catfish (*Clarias gariepinus*) were randomly selected and taken to Department of Biochemistry laboratory, University of Calabar, Nigeria for determining proximate composition and mineral content. The method used was the standard method of Association of Official Analytical Chemists (AOAC, 2005).

Statistical analysis

The results of proximate composition and mineral contents of the samples obtained were subjected to One-way Analysis of Variance (ANOVA) using SPSS version 19 to test for significant difference at 0.05 level. Results with $p<0.05$ were considered significantly different.

RESULTS

Proximate composition

The proximate composition of fresh and dried African catfish *Clarias gariepinus* from Nsidung Beach, Calabar South, Cross River State, Nigeria is shown in Table 1. Results show that crude protein content was significantly higher ($p<0.05$) in fresh fish samples 44.29% than oven dried 38.32% samples. Similarly, moisture content was higher ($p<0.05$) 87.50% in the fresh fish samples than dried samples 10.50%. However, carbohydrate in the fresh fish sample was significantly lower ($p<0.05$) 39.35% compared to oven dried sample 43.24%. Same thing was observed in crude fat content of the fresh fish samples 8.20% against the oven dried samples 9.40% ($p<0.05$). Crude fibre of fresh fish sample was insignificantly higher ($p>0.05$) 0.32% than oven dried samples 0.29%. Ash content was significant lower ($p<0.05$) 7.67% in the fresh fish samples than oven dried samples 8.50%.

Table 2 shows the mineral composition of fresh and oven dried fish samples of *C. gariepinus*. For the purpose of this experiment, only Sodium, Potassium, Iron, Calcium, Magnesium and Zinc were analyzed. Among the 6 element investigated, all were significantly different ($p<0.05$). In the fresh fish sample, 176.95 mg g^{-1} was recorded while the oven-dried sample had 148.60 mg g^{-1} sodium. Potassium recorded 28.40 mg g^{-1} in fresh fish sample and in oven-dried sample 23.92 mg g^{-1} was obtained. 128.30 mg g^{-1} of Iron was detected in the fresh fish sample with 78.34 mg g^{-1} of mineral in oven dried fish sample. The amount of Zinc recorded in fresh fish sample was 17.62 mg g^{-1} and 13.90 mg g^{-1} obtained in oven dried samples. In the fresh fish sample, 128.30 mg g^{-1} of Calcium was recorded while 78.34 mg g^{-1} was recorded in oven dried fish sample. Magnesium 22.52 mg g^{-1} was found to be higher in fresh fish samples while the oven dried fish sample recorded 18.87 mg g^{-1} value.

DISCUSSIONS

Proximate composition of fresh and dried fish samples of *Clarias gariepinus*

Ogbonnaya and Ibrahim (2009) studied the effect of drying methods on proximate compositions of catfish (*C. gariepinus*), they reported changes in moisture, protein, lipids energy value, vitamin A and phosphorus contents to be significant for the two drying methods, while ash, fiber, carbohydrate, vitamin C and potassium contents showed no significant differences for the two drying methods used in their study. Their results indicated that drying methods have effect on the proximate compositions of catfish and electric oven drying was recommended for healthy eating and for long shelf life of dried fish (Ogbonnaya and Ibrahim, 2009). Onwordi *et al.* (2009) studied the proximate and mineral content of traditional smoked fish gotten from lake Kainji in Nigeria, they reported that proximate analysis showed significant differences ($p<0.05$) among the fish samples.

The result in Table 1 indicates that there were 87.50% and 10.50% moisture content for fresh and dried fish samples respectively. (Olayemi *et al*., 2012) observed that about three quarter of the body weight of catfish consist of water and an urgent step must be taken for its protection against destructive agent like microorganisms. In this study, water content was rapidly removed in the fish exposed to oven drying. This observation is in agreement with the observation of Omafuvbe and Kolawole (2004); that oven drying generally achieved the required moisture content in food earlier and more uniformly than sun drying. The total water content in fish depends on the species, morphological and structural differences of the tissues, age, size, collection site or seasonality. According to Effiong and Mohammed (2008), the water content of fish affects the microbial and

chemical stability, physical properties, processing, storage and distribution. A safe moisture level of 6 to 8% in dried fish has been recommended in order to prevent spoilage due to microbe and pest proliferation. Aside moisture content, crude protein recorded the highest nutrient value with fresh *C. gariepinus* having greater crude protein than oven-dried *C. gariepinus*. This makes the fish an important living resources of dietary protein as other sea and fresh water fish (Zuraini *et al*., 2006). High lipid fishes had less water and more protein than low lipid fishes; this is in line with the report of Steffens (2006) that protein forms the largest quantity of dry matter in fish.

Table 1: Proximate composition of fresh and oven dried samples of *Clarias gariepinus* used for the study (mg per 100g dry matter)

Parameters	Fresh	Oven-dried	
Moisture	87.50±0.1%	10.50±0.1%	*
Ash	7.67±0.02%	8.50±0.1%	*
Crude Protein	44.29±0.01%	38.32±0.01%	*
Crude Fat	8.20±0.02%	9.40±0.1%	*
Crude fibre	0.32±0.02%	0.29±0.01%	Ns
Carbohydrate	39.35±0.01%	43.24±0.01%	*

Means ± SD, Ns indicates no significant difference ($p>0.05$), * indicates significant difference ($p<0.05$) Mineral Composition

Table 2: Elemental composition of fresh and oven dried samples of *Clarias gariepinus* used for the study (mg per 100g dry matter)

Parameters	Fresh	Oven dried	
Sodium	176.95±0.01%	148.60±0.1%	*
Potassium	28.40±0.1%	23.92±0.02%	*
Calcium	128.30±0.1%	78.34±0.02%	*
Magnesium	22.52±0.02%	18.87±0.02%	*
Iron	12.93±0.01%	9.03±0.01%	*
Zinc	17.62±0.01%	13.90±0.01%	*

*indicates significant difference ($p<0.05$), Means ± SD

The Ash content in the oven-dried samples was higher than in fresh samples because of water loss related to these treatments. Balogun (1988) recorded 1.6±76% ash content in sun dried *Sierrathrisa leonensis* while 4.60±0.06% were recorded as the ash content in *Arius parkii* and *Oreochromis niloticus* respectively. In this study, fresh fish had lower fat concentration of 8.20±0.02%, as against oven-dried samples (9.40±0.1%). Studies revealed that lipid content fluctuate considerably with age, feed and sexual cycle of fish (Silva and Santos, 2008). Based on 5% fat composition criteria for discriminating lean fish from fatty species (Ackman, 1989; Stansby, 1982), it was apparent that *Clarias gariepinus* could be regarded as fatty fish species. Higher amount of carbohydrate (43.24±0.01%) was found in the oven-dried fish while (39.35±0.1%) was present in fresh fish sample. This is dissimilar with report of Akinneye *et al.* (2010) who recorded 20.8% and 18.30% carbohydrate levels in fresh *Sardinella* sp. *and Heterotis niloticus* respectively which implies *Clarias gariepinus* contains more carbohydrate (39.35%) than *Sardinella* sp. and *Heterotis niloticus* when fresh. The main function of carbohydrate is to provide energy to the body so as to perform muscular contraction and numerous physiological functions. Low carbohydrate diet has been reported to lower blood pressure by causing weight loss and improving insulin sensitivity in diabetes (Holden *et al.*, 2003). The fibre content was low in both treatments. The higher fibre content (0.32±0.02%) was recorded in the fresh fish samples while (0.29±0.01%) was detected in oven dried fish sample, although a diet high in soluble fibre can reduce total serum cholesterol by as much as 15% in man. There is a meager or no fibre in animal product such as meat, egg or diary product. Fibre aids and speeds up the excretion of waste and toxin from sitting in the intestine or bowel for too long, and thereby avoiding a build-up of several diseases.

Mineral composition of fresh and dried fish samples of *Clarias gariepinus*

All fish samples examined contained appreciable concentrations of potassium, sodium, magnesium, zinc, iron and calcium, suggesting that this fish can be used as a good source of minerals. The minerals were in the order Na>Ca>K>Mg>Zn>Fe in composition. Potassium is an essential nutrient used to maintain fluid and electrolyte balance in the body. Iron is essential for metabolic reactions and regulation of cell growth and differentiation and is an important constituent of hemoglobin (Onwordi *et al.*, 2009). The concentration of Sodium (Na^+) numerically dominated other assayed elements, although all analyzed elements were significantly higher in fresh samples of *C. gariepinus* than oven-dried. This is an indication that the water body from which the fish was collected is very rich in Sodium and that must have allowed an active movement of this ion across the gill structure, which in turn may depend on the concentration in the external medium and that the richness in Sodium (Na^+) concentration would boost the osmo-regulatory activation in the organism (Bently, 1971). Values obtained in calcium (Ca) for fresh fish was high compared to that of the oven dried. Calcium is good for growth and maintenance of bones, teeth and muscles (Turan *et al*., 2003). Normal extra-cellular calcium concentrations are necessary for blood coagulation and for the integrity of intracellular cement substances (Okaka and Okaka, 2001). Magnesium (Mg) present in fish when eaten helps prevent cardiovascular diseases. It can also be used to treat diabetes and hypertension (Darl, 1972).

CONCLUSION

Moisture, protein, carbohydrate, fat, ash and fibre in fresh fish samples were 87.50±0.1%, 44.29±0.01%, 39.35±0.01%, 8.20±0.02%, 7.67±0.02%, 0.32±0.02% respectively, while in oven dried was 10.50±0.1%,

38.32±0.01%, 43.24±0.01%, 8.50±0.1%, 0.29±0.01% respectively. Generally, among the elemental composition analyzed, the values obtained were in the order of N>Ca>K>Mg>Zn>Fe in both fresh and dried fish samples. It can be suggested that taste, size, freshness and other related external appearances should be taken into consideration when making choices for consumption of fishes. This study has also provided an insight into the mineral content of these fish species in line with food and safety when consumed since the nutritional value of this species has been verified. Consumers can now know the benefit to derive when these fishes are consumed. More intake of these fish should be encouraged due to its high nutritional efficiency.

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