

EVALUATION OF THE NUTRITIVE QUALITIES AND ORGANOLEPTIC PROPERTIES OF LABEO COUBIE AND MORMYRUS RUME FROM THE CROSS RIVER, NIGERIA

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ABSTRACT

Two commonly available freshwater fish species (*Labeo coubie* and *Mormyrus rume*) of Ahaha, Cross River were evaluated for their proximate, mineral and organoleptic qualities. The samples were collected from fresh landings site in the study area. The biochemical analysis of moisture, protein, carbohydrate, fat, ash, element, potassium (K), sodium (Na), calcium (Ca), phosphorus (P), iron (Fe), magnesium (Mg) and zinc (Zn). Were done using the standard methods. The organoleptic properties of taste, flavour, colour, texture, oiliness and overall acceptability was determined using structured questionnaires from semi-trained panellist. The result of the proximate composition was found to be moisture (75.24%), protein (15.72%), carbohydrate (1.5%), fat (5.04%) and ash (2.72%) for *L. coubie* and 40.04, 33.16, 2.55, 11.96 and 12.44% respectively for *M. rume*. The mineral content decreased in the following order $K > P > Na > Fe > Ca > Mg > Zn$ for the both species. The organoleptic properties shows that flavour and texture have the highest mean score of 7.70 in *L. coubie* while the least mean score of 5.40 was recorded for taste in *M. rume*. The proximate and mineral compositions of *M. rume* were higher except moisture content which is lower than in *L. coubie*. The organoleptic properties were higher in *L. coubie* except oily than *M. rume*. The finding shows high values in the nutritive qualities of these fish species but within the recommended level by FAO and WHO for dietary requirement. Hence, *L. coubie* and *M. rume* can serve as an ideal dietary food fish and play a vital role in human health.

Keywords: *Labeo coubie*, Phytoplankton, Organoleptic, *Mormyrus rume*

Introduction

Fish is the most important food stuff due to high protein content and unsaturated fatty acids. It is also the most accessible and affordable source of animal protein for poor households in urban and semi-urban areas (Bene and Heck, 2005). Evaluation of nutritive qualities and organoleptic properties such as moisture, protein, lipids, ash, taste, flavour, tenderness and others are often necessary to ensure that they are within the range of dietary requirement and commercial specification (watchman 2000, Yola and Timothy, 2012). Fish protein is easily digestible and reduces levels of cholesterol in the blood, hence reducing the risks of heart disease (Javed *et al.*, 1995, Josson *et al.*, 2007). Fish muscles also contain minerals, vitamins and other nutritional compounds which are necessary in diet for proper growth and development (Rora *et al.*, 2003, Devi and Sarojnalini, 2012). According to Hossain *et al.*, 2008 consumer all over the world are becoming more interested about the health and nutritive qualities of food items due to increasing level of education in both rural and urban areas. Therefore knowledge of the proximate and mineral composition will be indispensable to ascertain what they eat.

Proximate, mineral and organoleptic analysis provides information on the nutritional value of a particular item used as a source of food Zafar *et al.*, 2004. The proximate composition, nutritive values and mineral compositions of fishes have been investigated in various parts of the world Joaquin *et al.*, 1997, Abdullahi and Abude, 2006, Olagunju *et al.*, 2012, Kefas *et al.*, 2014, Adeosun *et al.*, 2014. Effiong and Fakunle, 2011 studied the proximate composition of *Clarias gariepinus*, *Oreochromis niloticus*, *Bagrus bayad*, *Citharinus citharus* and reported that their protein content ranged from 21.62-60.57%, ether extract was 3.88-9.1%, while ash and crude fibre were 1.35-5.88% and 0.37-1.5% respectively. Adejonwo *et al.*, 2010 reported that the proximate composition of moonfish showed that moisture content is 77.1%, lipid (0.98%), crude protein (20.4%) and ash content (1.5%). Joaquin *et al.*, (1997) reported the proximate composition of hake, *Merluccius merluccius* as follows: moisture (28.66%), protien (39.10%), fat (14.13%), carbohydrate (11.20%),

ash (6.69%) and Ling (*Molva mola*) as moisture (31.34%), protein (43.6%), fat (14.80%), carbohydrate (3.13%) and ash (7.14%). The moisture content, crude protein, ether extract and ash content of *Gnathonemus demandua*, *Chrysichthys nigrodigitatus* and *Auchenoglanis biscutatus* ranged from 7.07 to 11.14%, 6.32 to 16.31%, 25.04 to 35.07% and 6.26 to 26.26% respectively Olele., 2012. The crude protein content of some freshwater fish species was reported as follows: *Tilapia zilli* (23.4%), *Channa obscura* (24.3%), *M. rume* (23.4%) and *Malapterurus electricus* (23.4%) Adewumi *et al.*, 2014, Shearer, 1994, and Morris, 2001 stated that protein and ash do not vary as often as lipid, since it is not necessarily impacted by diet but mainly by species type, genetic characteristic and size.

Minerals are essential nutrients and are components of many enzymes and metabolism for growth. The human body usually contains small amount of these minerals, deficiency of which may cause diseases (Mills, 1980). The most important micro-nutrients in form of mineral salts include Calcium (Ca), Potassium (K), Phosphorus (P), Sodium (Na) and Chlorine (Cl) while many others are required in trace amount (Iron (Fe), Magnesium (Mg) and Zinc (Zn). The deficiency in these principal nutritional mineral elements induces a lot of malfunctioning as it reduces productivity and causes diseases such as inability of blood to clot, osteoporosis and anaemia (Mills, 1980). Most of these microelements tend to become harmful when their concentrations in body tissue exceeds metabolic demands (Ako and Salihu, 2004). Bolawa *et al.*, 2011 and Fawole *et al.*, 2007 reported the proximate and mineral composition of *O. niloticus* as follows lipid (18,6%), protein (38.19%), moisture (27.66%), ash (1.76%) and zinc (0.43 mg/100 g). Gokoglu *et al.*, 2004 reported that the phosphorus level of 337.8 mg/100 g for rainbow trout was higher than 0.21–0.44 mg/100 g recorded for *Alestes baremoze*. The concentration of the micro element in *C. gariepinus* is reported in the order Fe>Zn>Mn (Adeniyi *et al.*, 2012).

Organoleptic (sensory) evaluation is the scientific method that measures, analyses and interprets responses from products through sight, smell, touch, taste and hearing (Lawless and Heymann, 1999). The sensorial attributes

as perceived by consumers include; appearance, colour, flavour, juiciness, tenderness, oiliness, taste and overall quality (Glover-Amengor *et al.*, 2002; Alam *et al.*, 2012). According to Yola and Timothy, (2012) significant changes were recorded in colour, texture, taste, juiciness and overall acceptability of *C. gariepinus* smoked with *Anogeissius leiocarpus*.

In Nigeria fish provides an important compliments to the predominantly carbohydrate based diet of many people Obubra Cross River State is no exception. Despite the increased attention and acceptance received by fish as source of animal protein and essential nutrients for human diets, fish is still faced with various degrees of preference among consumers (Fawole *et al.*, 2007, Elagba *et al.*, 2010). Lots of work has been done on the proximate composition of fishes, however, paucity of information is available of the proximate composition and consumer acceptability of *L. coubie* and *M. rume* constituting major landings of artisanal fisheries of Ahaha although considered as less preferred species by consumers but readily available and relatively cheap. This research is therefore conducted to compare the proximate, mineral contents and organoleptic properties of this two all-important freshwater fishes from Ahaha Obubra Cross River, Nigeria.

Materials and Methods

Sample collection and preparation: The fish samples for this study were purchased from fishermen *(at Ahaha fish landing site and transported using plastic bowls to Fisheries and Aquatic Science Department, Cross River University of Technology (Crutech), Obubra Campus. The fishes were caught from the Cross River which is a major perennial River in the central Cross River State, Nigeria and is located at latitude 4°30' to 7°15'N and longitude 7°15'-90°30'E. Fishing, petty trading, civil service and farming have remained the traditional occupation of the people. The collected samples of *M. rume* and *L. coubie* were immediately packed into ice blocks to sustain freshness, and taken to the Department of Animal Science Biochemistry Laboratory University of Calabar. Upon arrival, the fishes was de-scaled where necessary, beheaded, gutted thoroughly washed with distilled water and filleted.

The fishes were packed into separate bags and sealed to reduce microbial infestation. The fresh samples were shared into two groups. One group was use immediately for proximate analysis to determine moisture content, ash, crude protein, lipid, carbohydrate and mineral analysis to determine the concentration of Calcium (Ca), Potassium (K), Phosphorus (P), Sodium (Na), Magnesium (Mg), Iron (Fe) and Zinc (Zn) following the guidelines of Association of Official Analytical Chemist AOAC. The other group was prepared and immediately used for organoleptic test.

Preparation of fish samples for analysis

The fish samples were chopped into pieces, blended and homogenized using mortar and pestle. They were packed in different bottles and labelled accordingly. The samples were analysed for protein, fat, moisture, ash and carbohydrate according to AOAC, 2006 in each case, three replicates were maintained.

Determination of crude protein

This was measured following the kjeldahl method based on the total mineralization of the biological material in an acid environment, followed by distillation of nitrogen in ammonia form (AOAC, 2006). About 2 g of the sample was weighed into a kjeldahl flask. Concentrated sulphuric acid was added in the presence of small amount of copper sulphate, with selenium and potassium sulphate. Mercury will also be added as a metal catalyst. The flask was placed on an electric heater in a fume chamber until blacking occurs. Heating was continued for about 1 hr after the solution had cleared until the black specks disappear indicating complete digestion. The content will then be transferred into a 25 ml volumetric flasks and allowed to cool. The digestion was followed by the addition of a strong base (NaOH) to liberate ammonia. The ammonia distilled, trapped in 0.5% boric acid indicator will then be titrated with 0.01 M HCl. The weight of nitrogen in a sample was converted to protein using the appropriate conversion factor (6.25) according to AOAC.

$$\text{Crude Protein (\%)} = \frac{V_2 - V_1 \times N \times 14 \times 100 \times 6.25}{1000 \times W}$$

Where, V_1 = Volume of HCl used in blank titration

V_2 =Volume of HCl used in sample titration

N=Normality of HCl used in titration

W=Weight of dried sample

14=Conversion factor from Ammonium sulphate to nitrogen

6.25=Conversion from nitrogen to protein.

Determination of fat

A quantity of about 5 g of the sample was weighed and introduced into an extraction cartridge covered by cotton wool. The cartridge was placed in a 150 ml glass soxhlet (AOAC, 2006). The solvent container was weighed and 400 ml of n-hexane was added. The soxhlet will then be introduced into the container, placed on the heating mantle connected to a cryostat cooling thermostat. After 60 minutes, the flask was disconnected and the solvent allowed to evaporate. The container with the fat was placed in an oven for 4 hours at 100°C and then in a desiccators' for 30 minutes and weighed. The weight difference gives the fat content of the sample.

$$\text{Fat content (\%)} = \frac{\text{Weight of the extracted lipid content}}{\text{Weight of sample}} \times 100$$

Determination of moisture content

The moisture content of the sample was determined by oven method. Petri dishes was washed and dried in an oven, cooled in desiccators and weighed two grams (2 g) of the crushed sample was added to the separate dish labelled 1 and 2 and transferred to the oven set at 100°C for 5 hours. The dishes was removed after drying and allowed to cool before reweighing. The weight difference shows the moisture content (AOAC, 2006).

$$\text{Moisture (\%)} = \frac{\text{Weight of the sample} - \text{Weight of the dried sample}}{\text{Weight of sample}} \times 100$$

Estimation of ash content: Ash was determined by muffling the sample at 6000-7000°C to dry ash. By subtraction ash content was determined. Firstly clean porcelain crucibles was heated in a muffle furnace at 6000°C and crucibles will then be weighted until a constant weight was obtained. The sample with the crucible was weighed and recorded. The sample was ignited at 6000°C for 6 h or until the residue is uniformly greyish to white. Afterwards crucibles were transferred to the desecrator to cool them at room temperature for few minutes. Heating, desiccating, weighing, was repeated till a constant weight is obtained. Final constant weights of the crucibles was

recorded. The following equation will then be used to determine the ash content of the dry fish samples

$$\text{Ash (\%)} = \frac{\text{Weight of ash}}{\text{Weight of sample}} \times 100$$

Estimation of carbohydrate: The percentage of carbohydrate was calculated by simply subtracts the total percentage of protein, fat, moisture and ash from 100. The following equation was used to determine the amount of carbohydrate according to Emendu and Emendu (2014).

Calculation: Carbohydrate (%) $100 - (\% \text{ Protein} + \% \text{ Ash} + \% \text{ Moisture} + \% \text{ Fat})$

Mineral analysis

Some major minerals (Ca, Na, K, P, and Mg) and some trace minerals (Fe, Cu, Mn, and Zn) were analysed in the two fish species using Atomic Absorption Spectrophotometer (AAS) and Flame photometer. For mineral analysis accurately weighted ash samples were treated with nitric acid (HNO_3), HClO_4 and deionized water (AOAC, 2006). The concentration of mineral elements (sodium, iron, calcium, magnesium, zinc and manganese) was determined by Atomic Absorption Spectrophotometer (AAS). Phosphorus and potassium were determined using the calorimetry method at the appropriate wavelength. All determinations were done in triplicates and calculated as mean mineral content in (mg/100 g dry weight).

Organoleptic assessment

This was performed by semi-trained panellist using structured questionnaires on the following attribute (Table 1). Ten (10) members panel of assessors were recruited from the staff and student of Fisheries Department and each was presented with a questionnaire comprising of the attributes. The fish samples were steamed cooked for 10 minutes using kerosene stove without any spices. Drinking water was given to the panelist to rinse their mouth between evaluations of the samples. The judges were asked to tick for each parameter of all the samples. Drinking water was given to rinse the mouth between the evaluations of samples.

The 1- 7 hedonic scales was denoted as follows:

1. dislike extremely
2. dislike moderately

3. dislike slightly
4. Neither like nor Dislike
5. like slightly
6. like moderately
7. like extremely.

Data analysis: The data from the study was analyzed using the Analysis of Variance (ANOVA) and means were separated using Duncan multiple range test (DMRT) with Statistical Package for social sciences (SPSS version 20) as describe by Steel and Torie, (1987). The results were expressed in mean percentages and standard deviation.

Results

The result of the proximate composition of two freshwater fishes (*L. coubie* and *M. rume*) showing the mean percentages of moisture, protein, carbohydrate, fat and ash is presented in Table 2. The result showed that, mean values for *L. coubie* were $75.24 \pm 1.32\%$, $15.75 \pm 0.70\%$, $1.54 \pm 0.23\%$, $5.04 \pm 0.40\%$ and $2.72 \pm 0.43\%$ respectively. *Mormyrus rume* was found to contain $40.04 \pm 2.22\%$, $33.16 \pm 2.05\%$, $2.58 \pm 0.41\%$, $11.96 \pm 0.56\%$ and $12.44 \pm 0.43\%$. Moisture had the highest mean values while ash had the least in the both species. All the parameter observed were

higher in *M. rume* except moisture content which was higher in *L. coubie* (75.24%) than *M. rume* (40.04%). The mean values of the protein and fat contents of *M. rume* were almost twice higher than that of *L. coubie*.

The mean values of the mineral contents of the species investigated is shown in Figure 1. The result showed that the concentration of elements decreased in the order $K > P > Na > Fe > Ca > Mg$ and Zn for *L. coubie*. Similar trend was recorded for *M. rume*. The result also revealed that in all the samples *M. rume* had a higher concentration of the elements detected. Potassium, phosphorus and sodium had the highest concentration for the both species while zinc had the least. In *L. coubie* the element ranged from 27.60–236.20 mg/100 g and 28.36–238.00 mg/100 g for *M. rume*. Potassium had the highest concentration in *M. rume* (238.00 mg/100 g) and *L. coubie* (236.20 mg/100 g) while zinc was the least in both species, 28.36 mg/100 g and 27.60 mg/100 g for *M. rume* and *L. coubie* respectively. Sodium, potassium and zinc were not significantly different ($p > 0.05$) in the both species whereas other elements were higher ($p < 0.05$) in *M. rume*.

The result of some organoleptic properties of the species is presented in Table 3. The result shows the mean scores of the following properties, colour, flavour, texture, taste

Table 1. Description of organoleptic attributes used for steamed fish flesh evaluation.

S/N	Attributes	Description
1.	Colour (Appearance)	Intensity of “whitish”/“creamish” colour, typical of steamed fish.
2.	Flavour (Odour)	Intensity of perceived taste.
3.	Taste (Juiciness)	Intensity of juiciness of steamed fish flesh while chewing.
4.	Texture (Tenderness)	Intensity of softness perceived at the time of chewing.
5.	Oiliness	Intensity of oiliness perceived taste of a typical steamed fish flesh.
6.	Overall quality	Overall impression of the steamed fish based on the above.

Source: Alam et al., (2012).

Table 2. Mean proximate composition of *Labeo coubie* and *Mormyrus rume*.

Parameter	<i>L. coubie</i>	<i>M. rume</i>
Moisture	75.24 ± 1.32^a	40.04 ± 2.22^b
Protein	15.72 ± 0.70^b	33.16 ± 2.05^a
Carbohydrate	1.54 ± 0.23^b	2.58 ± 0.41^a
Fat	5.04 ± 0.40^b	11.96 ± 0.56^a
Ash	2.72 ± 0.43^b	12.44 ± 0.43^a

Means with the same superscript in the same column are not significant ($p < 0.05$).

Table 3. Mean scores of the organoleptic properties of *Labeo coubie* and *Mormyrus rume*.

Properties	<i>L. coubie</i>	<i>M. rume</i>
Colour	7.50 ± 0.71 ^a	6.60 ± 0.84 ^a
Flavour	7.70 ± 0.48 ^a	5.70 ± 0.67 ^b
Texture	7.70 ± 0.48 ^a	6.70 ± 0.67 ^b
Tastes	6.80 ± 0.63 ^a	5.40 ± 0.52 ^b
Oiliness	6.70 ± 0.48 ^b	7.50 ± 0.71 ^a
Overall acceptability	6.40 ± 1.07 ^a	6.90 ± 0.57 ^a

Means with the same superscript in the same column are not significant ($p < 0.05$).

oiliness and overall scores. The result revealed that all the properties were higher in *L. coubie* than *M. rume* except oiliness. The mean score ranged from 6.40 ± 1.07 – 7.70 ± 0.48 and 5.60 ± 0.51 – 7.50 ± 0.71 for *L. coubie* and *M. rume* respectively. The highest mean score of 7.70 ± 0.48 was recorded for flavour and texture in *L. coubie* and 7.50 ± 0.48 for oiliness in *M. rume*. However the overall acceptability had a higher mean score of 6.90 in favour of *M. rume* but not significantly different ($P > 0.05$) from that of *L. coubie*.

Discussion

Proximate composition

Fish is widely accepted because of its high palatability, low cholesterol and tender flesh (Onyia *et al.*, 2010). According to FAO (1999), fish meat is basically composed of moisture (60–80%), protein (16–21%), carbohydrates (<1%) Lipids (0.2–2.5%) and Ash (1.2 to 1.5%). Few consumers eat fish due to limited knowledge of its nutritional values. The nutritional composition of freshwater fishes is known to vary with species, sex, size, season and geographical location (Zenebe *et al.*, 1998). Perhaps these may have accounted for the variations recorded for these species in this study. The nutritional properties showed variable values in the proximate composition of the species. Moisture content of *L. coubie* (75.24%) was higher than that of *M. rume* (40.04%), although both were within the accepted range of 30–90% (FAO, 1999). The moisture content of *L. coubie* was higher than those reported for *Pseudotolithus senegalensis* (69.70%) and *P. typhus* (66.35%) Adejonwo (2016). *Labeo coubie* have higher moisture content comparable to some freshwater species; *Lates niloticus* (77.33%), *Bagrus bayad* (78.33%), *Labeo niloticus* (76.00%) and *Synodontis schall* (77.33%) Ahmed

et al. (2017). However the range of moisture reported for this study agrees with those recorded by other researchers who investigated on African freshwater species (Osibona, 2011, Adejonwo *et al.*, 2016, Ahmed *et al.*, 2017). High percentage moisture in fish is good indicator of its relative content of energy, protein and lipid (Olagunju *et al.*, 2012). Food intake and amount of fat in the body of an animal is said to influence moisture level (Maynard *et al.*, 1984). According to FAO (1999) moisture content is inversely related to the lipid composition in fishes. This is in agreement with the result of this study which recorded the moisture and lipid content of the species as *L. coubie* (75.24 and 5.04%) and *M. rume* (40.04 and 11.96%) respectively. Indicating that the higher the moisture the lower the lipid content.

Proteins are the second most important fish constituents and it is an excellent source of lysine, methionine, and cysteine used significantly to raise the value of cereal based diets deficient in this essential amino acid (FAO, 2005). According to Kasozi *et al.*, (2014), percentage protein in fish is usually between 15–25%, although in rare case may be as low as 13.5% and high as 28%. In this study, protein content of *L. coubie* (15.72%) was lower than that of *M. rume* (33.16%). Similar variation in crude protein of fishes have reported by several researchers on *Chrysichthys* spp, *C. gariepinus*, *H. longifilis*, and *O. niloticus* also abundant in the study area (Udo, 2012; Obaroh, *et al.*, 2015, Olopade *et al.*, 2015). Wide variations in the crude protein have also been reported for farmed and wild perch, *Perca fluviatilis* and blackspot seabream, *Pagellus bogaraveo* (Jankowska *et al.*, 2007, Alvarez *et al.*, 2009). Olopade *et al.*, (2015) protein content lower than that of *Chrysichthys walker* (19.47%) and *C. nigrodigitatus* (20.54%). The

relatively moderate to very high protein content of this species may be attributed to omnivorous feeding habits and high preference for diets of animal origin. This may also be attributed to the fish's consumption or absorption capability and conversion potentials of essential nutrients from their local environment into biochemical attributes needed by organism's body (Adewoye and Omotosho, 1997). The high protein content makes fish an important candidate of good dietary protein sources.

According to Ackman (1999) fish can be grouped into four categories based on their fat content, lean fish (<2%), low fat (2 to 4%), medium (4–8%) and high fat (>8%). In this study *L. coubie* has been observed to fall into the category of medium while *M. rume* is of high fat. Similar high lipid content on some freshwater fishes have also been reported (Osibona *et al.*, 2013, Oramadike, 2015). High lipid fishes have less water and more protein than the low-lipid fishes (Ahmed *et al.*, 2017). This assertion agrees with the result of this study where *M. rume* which have a higher fat content, had lower moisture content and a higher protein content. The variation in lipid content of the species could be attributed to the different abilities of fat metabolism and species. The quantity and quality of fat content in fishes are affected by feed quality, water quality, spawning season, fish migration, fish size and starvation (Hardy and King, 1998).

Carbohydrate in fishes is generally very low compare to protein and lipids content (Daniel and Ogar., 2013). The main function of carbohydrate is to provide the body with energy to perform physiological activities for growth and development. The carbohydrate content recorded for *L. coubie* (1.54%) was lower than that recorded for *M. rume* (2.58%) in this study both of which were low. Low carbohydrate diets is mostly recommended to adults and diabetic patients. According to Lovell (1988), low carbohydrate observed in fishes is attributed to their dietary habits and conversion to fats and glycogen stored in the tissues and muscle of fishes. Similar low (<3%) carbohydrate content was reported by Martinez (2000) and Abolude *et al.*, (2006) on several fishes. Adeniyi *et al.*, (2012) reported a higher carbohydrate content of 3.85% for *C. gariepinus* and very high (8.86%) for *Malapterurus*

electricus. High carbohydrate content in fishes is traceable to the fact that fish flesh yield glucose, fructose and mannose when digested all of which are energy producers (FAO, 2005). Adejonwo (2012) reported that the high carbohydrate content of *Pseudotolithus* spp may be attributed to the nature of their diets which are specifically shell organisms such as shrimps, crabs, and cephalods. The lower concentration of carbohydrate recorded for the species in this study is an indication that their type of diets could not provide them with sufficient sources of galactose, glucose and mannose.

Ash content is a measure of the mineral composition of any food including fish and can be influenced a number of factors such as seasonal, biological and physicochemical parameters of the water where the fish is caught (Akande and Faturoti, 2005). In this study the ash content of *L. coubie* (2.72%) and *M. rume* (12.44%) were higher than 1.38% recorded for *C. nigrodigitatus* and 1.19% for *C. gariepinus* (Olopade *et al.*, 2015; Abeni *et al.*, 2015). This is an indication that the species are good source of minerals.

Mineral composition

The species are good sources of elements such as calcium (Ca), phosphorus (P), iron (Fe), sodium (Na), potassium (K) and magnesium (Mg). The concentration of the element in this study showed a similar trend in the both species decreasing in the order K>P>Na>Fe>Ca>Mg> and Zn. All the elements examine were higher in *M. rume* than *L. coubie* complimenting it higher ash content. This variations and decreasing trends of elemental compositions agrees with the reports of Akinneye *et al.*, (2010) on the chemical composition of *Bonga* spp, *Sardinella* spp and *Heterotis niloticus*. Similar decreasing order of mineral form K was reported by Oladimeji and Salisu, (1991) on oven-dried *Sarotherodon galilaeus*, *Lates niloticus* and *synodontis schall*. In this study Zn had the lowest concentration among the micro elements (Fe, Mg and Zn), which disagrees with the study of Akinneye *et al.*, (2010) who reported Zn as the highest among the micro element in freshwater fish species *H. noliticus*. This can be attributed to type of species or the water quality of the

ambient environment of the fish. The mineral elemental content of each fish species is a function of the availability of these element in the water body where they live and the fish physiological state (Ako and Salihu, 2004). All the element in this species were higher than those reported by Adejonwo (2016) on *Pseudotolithus* spp and Ahmed *et al.* (2017) on some important commercial fishes of Jebel reservoir, Sudan. Literatures have reported that K and Na are needed for the regulation of the pH, osmotic pressure, water balance, nerve impulse transmission and active transport of amino acids (NRC, 2001). According to Watanabe *et al.*, (1997) calcium is responsible for clotting, muscle contraction, formation of bones and teeth in animals. In this study Ca was the lowest among the macro element (K, Na, P and Ca) similar to the study of Hei and Sarojinalini (2012) who reported that 99% of Ca is found in bones and teeth, implying that it is being completely utilized for body tissue building. Iron takes part in the formation of haemoglobin, myoglobin and haemenzyme (Onwordi *et al.*, 2009). The concentration of Fe in this study was higher than that reported by several other researchers on various species even though it is a trace element (Adejonwo, 2017; Ahmed *et al.*, 2017). However, all the element investigated in this study were within the WHO (1998) recommended and permissible level for aquatic species. This implies that the consumption of these fishes will provide the body with the required essential element for proper growth and development.

Organoleptic properties

Organoleptic properties of colour, flavour, texture and tastes were higher in *L. coubie* while *M. rume* was more oily and slightly acceptable in this study. The variation in the properties may be attributed to species, water quality, environment and the type of diet consumed. Alam *et al.*, (2012) reported that the organoleptic properties of farmed *Labeo rohita* was better than wild *L. rohita*. Food colour helps to determine quality, degree of processing and spoilage level (Clifford *et al.*, 1980). Flavour is the combination of odour and taste, and is considered an important factor in consumer's acceptance of fish (Oguzhan and Angis, 2013). High flavour and oiliness is an indication of a higher fat content in fish and may affect the taste giving them the characterization of more juicy and a white flesh (Alam *et al.*, 2012). Rawson, (1998) showed a very strong correlation of sensory fitness and juiciness to the fat content. Fat have been proposed to modify tenderness, bite, lubrication, elasticity and juiciness (Maga, 1987). In this study *M. rume* had a higher fat and protein composition but less tasty than *L. coubie*, meaning that fat is not the only determinant for taste and flavour. The sensitivity of the taste buds of the panellist and the perception about a particular fish species may have been responsible for the differences in the properties recorded in this study. However, undesirable reactions associated with lipids and proteins may lead to detrimental changes

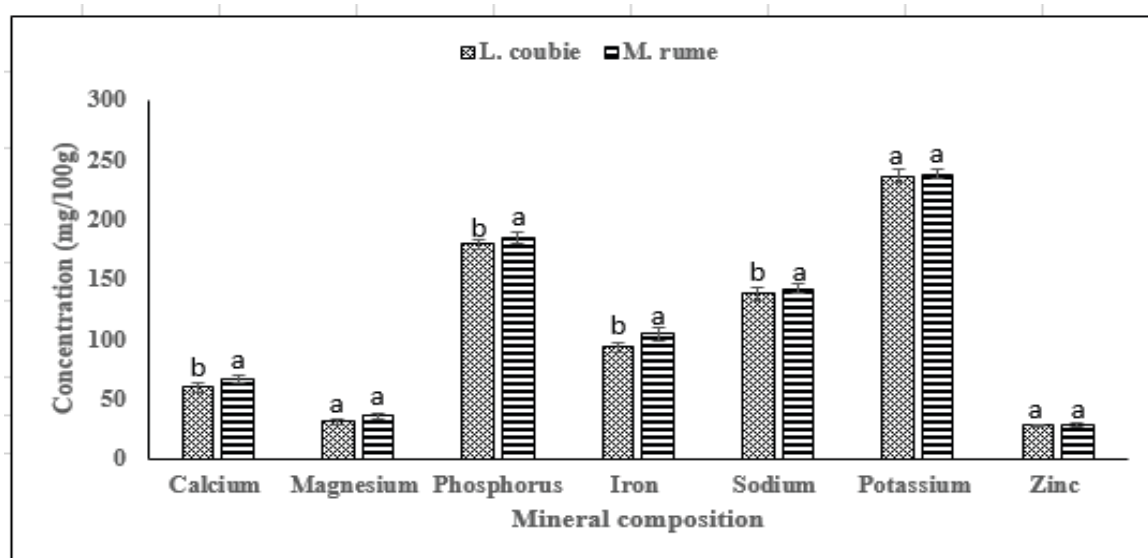


Figure 1. The mean values of the mineral composition of *L. coubie* and *M. rume* of cross river.

in nutritional sensory properties of fishes (Erickson, 1997).

Conclusion and Recommendations

This study revealed the importance of *L. coubie* and *M. rume* as good sources of protein and other nutrients. They have good percentage of moisture content which is in inverse relationship with fat content. High percentage protein and highly rich in fat especially *M. rume*, hence are excellent reservoir for essential amino acids and fatty acids. The percentage ash content in these fishes is an indication of their good source of minerals required in human diets. The organoleptic properties were in favour of *L. coubie* except oiliness which was better in *M. rume*. The nutritional information so obtained in this study would probably enable consumers to know the benefits derivable from these species. I recommend that the consumption of these species since they possess very good source of protein, fat and essential minerals.

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