# Survey of Iced Fishes Sold in Makurdi Metropolitan

## Ogbu Chukwuemeka Princewill[1]*, P A Annune[1], Udeh Sylv[2] and J C Ogbu[3]

[1]Department of Fisheries and Aquaculture, University of Agriculture, Makurdi

[2]National Primary Health Care Development Agency, FCT Office, Abuja- Nigeria

[3]Department of Microbiology, University of Abuja

*Corresponding Author
Ogbu Chukwuemeka Princewill, Department of Fisheries and Aquaculture, University of Agriculture, Makurdi.

## Abstract
*This research was carried out to determine the morphometric, meristic and market price of iced fishes sold in makurdi metropolis. Twenty samples of each specie were randomly selected from three major markets and analyzed. Price of each fish species collected was recorded to determine the average price of each fish species. The data obtained from this study was subjected to descriptive statistics. The total weight (543.39g) was highest in Hake, and lowest in Horse mackerel (429.16g) sold in the markets. Total length was highest in Hake (39.08cm) followed by 38.39cm recorded in Sardine and 38.20cm in Croaker. Total length was lowest in the Horse mackerel (34.81cm). Standard length was highest in Hake (32.91cm). Standard length was lowest in Horse mackerel (28.53cm). Other morphometric characteristic showed significant difference across the different species of fish analysed. Croaker had the highest market price of N1200. The study concluded that fish species sold in the markets within Makurdi are small, which is an indication of over fishing resulting to the depletion of the fish species. The study recommends that relevant authorities in the Federal Department of Fisheries do everything possible to control the size of fishes harvested within coastal waters through regulation of mesh sizes of trawlers and small fishing vessels, and enforce laws guiding harvesting of fishes at sustainable rate.*

## 1. Introduction

Nigeria has a large number of public frozen seafood processing plants and retail markets are distributed around the country, where a considerable number of people buy their frozen seafood products daily. Fish and seafood constitute an important food component for a large section of world population [1]. They come after meat and poultry as staple animal protein foods where fish forms a cheap source of protein [1]. Today, even more people are turning to fish as a healthy alternative to real meat [2]. The low fat content of many sea foods and the effect on coronary heart disease of the n-3 polyunsaturated fatty acids food in fatty pelagic fish species are extremely important aspect for health conscious people particularly in affluent countries where cardiovascular disease mortality is high [2].

Food and Agriculture Organization (FAO), asserted that fish contributes about 60% of the world supply of protein and that 60% of the developing world derives more than 30% of their animal protein from fish [3]. Fish allows for protein improved nutrition in that it has a high biological value in term of high protein retention in the body, low cholesterol level and presence of essential amino acids [3]. The major feature of the proximate composition of fish and shellfish is the great variability in lipid content [4]. Lean species contain typically 0.3-1.0% lipid, most of which is phospholipid and the remainder triglyceride, whereas the total amount in fatty species can be as much as 30% [4]. In fatty species, the amount of lipid varies seasonally within species and may fall to as low as 1%; these changes are accounted for entirely by changes in the proportion of triglycerides [4]. As the amount of lipid increases, the amount of water falls in almost linear proportion, while the amount of protein remains fairly constant. Food contains a wide range of elements such as sodium, potassium, iron, calcium, boron, magnesium, selenium, copper and zinc. These elements are essential in trace quantities for the maintenance of cellular processes.

Fish is one of the best sources of protein food because of its balanced amino acids configuration, digestibility and low cholesterol level. To this end, the demand for fish has been on the increase. Hence, in 1981, 384000 tons of fish were consumed in Nigeria out of which 296000 tons were produced locally and the balance imported [5]. Fish also contribute 6-8% of agricultural sector total contribution to GDP [5]. By this, the fishery subsector provides employment opportunities to many Nigerians including those involved in direct fish processing and marketing.

It is important to evaluate marketing systems of fish because they indicate how the various market participants are organized to accomplish the movement of the commodity from the producer to the ultimate consumer [6]. Marketing of fish is not usually based on fisherman to consumer [7]. There are several middlemen in the link between producers (fishermen) and consumers [8]. Therefore, price of fish changes as it passes through middlemen such that by the time it reaches the final consumer, it has increased considerably. Since proper marketing of fish ensures that fish is made available to all and sundry, it therefore becomes imperative that assessment of fish marketing be carried out to determine the viability and effectiveness of marketing system of fish. Marketing of fish could be regarded as the performance of all business activities involved in the flow of fish from the point of production (fisherman or fish farmer) to the final consumer [6,9,10].

Different (ice) fish species dominates the Nigerian fish markets, preference of this fish by customers varies from customer to customers. There ae different reasons why a customer may choose on species of the ice fish over the other species. Simpson and Aliboh identified and classified those factors into, price of the species, taste, and quality of the muscles and size of the fish [11]. Other factor may include the nutritional quality of the fish and the total fat content. This present research however is carried out to evaluate the species ice fish sold in markets within Makurdi metropolis.

The iced fish market is an ever-increasing market in Nigeria even with the current policy on the ban on importation of frozen food. Different species of iced fish is sold on daily bases in different fish markets across the country. This research therefore focuses on the assessment of iced fish species sold in markets within makurdi metropolis, their prices and morphometric characteristics. The result of this research therefore will be used to fully appraise the iced fish market and to describe the morphometric and meristic characteristic of respective iced fish species.

## 2. Materials and Methods
### 2.1 Description of Study Area
This study was carried out in Makurdi, the capital of Benue State. The state is bounded by Taraba State to the East, Nassarawa to the North, Kogi to the West, Enugu to the South East and Cross River to the South. This area lies between longitude 8° and 9° East and latitude 7° and 8° North.

### 2.2 Sample Collection
Twenty samples of each species of iced fish sold in Makurdi Metropolis were randomly selected from three major markets within makurdi which included Wurukm market, Northbank market and Wadata market. Fish were transported to the Department of Fisheries and Aquaculture University of Agriculture Makurdi for the experiment on morphometric and meristics characterization.

Price of each fish species collected was carefully recorded to determine the average price of each fish species collected.

### 2.3 Fish Identification
Fish samples collected were identified and classified following the procedure of Simpson and Aliboh using a marine fish identification key handbook Measurement of Morphometric and Meristic Characteristics Divider and measuring board, having graduations in centimetres was used for the various measurements [11].

Morphometric and Meristic characteristics was studied following the standard procedures described by Appa (1966), as well as Dwivedi and Menezes (1974).

The following morphometric characters were obtained for each fish.

**a. Total weight (TW):** Total weight of the fish was measured by placing the fish on the weighing balance.

**b. Total length (TL):** The distance from tip of the snout to the tip of longest ray of caudal fin.

**c. Standard length (SL):** The distance from the tip of the snout to the end of caudal peduncle.

**d. Fork length (FL):** The distance from the tip of the snout to the end of the middle caudal fin rays.

**e. Dorsal fin length (LD):** Length of the longest fin ray of the dorsal fin.

**f. Anal fin length (LA):** Length of the longest fin ray of the anal fin.

**g. Caudal fin length (LC):** Length of the longest fin ray of the caudal fin.

**h. Pectoral fin length (PCL):** Length of the longest ray of the pectoral fin.

**i. Pelvic fin length (PEL):** Length of the longest ray of the pelvic fin.

**j. Adipose fin length (LAD):** Length of adipose fin.

**k. Body depth (D):** The distance from the anterior end of first dorsal fin to the ventral surface of the fish at deepest part.

**l. Eye diameter (ED):** Distance from the anterior to the posterior rims of the eye in the longitudinal axis.

**m. Head length (HL):** The distance from tip of the snout to the posterior point of opercula membrane.

Meristic characters that will be studied in this present research will include the fin ray count, and spine count.

### 2.4 Statistical Analysis
The data obtained from this study was subjected descriptive statistics such as mean, standard deviation and analysis of variance (ANOVA).

### 3. Results
The results of the survey to determine the different iced fish species and their morphometric and meristic characteristics is presented in tables below. The results in table 2 shows the Morphometric Characteristics of Selected Frozen Fish Sold in Makurdi Metropolis. The table revealed that different species of iced fish are sold in markets within Makurdi. This species identified in the survey were Croaker, Horse mackerel, Sardine, Hake and Chub mackerel.

The morphometric characterization of the different species was identified and the results presented. Parameters measured were total weight, total length, fork length, standard length, dorsal fin length, anal fin length, adipose fin length, body depth, eye diameter, head length, total weight, pectoral fin length, pelvic fin length. The results analysed showed that the morphometric characteristics of the fishes does not differ significantly (P>0.05). The total weight was highest in the Hake (543.39±50.88g) sold in the market, followed by 504.09±56.26g recorded for Sardine. Iced fish species with the lowest body weight was Horse mackerel (429.16±57.14g). Total length was highest in Hake (39.08±1.93cm) followed by 38.39±2.02cm recorded in the Sardine and 38.20±1.69 recorded in Croaker. Total length was lowest in Horse mackerel (34.81±1.71cm).

Standard length was highest in Hake (32.91±1.74cm) followed by 32.70±1.87cm recorded in the Sardine species and 31.25±1.19cm recorded for the Croaker. Standard length was lowest in Horse mackerel (28.53±1.28cm). Body depth was highest in the Sardines (9.51±1.47) followed by the Hake (9.21±0.59) while it was lowest in Chub mackerel (6.97±0.61). Eye diameter was widest in Chub mackerel (3.64±1.02) and lowest in the Horse mackerel (1.87±0.08). Head length was highest in Hake (9.80±0.66cm) while it was lowest in the Chub mackerel (8.09±0.45).

Table 2 shows the meristic characteristics of selected frozen fish sold in Makurdi Metropolis. Pectoral fin ray was highest in Horse mackerel (24.00±0.00) followed by (20.00±0.00) recorded for Croaker, Sardine, and Chub mackerel. The number of pectoral fin ray was lowest (14.00±0.00) in Hake. Pelvic Fin Ray was highest in Sardine (13.00±0.00) while it was lowest in Chub mackerel (5.00±0.00). Anal fin ray was highest in Horse mackerel (40.00±0.00) while it was lowest in Croaker (8.00±0.00). Dorsal fin ray was highest (20.00±0.00) in the Sardine and lowest in Hake and Chub mackerel with 10.00±0.00 dorsal fin rays respectively while no dorsal fin ray was observed in Croaker and Horse mackerel. Caudal fin ray was highest in Hake (34.00±0.00) and lowest in Croaker (20.00±0.00) and there was no caudal fin ray in Horse mackerel. Anal fin spines were only recorded in the Croaker (1.00±0.00). Dorsal fin spines were also found only in the Croaker (37.00±0.00).

Significant difference was observed in the fork length of the fishes examined in this research shown in table 1b. This difference exists between the Croaker and the rest of the fishes. Coaker has no fork length (0.00±0.00) while the highest fork length was recorded in Hake (35.01±1.56) followed by Sardine (34.73±1.80) while it was lowest in Horse mackerel (32.18±1.33). Dorsal fin length was highest in Horse mackerel (16.07±2.01) followed by Hake (13.88±2.22) and Chub mackerel (33.32±1.39) while it was lowest in Sardine (11.15±2.28). Anal fin length was highest in Sardine (8.49±1.51) followed by Hake (8.47±1.50) while it was lowest in the Chub mackerel (4.89±0.51). Caudal fin length was longest in Sardine (6.54±0.53) and lowest in the Horse mackerel (5.85±0.34). Adipose fin length was only recorded in Hake and Chub mackerel with the highest (17.54±1.21) in Hake and lowest (4.33±0.35) in Chub mackerel. Pelvic fin length and Pectoral fin length were highest in Hake (5.20±0.45 and 7.19±0.54 respectively) while Horse mackerel has the lowest (4.69±0.49) and Chub mackerel (6.28±0.65) respectively.

| Common name | Species | Total Weight | Total Length | Standard Length | Body Depth | Eye Diameter | Head Length |
|---|---|---|---|---|---|---|---|
| Croaker | *Micropogonias undulatus* | $452.39\pm52.21^{ab}$ | $38.20\pm1.69^{a}$ | $31.25\pm1.19^{a}$ | $7.82\pm0.71^{c}$ | $2.76\pm0.66^{b}$ | $8.92\pm0.51^{ab}$ |
| Horse mackerel | *Trachurus trachurus* | $429.16\pm57.14^{c}$ | $34.81\pm1.71^{c}$ | $28.53\pm1.28^{b}$ | $8.58\pm0.68^{b}$ | $1.87\pm0.08^{c}$ | $8.60\pm0.60^{b}$ |
| Sardine | *Sardinella eba* | $504.09\pm56.26^{a}$ | $38.39\pm2.02^{a}$ | $32.70\pm1.87^{a}$ | $9.51\pm1.47^{a}$ | $2.63\pm0.65^{b}$ | $9.17\pm0.71^{a}$ |
| Hake | *Merluccius merluccius* | $543.39\pm50.88^{a}$ | $39.08\pm1.93^{a}$ | $32.91\pm1.74^{a}$ | $9.21\pm0.59^{a}$ | $1.94\pm0.11^{c}$ | $9.80\pm0.66^{a}$ |
| Chub mackerel | *Scomber japonicus* | $440.64\pm50.93^{bc}$ | $36.67\pm1.81^{b}$ | $30.54\pm1.28^{a}$ | $6.97\pm0.61^{c}$ | $3.64\pm1.02^{a}$ | $8.09\pm0.45^{c}$ |
| *P-Value* | | 0.52 | 0.49 | 0.23 | 0.24 | 0.26 | 0.33 |

*means in the same column with different superscripts differ significantly*

**Table 1: Morphometric Characteristics of Selected Frozen Fish Sold in Makurdi Metropolis**

| Parameter | Croaker (*Micropogonias undulatus*) | Horse mackerel (*Trachurus trachurus*) | Sardine (*Sardinella eba*) | Hake (*Merluccius merluccius*) | Chub mackerel (*Scomber japonicus*) | P-Value |
|---|---|---|---|---|---|---|
| Fork Length | $0.00\pm0.00^{a}$ | $32.18\pm1.33^{b}$ | $34.73\pm1.80^{b}$ | $35.01\pm1.56^{b}$ | $33.32\pm1.39^{b}$ | 0.00 |
| Dorsal Fin Length | $13.55\pm2.29^{a}$ | $16.07\pm2.01^{a}$ | $11.15\pm2.28^{a}$ | $13.88\pm2.22^{a}$ | $13.58\pm2.34^{a}$ | 0.66 |
| Anal Fin Length | $4.97\pm0.50^{a}$ | $6.29\pm0.68^{ab}$ | $8.49\pm1.51^{b}$ | $8.47\pm1.50^{b}$ | $4.89\pm0.51^{a}$ | 0.03 |
| Caudal Fin Length | $6.28\pm0.47^{a}$ | $5.85\pm0.34^{a}$ | $6.54\pm0.53^{a}$ | $6.23\pm0.36^{a}$ | $6.18\pm0.52^{a}$ | 0.88 |
| Adipose Fin Length | $0.00\pm0.00^{a}$ | $0.00\pm0.00^{a}$ | $0.00\pm0.00^{a}$ | $17.54\pm1.21^{c}$ | $4.33\pm0.35^{b}$ | 0.00 |
| Pelvic Fin Length | $4.94\pm0.57^{a}$ | $4.69\pm0.49^{a}$ | $5.11\pm0.60^{a}$ | $5.20\pm0.45^{a}$ | $4.80\pm0.59^{a}$ | 0.96 |
| Pectoral Fin Length | $6.46\pm0.60^{a}$ | $6.75\pm0.51^{a}$ | $7.12\pm0.67^{a}$ | $7.19\pm0.54^{a}$ | $6.28\pm0.65^{a}$ | 0.77 |

*means on the same row with different superscripts differ significantly*

**Table 1b: Mean Morphometric Characteristics of Selected Frozen Fish Sold in Makurdi Metropolis**

| Common names | Pectoral Fin Ray | Pelvic Fin Ray | Anal Fin Ray | Dorsal Fin Ray | Caudal Fin Ray | ADFR | Anal Fin Spine | Dorsal Fin Spine |
|---|---|---|---|---|---|---|---|---|
| Croaker | $20.00\pm0.00^b$ | $7.00\pm0.00^{bc}$ | $8.00\pm0.00^c$ | $0.00\pm0.00$ | $20.00\pm0.00^c$ | $0.00\pm0.00$ | $1.00\pm0.00^a$ | $37.00\pm0.00^a$ |
| Horse mackerel | $24.00\pm0.00^a$ | $10.00\pm0.00^b$ | $40.00\pm0.00^a$ | $0.00\pm0.00$ | $0.00\pm0.00$ | $0.00\pm0.00$ | $0.00\pm0.00$ | $0.00\pm0.00$ |
| Sardine | $20.00\pm0.00^{ab}$ | $13.00\pm0.00^a$ | $20.00\pm0.00^b$ | $20.00\pm0.00^a$ | $30.00\pm0.00^a$ | $0.00\pm0.00$ | $0.00\pm0.00$ | $0.00\pm0.00$ |
| Hake | $14.00\pm0.00^c$ | $7.00\pm0.00^{bc}$ | $13.00\pm0.00^b$ | $10.00\pm0.00^b$ | $34.00\pm0.00^a$ | $45.00\pm0.00^a$ | $0.00\pm0.00$ | $0.00\pm0.00$ |
| Chub mackerel | $20.00\pm0.00^{ab}$ | $5.00\pm0.00^c$ | $10.00\pm0.00^{bc}$ | $10.00\pm0.00^b$ | $26.00\pm0.00^b$ | $10.00\pm0.00^b$ | $0.00\pm0.00$ | $0.00\pm0.00$ |

*means on the same row with different superscripts differ significantly*

**Table 2: Meristic Characteristics of Selected Frozen Fish Sold in Makurdi Metropolis**

The mean price of the iced fish species are presented in the results. The results of this survey showed that Croaker is the most expensive iced fish species in the markets within Makurdi sold at mean price of N1200±95.34, followed by Chub mackerel sold at a mean price of N700±100.00. The fish species with the lowest price in the market was Sardine, sold at 450±50.20.

| Fish species | Iced (₦)/kg |
|---|---|
| Croaker *(Micropogonias undulatus)* | $1200\pm95.34^a$ |
| Horse mackerel *(Trachurus trachurus)* | $650\pm105.00^b$ |
| Sardine *(Sardinella eba)* | $450\pm50.20c$ |
| Hake *(Merluccius merluccius)* | $750\pm50.20^{ab}$ |
| Chub mackerel *(Scomber jopanicus)* | $700\pm100.00^b$ |
| p-value | 0.003 |

*means on the same row with different superscripts differ significantly*

**Table 3: mean price of different iced fish species sold in markets within makurdi metropolis**

## 4. Discussion

The results of the survey as presented in tables above represents the morphometric, meristic and price analysis of iced fish species sold within makurdi metropolis.

Present research work was focused on Morphometric and meristic parameters of iced fish species sold in makurdi. All the Morphometric parameters of the fish species revealed a proportional increase in total length of fish under study shown in the results. The meristic counts Including dorsal fin ray, anal fin ray, caudal fin ray, pectoral fin ray, pelvic fin ray, etc were observed. The value of meristic counts of all the fish species are shown in the results. The Morphometric parameters showed proportional positive increase with increase in the length of fish. Ujjania et al. (2012) also observed the positive growth recorded in Morphometric parameters with increase in fish length.

The meristic counts were almost constant in all the length groups of fish with different body length, so it concludes that the meristic counts were independent of body length (Talwar and Jhingram 1992; Zafar et al. 2002). Morphological differences have been reported in many marine pelagic species, especially in clupeids (Thomas et al., 2014). In Hake (Merluccius merluccius), morphological differences were associated with behavioural and ecological differentiation (McAdam et al., 2012). The two behavioural types, coastal and frontal, were associated with

distinct morphological characteristics such as gape of mouth, eye position and spaces between fins and depth of body. The patterns of habitat use, foraging and migratory behaviour were different in the two types (Grabowski et al, 2011).

The variation in the morphometric and meristic characterisation of the iced fish species in this present research could be as a result of the conditions reported above. it could be based on the order of and demand of the marketers which can determine the size and age of fish supplied to the market, maybe due to customer demands and economic condition.

The mean price of the different fish species were also determine in this present studies, the results are as presented in the result. The results revealed that there exist price variation among the different fish species. This variation could be as a results of the demands of the particular species from the consumers and other factors such a size and taste of the fish. The variation could also be based on the cost price for the marketers [12]. In this research, the most expensive fish species was the Croaker. This fish have been described as a very sweet and highly demanded by people. The high cost of this fish compared to the others can be explained by the demand of the fish.

## 5. Conclusion
Following the results of this research, it is concluded that fish species sold in the markets within Makurdi are small in size, with the biggest size of 543.39±50.88 (Hake), which is an indication of over fishing, resulting to the depletion of the fish species. It is concluded that the fish are in danger of conservation with mostly smaller fish been sold in the market.

It is also concluded that Croaker 1200±95.34 (#/kg) is the most expensive and highly demanded, maybe due to consumer factors such as its taste, which may lead to overfishing of Croaker.

## 6. Recommendation
The study recommends that relevant authorities in the Federal Department of Fisheries do everything possible to control the size of fishes harvested within the coastal waters through regulation of mesh sizes of both trawlers and small fishing vessels, and also enforce harvesting of fishes within coastal waters at a sustainable rate.

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