

# Seasonal Variation in Nutritional Quality of Catfish (*Clarias gariepinus*) from Upper Jebba Basin, Nigeria

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## Abstract

Fish protein is regarded as quality protein being rich in essential amino acids with a high digestibility value. The biochemical composition of the fish differs with the change in habitat as well as season. Samples of freshwater catfish (*Clarias gariepinus*) from Upper Jebba Basin, Nigeria were analyzed during the dry and wet seasons to study the variation in proximate composition of nutrients and mineral content using standard procedures in dry weight basis. The results revealed the presence of the moisture content with an average mean of  $4.26 \pm 1.04\%$  in dry season while wet season recorded  $5.63 \pm 1.27\%$ . The ash content in dry and wet season is  $6.10 \pm 0.85\%$  and  $4.66 \pm 0.46\%$  respectively while the crude fibre were generally low with significantly variation ( $P < 0.05$ ) between  $0.84 \pm 0.12\%$  in dry months and  $0.57 \pm 0.25\%$  in wet months. The average mean values of crude protein were slightly higher at  $64.47 \pm 0.58\%$  in wet months than  $63.10 \pm 2.10\%$  in dry months. Variation in crude fat content for both season were within a narrow range with an average mean of  $4.03 \pm 0.16\%$  and  $4.09 \pm 0.03\%$  for dry and wet season respectively. Average Nitrogen Free Extract (Carbohydrate) of  $20.76 \pm 1.43\%$  in dry season was comparatively higher than  $19.86 \pm 1.55\%$  in wet months. The mineral composition of the fish in both seasons varied significantly ( $P < 0.05$ ) in Ca, K, Cu and Zn% mean concentration.

**Keywords:** Composition; Nutrient; Seasonal; Variation

## Introduction

The main components of fish are; water, protein, lipid and carbohydrate [1], while sodium, potassium, calcium, magnesium, phosphorus, sulphur, iron, chlorine, silicon, manganese, zinc, copper, arsenic and iodine are the common minerals found in fish [2].

These nutrient composition of a particular species often appears to vary from one fishing ground to another [3] and from season to season [3-5], but the basic causes of change in composition are usually variation in amount and quality of food that the fish eats, mobilization of essential elements within its system and for reproduction activities [5] and the amount of movement it makes. Abundance of food supply can markedly change the composition of a species. Therefore, if natural primary productivity is decreased, as would happen in the wet season months, some nutrient reserves might decrease. Furthermore, if a fish is an herbivore, it might lose more reserves than a carnivore or vice versa [5]. Moreover, fishes when overcrowded, insufficiency of food causes low intake and changes in composition accordingly [3]. Hence, fish of various species do not provide the same nutrient profile to their consumers [6,7]. The chemical composition of fish varies greatly from one species and one individual to another depending on age, sex, environment, season and geographical location [8-10].

The African catfish, *Clarias gariepinus* is an ecologically important and commercially valued fish for the Nigerian fishing industry [11]. These mud fish are frequently and widely cultured in ponds and they also occur freely in Nigeria natural fresh water [12].

Generally, the nutrient profile of catfish shows that it is highly nutritious—high in protein, low in fat and cholesterol, and a good source of certain vitamins and minerals [13]. It is also known for its high tolerance to adverse environmental conditions, relatively rapid growth and good market value.

Desire to obtain a nutritionally balanced level of protein intake is the major cause of the high catfish demand in Nigeria. Information

concerning the chemical composition of freshwater fishes in general is of great significance to nutritionists concerned with readily available fish sources of low fat and high protein food [14-16]. It is of utmost importance for the ecologists and environmentalists to determine the effects of changing biological and environmental conditions on the composition, survival and population changes within fish species. However, there is less information in the literature as regards to the nutrient composition of fish from the tropical lake.

The knowledge of fish composition is essential for its maximum utilization [17]. Although fish is purchased on a weight basis, the edible portion is generally only the fillet which usually contain nutrient required from such product. Accordingly, edible portion yield (usually fillet) of fish is important when comparing price of fish purchased on the market. This work compares the nutritive value of *C. gariepinus* in dry and wet season. The species was chosen because of its abundance, ease of recognition by fishermen, availability year-round, and public acceptance as food item.

## Materials and Methods

### Study area

Jebba Upper Basin was dammed to create Jebba Lake in August 1983 as part of a hydroelectric scheme. The basin extends from the dam site at Jebba to southern tip of the Kainji dam at Kainji. The lake

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is therefore unique as the first and the only man-made lake in Nigeria that has a direct flow from another man-made lake located upstream to it. It is located in the northern hemisphere between latitudes  $4^{\circ} 34'12''-4^{\circ} 43'48''E$  and falls within the Guinea savanna comprising of various species of shrubs and high forest plants along the streams and depressions in the area. The climate of the study area usually alternates between dry and rainy season. The area lies within the middle belt of Nigeria with a total annual rainfall between 1270 mm and 1524 mm, spread over the month of April to October [18]. The highest amount of rainfall is observed in the month of August. Monthly temperature is highest in March at about  $30^{\circ}C$  and lowest in August at about  $25^{\circ}C$  [19]. It has a maximum length of 134 km, maximum width of 24.1 km, mean and maximum depth of 11 m and 60 m respectively, surface area of  $1270\text{ km}^2$ , a volume of  $13 \times 109\text{ m}^3$ , and catchment's area of  $1.6 \times 10^6\text{ km}^2$  [20]. Its tributaries include the Awun, Eku, Moshi and Oli rivers. It falls within the savanna zone, but specifically Guinea savanna [21].

Though the primary purpose of constructing the dams is the generation of hydroelectric power, the creation of these lakes offered opportunities for a variety of development projects such as fisheries, irrigated agriculture and improved navigation from the coast up to the Republic of Niger [22].

The predicted fish catch potential using primary productivity and morphoedaphic factors of Kainji Lake Lower Basin (Upper Jebba Basin) was estimated at 909–1818 tons/annum (fresh weight) [21].

### Source of samples

Fresh three sub-adult specimens of *Clarias gariepinus*  $379.33 \pm 25.56\text{ g}$  and  $33.07 \pm 1.50\text{ cm}$  in body weight and length, respectively were procured monthly for six months representing three month of both dry (February to April) and wet season (May to July) making at least nine fish samples per species per season from commercial fishermen using gill nets, cast nets, long lining, and gura traps at Awuru landing site of Upper Jebba Basin, Borgu Local Government Area, Niger state. This fish species size (weight and length) were measured using sensitive scale and meter rule before being put in sterile polythene bags and taken in ice pack to the laboratory. Fish samples were further identify taxonomically using standard reference sources. The sample was transferred into sterile sample container, labeled before taken to laboratory for chemical composition analysis [23,24].

### Sample preparation

Prior to analysis, fish scales were detached and washed with running water before edible muscles (fish meat) samples portion were carefully filleted, which was taken for further processing. Edible muscles were oven dried at  $110^{\circ}C$ , powdered with pestle and mortar and stored until chemical analysis. Prior to digestion samples were separately dried in a laboratory oven at  $65^{\circ}C$  for three days to obtain a constant dry weight of 0.5 g from each sample. The dried samples were each ground to powder, using laboratory ceramic mortar and pestle, and sieved with 2 mm sieve readiness for nutrient analysis according to the method of A.O.A.C. [23] at the chemical laboratory of National Institute for Freshwater Fisheries Resources (NIFFR), Nigeria.

## Results

### Proximate composition of Catfish (*Clarias gariepinus*) in dry and wet season

The proximate composition of dry sample of *Clarias gariepinus* in dry and wet season was presented in Table 1. The moisture content with an average mean of  $4.26 \pm 1.04\%$  while wet season recorded  $5.63$

$\pm 1.27\%$ . The mean ash content in dry and wet season is  $6.10 \pm 0.85\%$  and  $4.66 \pm 0.46\%$  respectively while the crude fibre were generally low at  $0.84 \pm 0.12\%$  in dry months and  $0.57 \pm 0.25\%$  wet months.

The mean values of crude protein were slightly higher ( $64.47 \pm 0.58\%$ ) wet months than  $63.10 \pm 2.10\%$  in dry months. Significant variation ( $P < 0.05$ ) in crude fat content were between an average mean of  $4.03 \pm 0.16\%$  and  $4.09 \pm 0.03\%$  for dry and wet season respectively.

Average Nitrogen Free Extract (Carbohydrate) of  $20.76 \pm 1.43\%$  in dry season was comparatively higher than  $19.86 \pm 1.55\%$  in wet months.

### Mineral concentration of catfish (*Clarias gariepinus*) in dry and wet season

The result of the mineral analysis of the *C. gariepinus* for both dry and wet season was presented in Table 2. The result revealed the presence of both macro elements and micro elements in both season though minute quantity of these elements are presence except for significant seasonal variation ( $P < 0.05$ ) in Calcium and Potassium which are of average mean of  $1.05 \pm 0.19$  and  $5.31 \pm 0.53\text{ mg/g}$  in dry season and  $2.09 \pm 0.93$  and  $4.65 \pm 2.54\text{ mg/g}$  in wet season respectively. Another notable observation is the significant variation in Copper (Cu) and Zinc (Zn) recorded for both dry and wet season.

Overall, the essential mineral composition of the fish in both season are of valuable quantity (Figure 1).

## Discussion

The biochemical composition of the fish muscle generally indicates the fish quality [3]. Therefore, proximate biochemical composition of a species helps to assess its nutritional and edible values.

Nutritional composition of the studied species fell within reported values for fish in the tropics [4,25]. The variation in nutrients of this species often appears to vary from season to season; probably the basic causes of change in composition are usually variation in amount and quality of food that the fish eats and the amount of movement it makes [3] as well as physiological activities. Abundance of food

Nutrient composition (%)	Dry season	Wet season
Moisture	$4.26 \pm 1.04$	$5.63 \pm 1.27$
Ash	$6.10 \pm 0.85$	$4.66 \pm 0.46$
Crude fibre	$0.84 \pm 0.12$	$0.57 \pm 0.25$
Crude protein	$63.10 \pm 2.10$	$64.47 \pm 0.58$
Crude fat	$4.03 \pm 0.16$	$4.09 \pm 0.03$
Carbohydrate (NFE)	$20.76 \pm 1.55$	$19.86 \pm 1.55$

Values are mean  $\pm$  standard error. Means in a row without superscript are not significant different ( $P < 0.05$ )

**Table 1:** Proximate composition of Catfish (*Clarias gariepinus*) in dry and wet season.

Mineral composition (mg/g)	Dry season	Wet season
Phosphorus (P)	$0.08 \pm 0.05$	$0.05 \pm 0.02$
Calcium (Ca)	$1.05 \pm 0.19$	$2.09 \pm 0.93$
Magnesium (Mg)	$0.11 \pm 0.05$	$0.09 \pm 0.07$
Potassium (K)	$5.31 \pm 0.53^a$	$4.65 \pm 2.54^b$
Sodium (Na)	$0.68 \pm 0.01$	$0.68 \pm 0.06$
Manganese (Mn) (100mg/g)	$0.23 \pm 0.05$	$0.20 \pm 0.10$
Iron (Fe) (100mg/g)	$12.33 \pm 1.25$	$13.00 \pm 1.63$
Copper (Cu) (100mg/g)	$0.76 \pm 0.73^a$	$2.60 \pm 0.00^b$
Zinc (Zn) (100mg/g)	$0.73 \pm 0.37^a$	$0.31 \pm 0.05^b$

Values are mean  $\pm$  standard error. Means in a row without superscript are not significant different ( $P < 0.05$ )

**Table 2:** Mineral concentration of Catfish (*Clarias gariepinus*) in dry and wet season.

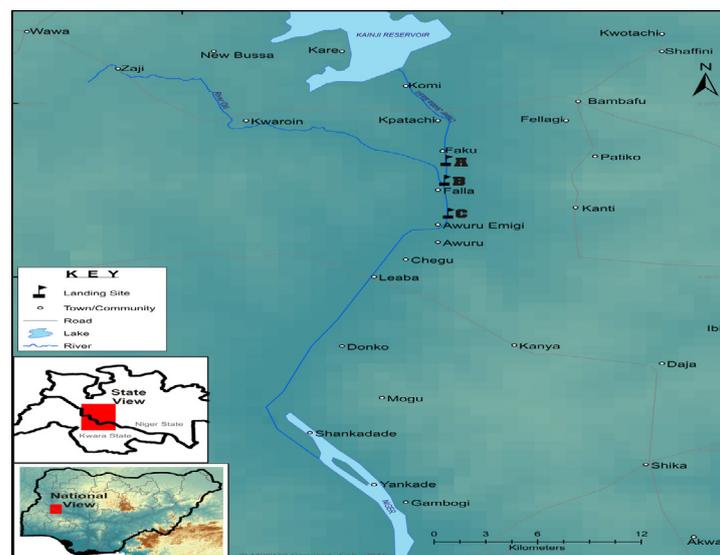


Figure 1: Map of the study areas on Jebba Basin.

supply can markedly change the composition of a species. Moreover, fishes when overcrowded, insufficiency of food causes low intake and changes in fish quality accordingly [5,26]. The high ash content in dry season comparatively with wet season is responsible for more mineral concentration in the fish during the dry season. The findings of the present study with increase in nutrient composition (protein) in wet season than that of the dry conditions are in conformity with the suggestions put forwarded by the previous workers [3,5,26,27].

## Conclusion

The present work has elucidated the importance of local freshwater commercial fish as good sources balance diet, having provides not only palatable meat, but the abundance nutrients and minerals. Catfish contain all requisites amount of essential nutrients with a high biological value for the human use. Though the consumers do eat fish-flesh because of its availability and palatability, but the present work has suggested richness of these nutritional components seasonally. However, the presence of essential nutrients in both seasons is an indication that fish remain a valuable food irrespective of the season.

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