



## PROXIMATE AND ESSENTIAL MINERAL COMPOSITION OF FRESH AND SMOKED CATFISH AND BEEF SOLD IN MINNA, NIGER STATE



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**Abstract:** This study was carried out to assess the nutritional composition of fresh and smoked Catfish and beef available in Minna, Niger state. Samples were analyzed for proximate parameters (moisture, crude protein, crude fibre, ash, fat and carbohydrate) and essential mineral contents (Na, K, Ca, Mn and Cu). The results of proximate analysis revealed high protein content of  $41.15 \pm 1.87$  and  $36.66 \pm 0.61\%$  in smoked catfish and beef respectively, while the low level of protein with  $11.65 \pm 1.99$  and  $9.85 \pm 2.19\%$  in fresh catfish and beef. Low level of crude fat of  $4.67 \pm 1.74$  and  $9.46 \pm 0.98\%$  were observed in fresh and smoked beef, while high level of crude fat with  $24.42 \pm 5.32$  and  $20.99 \pm 2.30\%$  were recorded for fresh and smoked catfish. The samples also contain some appreciable amount of essential minerals with potassium having the highest concentration of essential mineral of ( $239.70 \pm 66.91$  and  $319.44 \pm 4.13$  mg/100g) and ( $452.26 \pm 41.03$  and  $444.76 \pm 23.18$  mg/100g) in fresh and smoked fish and beef. While manganese Mn the lowest concentration ( $0.25 \pm 0.21$  and  $0.25 \pm 0.11$  mg/100g) and ( $0.15 \pm 0.01$  and  $0.18 \pm 0.05$  mg/100g) in fresh and smoked fish and beef, respectively. From this study, it has been established that fresh and smoked catfish and beef contain series of proximate parameters and essential minerals which can be added to the diet to complement human nutritional requirements.

**Keywords:** Fish, nutritional, proximate, composition, minerals, beef

### Introduction

One of the complex issues faced in developing countries like Nigeria is food security where animal derived proteins, such as meat and meat items, fish and fish items are lacking in most diet of the populace which has resulted in chronic malnutrition. The nutrient content in the consumer's food can be used to estimate the adequacy of dietary intake of the population, diet disease relationships, health and nutritional status and for achieving the dietary intake goals of the population (Ogundiran *et al.*, 2014). Meat products are very essential in the diet of man since it contain the vital nutrients needed for the proper growth and maintenance of the body (Onyango *et al.*, 2017). Fresh meat and fish are the most perishable products if not adequately preserved since they can easily be attacked by microbes. Preserving of foods make them to be safe for consumption and also increase their shelf lives. A number of processing techniques are utilized for the preservation of meat and fish and these include chilling, freezing, salting, canning, drying and smoking (Stumbo, 2013). However, smoking is the most popular method used. Smoking as a food processing technique is a temporary, but an effective method of preserving food products. It helps to improve texture and also adds flavor to them (Abolagba *et al.*, 2015).

The essential minerals and proximate compositions of food are important for assessing the economy viability of any nation. Since a healthy man brings about a healthy economic development and invariably a healthy nation. Preservation of food by smoking often affect some of these essential minerals and proximate compositions of meat and fish by either denaturing them depending on the smoking temperate and nature of woods type used (Adeyeye *et al.*, 2015).

Most diets of man are deficient of these essential minerals derivable from animals. This has led to malnutrition and increase in various health challenges amongst the populace. Global changes in consumer's life style marked by the increasing demand for nutritional and healthy food products has resulted in the continuing rise in demand for fresh and ready-made food such as fish and meat, Fish and meat account for the greater percentage of total protein intake in our diet (Akinsegun *et al.*, 2014; Onyango *et al.*, 2017). The knowledge of their proximate and essential mineral compositions is very important for the estimation of their quality and adequacy in the diet of the consumer. It is

therefore imperative to assess the proximate and essential mineral contents of these food products (Fresh beef and catfish (*Clarias gariepinus*) and smoked beef and catfish (*Clarias gariepinus*) and comparing the experimental result obtained with the recommended limits so as to ensure consumer safety and healthy living since the minerals when present at lower or greater concentrations, pose hazard to human health.

### Materials and Methods

#### Sample collection

Fresh fish and dried catfish (*Clarias gariepinus*) samples were obtained from fish market behind Mobil filling station Minna while fresh beef samples were obtained from Minna Abattoir, Niger State, Nigeria. The smoked beef samples were obtained from the local road side smoked meat vendors (known as Mai Suya in Hausa) and labeled accordingly. The fish samples were placed in polyethylene bags and were immediately transported to Water Aquaculture and Fishery Technology (WAFT) Department laboratory in the Faculty of Agriculture and Agricultural Technology, Federal University of Technology, Minna for identification and authentication.

#### Preparation of fresh and smoked samples

Both fresh catfish and beef samples were washed with tap water and then with distilled water to remove adhering substances and then drained. The catfish was dismembered with a knife and the guts were removed. The fresh sample was oven-dried at a temperature of  $105^{\circ}\text{C}$ , pulverized into powder and was then stored in a capped plastic container for further analysis. Furthermore, the smoked sample was deboned, pulverized and stored for further analysis.

#### Proximate analysis

Proximate composition (moisture, ash, Fat, crude fibre, crude protein and carbohydrate) of the smoked and fresh beef and Catfish samples were carried out according to the AOAC (2007) method.

#### Digestion of samples for essential mineral analysis

The digestion of samples (Fresh beef and fish and smoked beef and fish) was carried out using a mixture of concentrated  $\text{HNO}_3$  and  $\text{HClO}_4$  in the ratio of 2:1.  $10\text{ cm}^3$  of the mixture was added into a digestion flask containing 2.0 g of the pulverized fresh beef sample. It was then digested in a fume hood until a clear solution/digest was obtained. This was then cooled filtered using Whatman No1 filter paper into a  $100\text{ cm}^3$

volumetric flask and it was made up to the mark with distilled water. Same digestion method was carried out for fresh fish, smoked meat and fish samples.

The essential mineral compositions (Ca, Mn, Fe, and Cu) were analysed using AAS (Bulk Scientific, Model: Accusys 211) atomic absorption spectrophotometer and the Na and K content in the sample by flame photometric method.

**Results and Discussion**

The result of the proximate compositions of the different beef and cat fish samples is presented in Table 1. From the result on the proximate of the studied catfish and beef, the moisture content of the smoked samples was lower than the fresh samples. Fresh catfish and meat had the highest moisture contents of 55.33±3.56 and 70.37±0.47%, while the smoked samples had 22.59±1.18 and 32.51±1.33% separately. This result is comparable with the findings of Jolaoso *et al.* (2016) of between 20.96 to 76.70% moisture content in smoked fish and 43.24 to 76.79% in fresh fish samples respectively. Moisture content of food is an indication of the relative stability of food substances and this also influences the protein and lipid compositions (Olagunju *et al.*, 2012). Since the higher the moisture content of food, the less stable the food, if not adequately preserved.

The highest crude protein content of 41.15±1.87% was obtained from smoked catfish while the least value of 9.85±2.19% was obtained from fresh beef. The percentage crude protein of a food determines its dietary quality. This finding is in line with the report of Lucas *et al.* (2013), from their study on the nutritional compositions of *Clarias gariepinus* obtained from NIOMR smoking furnace and opined that the protein content of the fish increases with smoking. The high composition of proteins from the present study can account for good sources of protein for the consumer. While the variation across species can be attributable to the age, breeding and feeding habit of the fish and cow (Jolaoso *et al.*, 2016). In this study, smoked samples had higher crude protein content compared to the fresh samples. This is also in line with the report of Akintola (2014). The high protein content in smoked samples goes to suggest that that smoking of the food bring about

concentration of crude proteins in the smoked fish and beef due to decrease in moisture content (Aladetohun and Ndimele, 2010).

The high content of crude fiber in the smoked fishes could be as a result of oxidation of the poly unsaturated fatty acids (PUFA) present in their tissues into peroxides, aldehydes, ketones and free unsaturated fats (Ayinsa and Maalekuu, 2013).

In this study, there was variation in the ash content of both fresh and smoked meat and fish samples, with smoked catfish having the highest ash content of 3.19±0.16%, while smoked beef had the least with 2.05±0.16%. This could be due to the variation in the feeding rate or the type of feed from which the sampled animals were fed. Ash content is a measure of the mineral content of food substance. It is the inorganic deposit that remaining after the organic component has been burnt off (Akinsegun *et al.*, 2014). The level of ash content from the present study is an indication that the analyzed fish and beef samples could act as great sources of minerals such as, sodium, calcium, potassium, manganese and copper.

Smoking and salting can be attributed to the high fat content in smoked fish samples due to the oxidation of the poly unsaturated fats (PUFA) contained in the fish tissue into peroxides, aldehydes, ketones and the free unsaturated fats by these additives (Holma and Maalekuu, 2013), thus, bringing about the high crude fat content as observed for smoked fish in from this study. However, the contrary was observed for smoked beef. This variation could be attributable to the feeding habit and other environmental factors associated with their habitat (Abolagba *et al.*, 2015). The low fat content in beef sample could also be attributed to the utilization of stored fat by the cow through the process of walking and running by the animal when alive.

Carbohydrate helps in body development. The low carbohydrate content from the analyzed meat and fish samples could be due to the high moisture and protein contents in the samples. The low carbohydrate in catfish compared to beef could be attributed to the fact that the glycogen content in the fish sample does not contribute much to the carbohydrate content in the fish tissue (Daniel, 2015).

**Table 1: Proximate compositions of fresh and smoked catfish (*Clarias gariepinus*) and beef samples**

Parameter	<i>Clarias gariepinus</i>		Beef	
	Fresh	Smoked	Fresh	Roasted
Moisture	55.33±3.56 <sup>c</sup>	22.59±1.18 <sup>a</sup>	70.37±0.47 <sup>d</sup>	32.51±1.33 <sup>b</sup>
Crude protein	11.65±1.99 <sup>a</sup>	41.15±1.87 <sup>b</sup>	9.85±2.19 <sup>a</sup>	36.66±0.61 <sup>b</sup>
Crude fibre	0.71±0.02 <sup>a</sup>	0.68±0.24 <sup>a</sup>	-	-
Ash	2.26±0.08 <sup>ab</sup>	3.19±0.16 <sup>c</sup>	2.84±0.23 <sup>bc</sup>	2.05±0.16 <sup>a</sup>
Fat	24.42±5.32 <sup>c</sup>	20.99±2.30 <sup>bc</sup>	4.67±1.74 <sup>a</sup>	9.46±0.98 <sup>ab</sup>
carbohydrate	5.66±0.11 <sup>a</sup>	11.37±0.76 <sup>b</sup>	12.26±3.66 <sup>b</sup>	19.34±1.11 <sup>c</sup>

Results are Mean ± Standard deviation of triplicate analysis. Those with different superscripts are significantly different, while those with similar superscripts are not significantly different at p ≤ 0.05.

**Table 2: Mineral composition (mg/100g) of smoked and fresh smoked catfish (*Clarias gariepinus*) and beef**

Parameter	<i>Clarias gariepinus</i>		Beef		FAO/WHO (2011)
	Fresh	Smoked	Fresh	Roasted	
Na	127.56±8.54 <sup>a</sup>	143.98±33.18 <sup>b</sup>	184.18±0.40 <sup>c</sup>	185.11±4.78 <sup>c</sup>	-
K	239.70±66.91 <sup>a</sup>	319.44±4.13 <sup>b</sup>	452.26±41.03 <sup>c</sup>	444.76±23.18 <sup>c</sup>	-
Ca	69.35±3.09 <sup>b</sup>	110.82±14.27 <sup>c</sup>	34.20±0.80 <sup>a</sup>	36.16±3.35 <sup>a</sup>	5.00-502.00
Mn	0.25±0.21 <sup>b</sup>	0.25±0.11 <sup>b</sup>	0.15±0.01 <sup>a</sup>	0.18±0.05 <sup>a</sup>	2.00-9.00
Cu	0.40±0.18 <sup>a</sup>	0.42±0.02 <sup>a</sup>	0.34±0.0 <sup>a</sup>	0.30±0.09 <sup>a</sup>	3.00

Results are Mean ± Standard deviation of triplicate analysis. Those with different superscripts are significantly different, while those with similar superscripts are not significantly different at p ≤ 0.05.

Essential minerals are very important for body metabolic processes of living organism. Catfish and beef are among the most important sources of these minerals. Table 2 shows the mineral constituents of the studied fresh and smoked fish and beef. From the result, fresh fish had essential mineral concentrations ranging from  $0.25 \pm 0.21$  to  $239.70 \pm 66.91$  mg/100g while essential mineral content in smoked fish ranged from  $0.25 \pm 0.11$  to  $319.44 \pm 4.13$  mg/100g with potassium having the highest and manganese the least for both fresh and smoked fish. Similar trends was observed for smoked and fresh beef, with fresh beef having essential mineral concentrations ranging from  $0.15 \pm 0.01$  to  $452.26 \pm 41.03$  mg/100g and the smoked beef ranging from  $0.18 \pm 0.05$  to  $444.76 \pm 23.18$  mg/100g with potassium having the highest and manganese the least for both fresh and smoked beef. This result is general higher than those reported by other workers in their study on essential minerals composition in selected fish samples (Bello *et al.*, 2016). Generally, most of the minerals analysed are within the FAO/WHO (2011) recommended limit. It can also be observed from the result, that the smoked fish and beef had higher concentrations of these minerals compared to the fresh samples. The high concentrations of these metals in smoked catfish and beef compared to the fresh samples could be attributed to the smoking process that may have led to the oxidation of some of the metallic materials used for the smoking resulting to their deposition on the fish and beef samples and subsequent increase in the concentration of these metals in the smoked fish and beef compared to the fresh samples. It can also be attributable to other additives added to the fish and beef during their smoking process.

#### Conclusion

The result from this study has provided vital information on the proximate and essential mineral compositions of fresh and smoked *Clarias gariepinus* and beef sold within Minna metropolis, Niger state. From this study, it has been established that fresh and smoked catfish and beef contain series of proximate parameters and essential minerals which can assist in complementing the nutritive values derivable from the consumption of these fish and meat. From this study, it can be stated that catfish has more of the essential minerals analyzed compared to beef.

From the results obtained from this study, it is recommended that since fish and meat provide consumers with essential nutrients required for healthy growth, frantic effort should be made by food regulatory bodies to carry out routine analysis of nutrient composition of smoked catfish and beef to ensure that their essential and heavy metal contents are within the permissible limit that will not be deleterious to the health of the consumers.

#### Conflict of Interest

Authors declare that there is no conflict of interest related to this study.

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