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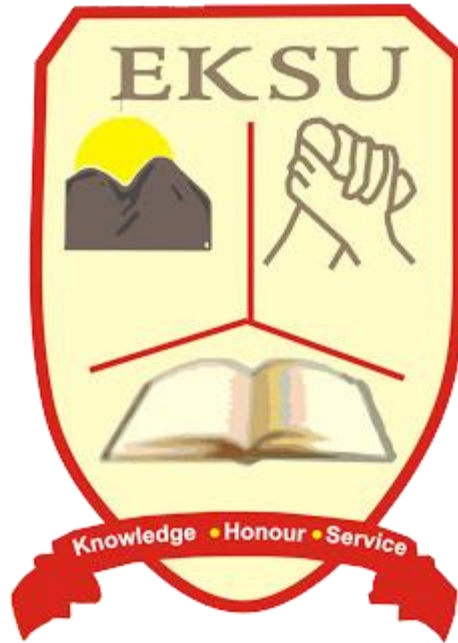
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Evaluation of the Nutritional Qualities of Edible Portions of Two Commercially Important Prawns in Southwest Nigeria.

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Abstract:

The nutritional qualities of the edible portions of prawn: *Macrobrachium macrobrachion* (*M. macrobrachion*) and *Macrobrachium vollenhovenii* (*M. vollenhovenii*) collected from Oluwa Creek, Ondo State, and Asejire Reservoir, Oyo State respectively were evaluated for food security potential. Smoke-dried samples were selected for proximate and mineral analysis. The weight *M. macrobrachion* ranged from 0.93 to 2.9g (1.97 ± 0.62) and *M. vollenhovenii* ranged from 5 to 24g (12.42 ± 6.62). Standard procedures were used for biochemical and mineral analysis, and the data obtained were statistically analyzed. The values obtained for proximate and mineral analysis of *M. vollenhovenii* and *M. macrobrachion* were proteins (69.58 ± 0.02 and $72.47 \pm 0.04\%$), carbohydrates ($11.15 \pm 0.00\%$ and $6.07 \pm 0.07\%$), fats ($10.93 \pm 0.06\%$ and $12.43 \pm 0.18\%$), moisture (4.79 ± 0.01 and $5.49 \pm 0.15\%$), ash (3.21 ± 0.01 and $3.17 \pm 0.01\%$) and crude fibers (0.33 ± 0.01 and $0.37 \pm 0.01\%$), respectively. Significantly higher amount of magnesium ($32.82 \pm 0.00\text{mg/l}$), potassium ($161.31 \pm 0.03\text{mg/l}$) and sodium ($90.17 \pm 0.04\text{mg/l}$) were obtained in samples of *M. macrobrachion* while, *M. vollenhovenii*, showed higher amount of calcium ($351.53 \pm 0.05\text{mg/l}$), manganese ($0.57 \pm 0.01\text{mg/l}$), iron ($4.32 \pm 0.04\text{mg/l}$), zinc ($1.12 \pm 0.00\text{mg/l}$) and copper ($0.38 \pm 0.00\text{mg/l}$). The caloric energy value of $426.05\text{kg}/100\text{g}$ determined in *M. macrobrachion* was higher than the value of $421.29\text{kg}/100\text{g}$ for *M. vollenhovenii*. Values obtained for both species were significantly different ($P < 0.05$) for the proximate and mineral compositions, except for ash, moisture, and crude fiber. The result affirmed that these shellfishes are nutritionally valuable, and are profitable for human consumption, not only as a delicacy, but also for their nutritive qualities which compare favourably with other animal protein sources.

Keywords: Asejire, reservoir, *Macrobrachium macrobrachion*, *Macrobrachium vollenhovenii*,

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Introduction

The continuous rise in the human population especially in the developing countries necessitates the search for additional sources of animal protein (El-Katcha *et al.*, 2015) to mitigate widespread deficiency in the diet. In Nigeria, the deficiency of animal protein security is indicated by the consumption put at 10 g/head compared to the minimum daily intake of 65 g recommended by the

Food and Agricultural Organization (FAO) and the minimum requirement for the growth and development of the body (Adamu *et al.*, 2015; El-Katcha *et al.*, 2015). Shellfishes have been identified as an additional source of food derived from the aquatic environment. Shellfishes contain varying levels of high-quality protein rich in all the valuable dietary essential amino acids (Udo, 2004), and are

superior to those in meat and poultry (Ehigiator and Oterai, 2012). Shellfish is a fisheries and culinary term for exoskeleton-bearing aquatic invertebrates used as food. They can be divided into two groups, viz: molluscs and crustaceans. Crustaceans commonly eaten are shrimps, prawns, lobsters, crayfish, and crabs.

Prawn is one of the popular crustaceans widely consumed in Nigeria mostly among the middle and low-income groups (Abulude *et al.*, 2006). Prawns that are caught in Nigerian waters are transported and concentrated in open and organized markets, where they are sold as cheap and affordable delicacies eaten either whole (shell with flesh) after drying or are processed flesh only (Udo, 2004). Its neutral flavour makes it a natural additive in food, such as salads, pasta, curry, soups, stew, stir-fried dishes, and are traditionally used as a condiment. Apart from being a delicacy, they are valuable in the diet for the supply of good quality proteins and vitamins and are good sources of dietary minerals such as calcium, phosphorus, iron, magnesium, etc. which are beneficial to man and animals (Abulude *et al.*, 2006). Freshwater prawns of the genus *Macrobrachium* are decapods crustaceans in the family Palaemonidae; this family, together with the family penaeidae (marine shrimps), has been globally acknowledged for recruitment into aquaculture (New, 2002). They are usually found in lakes, rivers, swamps, irrigation ditches, canals, ponds, and estuarine areas (New, 2002). Out of the 200 species that make up the genus; only four have been reported in Nigeria, and the two largest species of them, *Macrobrachium macrobrachion* and *Macrobrachium vollehovenii*, are commercially important shrimps/prawns which are extensively exploited in Nigeria (Hu *et al* 2002; Willet, 2007).

Due to their economic importance, previous studies on these two species have been on the aspects of the abundance, meristic and morphological characterization, biology, food and feeding habits, and proximate and mineral composition of these Palaemonid prawns (Deekae and Abowei, 2010; Ehigiator and Nwangwu, 2011; Olawusi-Peters and Ajibare, 2014; Arazu and Udo, 2015; Udo, 2015). The knowledge of the biochemical composition of any edible organism is extremely important since the nutritive value is reflected in biochemical contents, such as protein, amino acids, lipids, fatty acids, carbohydrates, vitamins, and minerals (Nagabhushanam and Mane 1978). Studies on the

biochemical composition have focused on species from the Southern and Eastern parts of the country; there is the dearth of information on these species from Southwestern part, except the relatively few from Lagos Lagoon, hence, this study was conducted to provide information on the nutrient composition of the two Caridean prawns from other Southwestern parts of the country, Ondo and Oyo States.

Methodology

Sample Origin

Oluwa Creek in Igbokoda lies in Latitude 6.2833 and longitude 4.8167. This area falls within the oil prospecting zone in Nigeria called the Oluwa region. The river is in the Ilaje Local Government Area, which is at the extreme southern part of Ondo State. It shares boundaries with Okitipupa Local Government Area in the North; the Atlantic Ocean in the South; Ijebu Waterside Local Government Area (Ogun State) in the West and Delta State in the East. This brackish watercourse is bounded by thick vegetation with a low occurrence of rhizoid plants and a higher profile of salt marshes and surface macrophytes that extend into the tributaries and mark the breeding grounds for the prawns. Asejire reservoir lies between longitudes 4^E and 4^{007E} and latitudes 7^{0N} and 7^{021N}. The reservoir took its source from the Osun river and flows through Oluwo and Alaye-ala down to Asejire. Asejire reservoir is in Egbeda Local Government Area of Oyo State, Southwestern Nigeria. The reservoir supplies water to Ibadan in Oyo State and some towns and villages in Osun for domestic uses. The reservoir is bi-focated with two unequal arms surrounded by a large mass of land. The left longer arm is fed by Rivers Oba and Osun while the right arm is supplied by River Agboiro. The catchment area of the reservoir is 78km² and the impounded area is 2,342 hectares. The reservoir has a normal pool elevation (water level) of 150m and maximum flood elevation of 152.4m. The reservoir has approximated gross storage of 7,403 million liters.

Collection of Samples

Thirteen and 12 prawn samples (*M. macrobrachion* and *M. vollehovenii*) with weight ranging from 0.93 to 2.9g and 5 to 24g respectively were procured from prawn mongers at the landing sites at Oluwa Creek, Igbokoda, Ondo State and Asejire Reservoir, Oyo State. The prawn samples were transported to

the laboratory of the Department of Animal and Environmental Biology, Adekunle Ajasin University, Akungba-Akoko, for further analysis.

Sample Identification and Preparation

Samples were identified from taxa to species level using taxonomic keys from the Food and Agricultural Organization Identification sheets (FAO, 1981) and Powell, (1982). The meristic and morphometric features such as colouration, the shape of rostrum, and the number of spines on the rostrum of each species were used for the identification. The samples were further smoke-dried to constant weight and were separated into waste (head with carapace, all the limbs with the pleopods, exoskeleton (body sheath on the abdomen), and flesh. The prawn's flesh, whole body, and exoskeleton were weighed with a digital weighing balance "Scout Pro" to the nearest .01gram. The prawn's flesh was ground into a fine powder using a "MOERGOLD MGB-242" electric blender, packed in a hermetic nylon material with labels, and stored in the desiccator for biochemical analysis.

Proximate and Mineral Analysis

The proximate components of the samples were determined using methods described by the Association of Official Analytical Chemists (AOAC), (2005). Moisture was determined by drying of samples for 24hrs at 105°C, ash was determined from the residue left after incineration of a weighed portion of the sample at 550 C using a muffle furnace, Carbohydrate content of the samples was determined as difference from the total percentage

(100%). The energy values of the prawns were calculated according to Palani *et al.* (2014), using the crude values of protein, fat, and carbohydrate as obtained from the proximate analysis. Energy value $\text{kg}/100\text{g} = \text{P} \times 4.00 \text{ (protein)} + \text{C} \times 4.00 \text{ (carbohydrate)} + \text{F} \times 9.00 \text{ (fat)} \text{ kcal}/100\text{g}$. Mineral components- Calcium, Magnesium, Potassium, Sodium, Manganese, Iron, Copper, and Zinc of the samples were determined by Atomic Absorption Spectrophotometric method at appropriate wavelengths. All analyses were done in duplicate, and all determinations were done on a dry weight (matter) basis.

Statistical Analysis

The statistical interpretation of the data was performed using Statistical Package for Social Sciences (SPSS version 21.0) for the mean and standard deviation. An Independent sample t-test at a confidence level of 95% was used to compare data to determine the significant differences between the values obtained from both species.

Results

Morphometric

The average weight composition of the prawn samples is presented in Table 1. For *M. vollehovenii*, weight varied from 5 to 24g; 1 to 9g and 3g to 14g, respectively for the whole body, flesh, and waste; whereas, weights obtained for the whole body, edible portion (flesh), and waste for *M. macrobrachion* ranged from 0.93 to 2.9g; 0.29 to 0.88g, and 0.63 to 2.02g respectively.

Table 1: The Average Weight Composition of the Palaemonid Prawns (Mean $\pm$ SD)

Species	Whole prawn (g)	Edible portion (Flesh) (g)	Waste (g)
<i>M. macrobrachion</i> (n=13)	1.97 $\pm$ 0.62	0.65 $\pm$ 0.19	1.31 $\pm$ 0.47
<i>M. vollehovenii</i> (n=12)	12.42 $\pm$ 6.62	4.35 $\pm$ 2.52	7.92 $\pm$ 4.18

Proximate

The proximate compositions ($\text{g } 100\text{g}^{-1}$) of the prawn samples are shown in Table 2. Mean crude protein values of (69.58 $\pm$ 0.02 and 72.47 $\pm$ 0.042) were found to be the highest, and the least proximate values were obtained for crude fiber (0.33 $\pm$ 0.01 and 0.37 $\pm$ 0.01) in *M. vollehovenii* and *M. macrobrachion* respectively. Values obtained for protein (72.47 $\pm$ 0.042) and fat (12.43 $\pm$ 0.18) were

significantly higher in *M. macrobrachion* than in its freshwater counterpart. *M. vollehovenii* had higher carbohydrate (11.15 $\pm$ 0.00) and ash content (3.21 $\pm$ 0.01), and lower moisture (4.79 $\pm$ 0.01) and crude fiber (0.33 $\pm$ 0.01) components than *M. macrobrachion*. However, statistically, there was no significant difference ($P > 0.05$) in the moisture, ash, and crude fiber values, as observed to have existed

in other proximate parameters for both *Macrobrachium* species.

Table 2: Proximate Composition of Prawn Samples (g 100g⁻¹)

Parameter %	<i>Macrobrachium macrobrachion</i>	<i>Macrobrachium vollenhovenii</i>
Protein	72.47 ± 0.04	69.58 ± 0.02
Moisture	5.49 ± 0.15	4.79 ± 0.01
Fat	12.43 ± 0.18	10.93 ± 0.06
Ash	3.17 ± 0.01	3.21 ± 0.01
Crude fibre	0.37 ± 0.01	0.33 ± 0.01
Carbohydrate	6.07 ± 0.07	11.15 ± 0.00
Dry Matter	94.51 ± 0.15	95.21 ± 0.01

Means ± SD are values of duplicate determination

Mineral Composition

In Table 3 are some macro and micro mineral components (mg/l) contained in the prawn samples. For macro minerals, the result showed that calcium had the highest mean values of (351.53±0.05 and 179.67±0.176mg/l), with magnesium recording the least values of (22.75±0.00 and 32.82±0.002mg/l) in *M. vollenhovenii* and *M. macrobrachion* respectively. Iron showed the highest values (4.32±0.04 and 3.02±0.035mg/l), and the values

obtained for copper (0.38±0.00 and 0.24±0.001mg/l) were respectively the least for micro minerals. *M. vollenhovenii* showed statistically higher amount of micro minerals: Mn (0.57±0.01), Fe (4.32±0.04), Cu (0.38±0.00), and Zn (1.12±0.00); conversely, except for calcium, significantly higher macro minerals values for Mg (32.82±0.00), K (161.31±0.03), and Na (90.17±0.04) were obtained for *M. macrobrachion*.

Table 3: Mineral Contents of Prawn Samples

Minerals (mg/l)	<i>Macrobrachium macrobrachion</i>	<i>Macrobrachium vollenhovenii</i>
Calcium	179.67±0.17 ^b	351.53±0.05 ^a
Magnesium	32.82±0.00 ^a	22.75±0.00 ^b
Potassium	161.31±0.03 ^a	117.60±0.02 ^b
Sodium	90.17±0.04 ^a	55.68±0.01 ^b
Manganese	0.37±0.00 ^b	0.57±0.01 ^a
Iron	3.02±0.03 ^b	4.32±0.04 ^a
Copper	0.24±0.00 ^b	0.38±0.00 ^a
Zinc	0.93±0.02 ^b	1.12±0.00 ^a

Means ± SD are values of duplicate determination

Discussion

The protein content obtained in *M. vollenhovenii* and *M. macrobrachion* were high to other biochemical compositions, corroborating assertions by Yanar and Celik, (2005) that shrimp meat is an excellent source of protein, Dayal et al., (2013) that nearly 80% of the portion (dry matter) of prawns comprises of protein, and Dinakaran et al., (2009) which stated that protein is the most prominent biochemical component of crustaceans. However,

the protein content of *M. vollenhovenii* (69.58%) was significantly lower compared to (72.47%) obtained for *M. macrobrachion*, ($p < 0.05$). The protein content of both species compares favourably with Ehigiator and Oterai (2012) for *M. vollenhovenii* (71.37%), and Reddy and Reddy (2014) for cultured *M. rosenbergii* (72.24%), but is higher than Udo (2015) for *M. vollenhovenii* (22.63%) and *M. macrobrachion* (20.30%), Ehigiator and Nwangwu (2011) for edible portion of *M. vollenhovenii*

(53.85%) and *M. macrobrachion* (58.92%), Arazu and Udo (2015) for dried *M. macrobrachion* (27.68%), Dinakaran et al., (2009) for *M. idae* (57.32%), Fasakin et al. (2000) for *M. vollenhovenii*, (16.99%), *M. rosenbergii* (17.30%), Omomo et al., (2014) for Chokor smoke-dried (55.88%), and for the Altona smoke-dried (58.87%) *M. vollenhovenii*, and Asaikkutti et al., (2016) for edible portion of wild *M. rosenbergii* (52.74%).

Minerals make up the micronutrients that are necessary for physiological and biochemical processes by which the human body takes in and utilizes food to maintain health and activity (Mohapatra et al., 2009). The calcium content recorded for *M. vollenhovenii* (351.53mg/l) was significantly higher than that of *M. macrobrachion* (171.67mg/l). However, both species' calcium contents were lower than (Abulude, et al., (2006), Ekpenyong et al., (2013) and Arazu and Udo (2015). Nonetheless, the value obtained for *M. vollenhovenii* was higher than Arazu and Udo (2015) for fresh (33.0mg/100g) and dried (28.8mg/100g) samples of *M. macrobrachion*, Omomo et al., (2014) for Chokor smoke-dried (5.66%), and Altona smoke-dried (4.20%) *M. vollenhovenii*, and Ehigiator and Akise (2013) for *M. vollenhovenii* (8.86mg/100g). Macro minerals: potassium, sodium, and magnesium obtained in *M. macrobrachion* were higher, statistically than what was contained in its freshwater counterpart. These are found to be lower than Abulude et al., (2006) for *M. vollenhovenii* (176mg/100g), (165mg/100g), and (330mg/100g) respectively. They are however, higher than Ehigiator and Akise (2013) for *M. vollenhovenii*

(11.94mg/100g and 15.17mg/100g) respectively and Ehigiator and Oterai (2012) for *M. vollenhovenii*. Significantly higher micro minerals: Mn (0.57mg/l), Fe (4.32mg/l), Cu (0.38mg/l) and Zn (1.12mg/l) were obtained for *M. vollenhovenii*, when compared with values obtained for *M. macrobrachion* however, the values are still lower than Ehigiator and Akise (2013) that recorded Mn (4.33mg/100g), Fe (40.44mg/100g), Cu (2.22mg/100g), and Zn (11.93mg/100g) for flesh of *M. vollenhovenii*. Notwithstanding, the prawn samples contained considerable amount of essential minerals, and its consumption will help, among their numerous functions, regulate fluid balance (Sandstead, 1997), enzyme production, blood clotting (Abulude et al., 2006), metabolism of carbohydrates to produce energy (Hambidge, 2000), maintain blood pressure, transportation of oxygen, normal function of muscles, nerves, bones and promote good health.

Conclusion

From nutritional perspective, these prawns' flesh are excellent sources of high quality protein which is superior to those in meat and poultry; other varying inherent and essential nutrients can also compete favourably with those in meat from other animal sources. They also contain considerable amount of macro and micro minerals. The result further showed *Macrobrachium macrobrachion* to be richer in protein, fat, and some macro minerals than *Macrobrachium vollenhovenii*. Conclusively, consumption of the prawns, apart from being a delicacy, could also enhance food security because of their nutritional value

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