FATTY-ACID COMPOSITION OF MACROBRACHIUM VOLLENHOVENII IN OGUN ESTUARY, NIGERIA

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ABSTRACT

A study was carried out on the fatty-acid composition of *Macrobrachium vollenhovenii* (African river prawn) in Ogun estuary, Ogun State, Nigeria. Sexes and size groups were considered during the study. Fatty-acid analysis was done in triplicates and data obtained were analyzed using descriptive statistics, analysis of variance and Duncan's multiple range tests. Fatty acids analysed which included oleic acid, linoleic acid, stearic acid, myristic acid, palmitic acid and lauric acid were classified into saturated and monounsaturated fatty acids. All values of saturated fatty acids were higher in female (29.64%) than in male (25.50%) $p< 0.05$. So also the monounsaturated fatty acid also showed higher value in female (29.64%) than in male (25.50%). All fatty- acid values were higher in female *M. vollenhovenii* than in male. Meanwhile, myristic acid was highest in the two sexes and the combined sexes, (35.68% female), (33.14% male) and (34.74% combined sexes). The fatty-acid components were not influenced by the size of the fish. This study clearly indicated that the nutritive value of *M. vollenhovenii* is quite well comparable to the edible species of decapods already studied (shrimps, prawns and lobsters) and could be included in both human and livestock diets.

Keywords: Fatty, Composition, Macrobrachium, Ogun, Estuary

INTRODUCTION

Nigeria is among tropical countries endowed with rich shellfish resources, the coastal waters of Nigeria are characterized by abundance of important living resources including prawns, predominantly members of the family penaeidae and palaemonidae. With a production capacity of 12,000 metric tons (MT) per year, Nigeria's shellfish supply is presently from capture fisheries (Zabbey *et. al.,* 2010).

Shellfish (prawn) provide high quality protein with all the dietary essential amino acids for maintenance and growth of the human body (Sogbesan, 2004). Shrimps caught from fresh, marine and brackish waters and ponds of various types are becoming delicacies in Nigeria. They are eaten either whole (Shell and flesh) after drying or as flesh alone (when fresh) and the exoskeleton is used for animal feeds. Crustaceans constitute important nutritional component in the diet of rural and urban communities in Nigeria, while some species are widely distributed, others are found in restricted areas and they are regarded as delicacies. Over 90% of crustaceans consumed in Nigeria are obtained from coastal artisanal and freshwater fisheries (FAO, 2006).

The chemical composition and nutritional properties of aquatic crustaceans are important in their uses as sources of protein to significant proportion of the world population, particularly in developing countries where animal protein is expensive and beyond the reach of the poor (Bello-Olusoji and Oke, 2005). It is valuable in the diet because apart from supply of good quality protein and vitamins A and D, it also contains several dietary minerals such as calcium and Iron etc. which are beneficial to humans and animals (Abulude *et. al.,* 2006).

It has a high market price and a good export potential. It is a nutritious delicacy for mankind. There are several reports available with respect to improvement of nutritional quality of *M. vollenhovenii* under culture conditions (Sogbesan, 2004). Freshwater prawns are important in the capture and culture fisheries scene and are extensively distributed in freshwater and estuaries of the world mostly in tropical and subtropical belts. It is a welcome substitute when fish becomes scarce in the market. However, the growth and mortality parameters of this species that contribute immensely to the economy of many developing countries are not well known (Powell, 1983).

Giant fresh water Prawn *M vollenhovenii* is among the largest known palaemonid in the world. Among crustacean, *M. vollenhovenii attracted* more attention in the recent years which causes to expand its distribution not only within its natural range, but even beyond (Mariappan, 2003). It also contain good amount of organic and inorganic constituents. The main constituents are protein, carbohydrate and lipid. In addition to that prawns also contain a significant proportion of minerals (Ca, P, Mg, Mn and Cl) and vitamins (A, C and D). However, these values vary considerably within and between species, size, sexual condition, feeding season and physical activity. Information on the nutritional value of this shellfish in Ogun estuary is lacking, which necessitate this study.

MATERIALS AND METHODS

This study was carried out between January and June, 2012. Samples of prawn, *M. vollenhovenii* were collected from Ogun estuary at Iwopin, Ogun water side Local Government Area of Ogun State, with a latitude of 6° 31 N and a longitude of 4° 10 E, is an extension of Lekki lagoon in which the water is almost fresh throughout the

year as inland waters, having very low salinity range with many tributaries as a result of influx from rivers making an Estuary.

The prawns were caught by the fishermen with the use of non-return valve. The samples were ranged from 81 to 150mm in length. 180 samples were collected and transported to the laboratory in live and fresh condition by keeping them in bucket containing freshwater. At the laboratory they were washed carefully with distilled water to remove dust and algal particles and ice killed. They were separated into two groups' *viz.*, male and female. Further grades were made according to the size and each group were graded in to seven size groups at 10 mm intervals. After grading, the exoskeleton were pealed out and homogenized with pestle and mortar. The grounded samples were then oven dried at 50^0C for 8hours to a constant weight. This was ground in a blender packed in polythene bags with labels and stored in a desiccator for subsequent chemical analysis.

The profile of fatty acids was done following gas chromatographic (GC) method (Nichols *et. al.*, 1995). Fatty acid concentrations equal or higher than 1mM may be easily determined by titrimetry even in the presence of other lipids. Titrimetry was classically used to determine the acid value (free fatty content) of vegetable oils and fats. This value is defined as the number of mg of KOH required to neutralize the fatty acids contained in 1g of the fat. It is very easy to express the results in other units as mg fatty acids per g of sample or moles per Kg.

Macro-method of Fatty acid analysis

Reagents:

Solvent mixture (95% ethanol/diethyl ether,1/1,v/v).0.1MKOH in ethanol accurately standardized with 0.1M HCL (pure ethanol may be also used if aqueous samples are analyzed), 1% phenolphthalein in 95% ethanol.

Procedure:

Weigh 0.1 to 10g of oil or fat (according to the expected acid value) in glass vial and dissolve in at least 50ml of the solvent mixture (if necessary by gently heating).

Titrate, with shaking, with KOH solution (in a 25ml burette graduated in 0.1ml) to the end point of the indicator (5 drops of indicator), the pink colour persisting for at least 10seconds.

The acid value is calculated by the formula: 56.1* N*V/M

Where V: is the number of ml of KOH solution used and N is exact normality, M is the mass in g of the sample. Other expressions can be easily calculated (concentration of fatty acids or their weight, considering an average molecular weight of 282). A non-aqueous flow injection titrimetric method has been described for the determination of free fatty acids in vegetal oil samples even with a background colour.

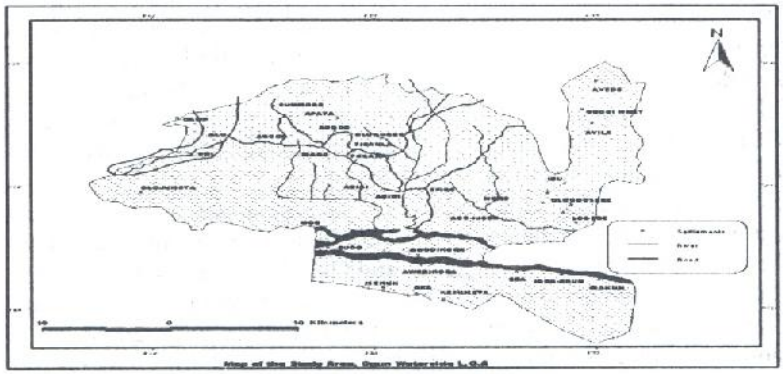

Figure 1: MAP SHOWING THE STUDY SITE

Size Distribution and Sex Ratio

1500 prawns collected were sorted into various sizes of 2cm class interval. Also they were sorted into sexes, male and female and the sexes were later combined.

Statistical analyses:

Statistical package such as spss (statistical package for the social science) was used to analyze the data collected. Tools like descriptive statistics, analysis of variance, and linear regression were critically examined.

RESULTS

Fatty acid composition of *M. vollenhovenii in* Ogun estuary

Result in Table 1 shows the fatty acid composition of *M. vollenhovenii* in Ogun estuary based on size class. Myristic acid was the highest and stearic acid was the lowest in the prawn during the study period. The oleic acid ranged between 21.38±1.23 to 31.37±0.31, with a class size of 81-90cm and 141-150cm respectively. There was a significant ($p<0.05$) difference among the means of oleic acid in all the size classes. Palmitic acid followed the same trend when compared with oleic acid.

The mean value of oleic acid was less than that of the oleic acid in the fish. Palmitic composition ranged from 14.09±0.99 to 28.62±0.25 in the respective size classes. Analysis of variance, ANOVA showed significant ($p<0.05$) difference among the means of palmitic acid composition of *M. vollenhovenii* in the estuary. Lauric acid composition of the shellfish was lower 20.15±0.31 than the palmitic acid 24.57±0.91. It increased from 17.13±1.08 in size class 81-90cm to 22.32±0.16 in the size class 141-150cm.

Linoleic acid was further reduced when compared to the former acids. The mean value in the stock during the study was 18.03±0.31. It increased with increase in size class, with minimum value of 21.39±0.36 in size class 141-150cm. ANOVA analysis showed significant ($p<0.05$) difference among the means. Stearic acid was the least among the fatty acids analysed in this study for *M.* vollenhovenii in the estuary. The mean value was 15.78± 0.41. The maximum value was 18.79±0.66 in size class 141-150cm and minimum value was 12.31±0.69 in size class 81-90cm. the means were significantly ($p<0.05$) different. Myristic acid had the highest value in the sample during the study, 34.73±0.37. Its minimum value was 31.21±0.49 and the maximum was 37.79±0.42. It followed the same trend with the other fatty acid components of *M. vollenhovenii* in the estuary. As shown in Table 2, oleic acid was highest in the female stock (29.64±0.49) and least in the male stock (25.50+1.16), there was no significant ($P>0.05$) difference among the means of oleic acid. The palmitic acid Content was maximum in the female (24.57±1.34) and minimum in the male (24.47±0.75) but it was not significantly different from the combined stock ($P>0.05$). The lauric acid values recorded for various Sexes ranged between 21.15±0.03 (female) and 48.519.17±0.61 (male), it was not significantly different from the male and combined stock ($P>0.05$). The highest value for linoleic acid was recorded in the female stock with 18.94±0.49 to 17.13±0.65 which is least in the male stock as shown in table 2. There was significant ($p<0.05$) different among the mean in terms of linoleic acid. But there was a significant different ($p<0.05$) when both stocks were combined which was no significantly different from the female stock. The stearic acid ranged between 17.16±0.52 in the female stock to 14.40±0.62 in the male stock as shown in table 2. Also, there was a significant different ($p<0.05$) when both stocks were combined. Meanwhile for myristic acid the highest value was recorded in the female stock with 35.95±0.45 to 33.51±0.63 which is least in the male stock as shown in table 2. But there was a significant different ($p<0.05$) when both stocks were combined which was no significantly different from the female stock which was not significantly different from the female stock ($p>0.05$). There was significant ($p<0.05$) different among the mean in terms of myristic acid.

Table 1: Result of fatty acid composition of *M. vollenhovenii* in Ogun estuary.

Mean ± standard error

Size class	Oleic acid	Palmitic acid	Lauric acid	Linoleic acid	Stearic acid	Myristic acid
81-90	23.37 ± 1.53^{a}	14.09 ± 0.99^{a}	17.13 ± 1.08^{a}	14.02 ± 0.68^{a}	12.31 ± 0.69^{a}	32.08 ± 0.75^{a}
91-100	21.38 ± 1.23^{a}	23.30 ± 0.11^{b}	18.20 ± 0.11^{a}	15.06 ± 0.18^{b}	13.19 ± 0.24^{b}	31.21 ± 0.49^{a}
101-110	27.29 ± 0.44^{b}	24.84 ± 0.32^{c}	19.69 ± 0.29^{b}	18.63 ± 0.30^{cd}	15.72 ± 0.31^{d}	34.90 ± 0.28^{c}
111-120	28.41 ± 0.29^{bc}	25.65 ± 0.24^{c}	20.14 ± 0.17^{b}	17.68 ± 0.35^{c}	14.46 ± 0.67^{cd}	33.70 ± 0.26^{b}
121-130	30.87 ± 0.27^{d}	28.21 ± 0.21^{dc}	22.14 ± 0.19^{c}	20.29 ± 0.17^{e}	18.41 ± 0.14^{e}	37.08 ± 0.18^{dc}
131-140	30.28 ± 0.19^{c}	27.29 ± 0.17^{d}	21.45 ± 0.14^{c}	19.17 ± 0.11^{d}	17.58 ± 0.18^{e}	36.36 ± 0.21^{d}
141-150	31.37 ± 0.31^{d}	28.62 ± 0.25^{e}	22.32 ± 0.16^{e}	21.39 ± 0.36^{e}	18.79 ± 0.66^{e}	37.79 ± 0.42^{e}
Mean±SE	27.56±0.57	24.57±0.19	20.15±0.31	18.03±0.31	15.78±0.41	34.73±0.37

Values with the same superscripts across the columns were not significantly ($p>0.05$) different.

Effect of sexes on fatty acid composition of *M. vollenhovenii* in Ogun estuary

The sexes of the stock *M. vollenhovenii* influenced ($p<0.05$) the acid compositions expect for palmitic acid. The female stock had higher acid compositions in all cases than the male and the combined sexes (Table 2). Myristic and oleic acids were both higher in female than the male indicating that the compositions of the stock differed with sexes (except in palmitic acid). However, myristic acid was significantly higher ($p<0.05$) in the female and combined sexes. All the acids were higher in female *M.* vollenhovenii than the male. Meanwhile, myristic acid had the highest value in both sexes and the combined sexes.

Table 2: Sexes with fatty acid composition of *M. vollenhovenii* Ogun estuary

Sexes	Oleic acid	Palmitic acid	Lauric acid	Linoleic acid	Stearic acid	Myristic acid
Male	25.50+1.16a	24.47±0.75a	19.17±0.6a	17.13±0.65a	14.40±0.62a	33.51+0.63a
Female	29.64±0.49b	24.57+1.34a	21.15±0.3b	18.94±0.49b	17.16±0.51b	35.95±0.45b
Combine	27.57+0.80ab	24.52±1.04a	20.14±0.42ab	18.03±0.57ab	15.78±0.52ab	34.74+0.52ab
Mean ±SE	27.57±0.81	24.57±1.04	20.15+0.44	18.03±0.57	15.78±0.55	34.73±0.53

Values with the same superscripts across the columns were not significantly ($p>0.05$) different.

DISCUSSION

Edible crustacean such as prawn constitute one of the major sources of nutritious food for human being. Among seafood, prawns and shrimps contribute about 20% by volume of the world seafood market. Seafood in general, prawns and shrimps in particular, are highly nutritious with good source of protein and amino acids (Ville, 1971). The fibre in prawns has a nutritional advantage in that it will assist in reducing constipation and other attendant problems in human consumers.

The nutritive values of crustaceans depend upon their biochemical composition, such as protein, amino acids, lipid, fatty acids, carbohydrate, vitamins and minerals. In the present study, the total values of saturated fatty acids were higher in females (35.95%) than in males (33.51%). Among various saturated fatty acids recorded, the amount of oleic acid in both sexes was more and when the sexes were combined. This agrees with the result of (Dinakaran *et. al.,* 2009) on *M. idea*. But when compared with males (17.13%) the females had more (18.94%) and contrary to the work of Murugesan (2007) who reported maximum amount in palmitic acid (20.09%) in *C. lucifera*. As in saturated fatty acids the total amounts of monounsaturated fatty acids in females were maximum (29.64%) rather than males (25.50%). Comparatively the total amount of monounsaturated fatty acids (oleic acid and linoleic acid) of *M. vollenhovenii* is minimum than saturated fatty acids(lauric acid, palmitic acid, stearic acid and myristic acid).

It has been reported that incorporation of essential fatty acids in the diet produced better growth rate and survival in aquaculture (Bell and Sargent, 2003). The ω-6 fatty acids have their own role in female reproductive cycle. The ω-9 fatty acids help to reduce the risk of arteriosclerosis, cardiovascular disease and stroke. Since *M. vollenhovenii* contains considerable amounts of PUFA it can provide a healthy choice of daily diet. However, this species is recommended for aquaculture.

CONCLUSION

The present research work revealed that *M. vollenhovenii* is a good source of protein; hence can be used as substitute for meat and fin fish and for feed formulation for animals. The study clearly indicated that the nutritive value of *M. vollenhovenii* is very well compared to the edible species of decapod crustaceans already studied (shrimps, prawns and lobsters). More essential research in the abundance of *M. vollenhovenii* in the coastal waters is essential in formulation of comprehensive and formidable policies that will wisely conserve this rich fish resource of the coastal diversity.

RECOMMENDATION

Since *M. vollenhovenii* is a good protein source and low in fat, this species of prawn can be recommended as a healthy choice for human consumption. Further detailed study on the proximate composition of closely related prawn species using advanced versatile technology is suggested.

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