E-ISSN: 2347-5129
P-ISSN: 2394-0506
(ICV-Poland) Impact Value: 5.62
(GIF) Impact Factor: 0.549
IJFAS 2019; 7(6): 255-259

www.fisheriesjournal.com
Received: 10-09-2019
Accepted: 12-10-2019

Akisani CA
Department of Fisheries and Aquaculture, Federal University of Agriculture, P.M.B 2373 Makurdi, Nigeria

Annune PA
Department of Fisheries and Aquaculture, Federal University of Agriculture, P.M.B 2373 Makurdi, Nigeria

Solomon SG
Department of Fisheries and Aquaculture, Federal University of Agriculture, P.M.B 2373 Makurdi, Nigeria

Corresponding Author:
Akisani CA
Department of Fisheries and Aquaculture, Federal University of Agriculture, P.M.B 2373 Makurdi, Nigeria

Proximate and mineral content of *Atya gabonensis* Giebel, 1875 and *Macrobrachium felicinum* Holthuis, 1949 from River Benue and River Niger, Nigeria

Akisani CA, Annune PA and Solomon SG

Abstract
Proximate and mineral composition of *A. gabonensis* and *M. felicinum* were studied. The moisture, ash, ether extract, crude protein, nitrogen free extract, Na, Zn, Fe, Cu, Mg, Ca, K and Mn were analyzed. The mean value of moisture, ash, ether extract, crude protein, nitrogen free extract, Na, Zn, Fe, Cu, Mg, Ca, K and Mn were 8.77%, 14.25%, 3.24%, 7.26%, 64.67%, 1.81%. 0.08mg/100g, 0.02mg/100g, 0.06mg/10g, 0.001mg/100g, 0.92mg/100g, 0.88mg/100g, 2.48mg/100g and 0.25mg/100g respectively in *M. felicinum* and 7.51%, 25.93%, 3.51%, 11.32%, 49.89%, 1.78%, 2.14mg/100g, 0.02mg/100g, 0.07mg/100g, 0.001mg/100g, 0.78mg/100g,0.89mg/100g,2.69mg/100g, 0.27mg/100g respectively in *A. gabonensis*. *M. felicinum* and *A. gabonensis* are good sources of protein and Ash, thereby, it can be used as substitute for fish, meat, plant protein and animal protein for feed formulation for animals and children because they compare favorably with the protein content of other conventional feed-stuff.

Keywords: Shellfish, shrimps, protein, ash

1. Introduction
An adequate supply of dietary protein is required for survival, growth and development, reproduction and maintaining a good health but it is in short supply in the country. In order to rescue the situation shellfish is one of the cheapest of these resources that can serve as an alternative source of protein and mineral for man. Shrimps and prawns are extremely good source of protein, yet are very low in fat and calories, making them a very healthy choice of food. They are valuable in the diet, because apart from supply of good quality proteins and vitamin A and D, they also contain several dietary minerals such as calcium, iron etc. which are beneficial to man and animals [1]. The chemical composition of food ingredients derived from marine organisms such as shrimp has a good value for human health. Almost all the minerals can be found in seafood. Types of minerals commonly found in seafood are magnesium, calcium, iron, potassium and fluorine [2]. Generally, fish and shellfish meat is considered to be highly nutritious, owing to its content of essential amino acids and proteins, for example, shrimp meat is an excellent source of protein [3] and shrimp is one of the most popular species as it is a part of almost every nation's traditional meal rich in protein and minerals. Due to low price and efficient availability, the prawns and shrimps have good source of animal protein for low income earners.
The proximate composition of fatty acid profile, cholesterol and total carotenoid contents of prawns change seasonally [3-5].
The proximate body composition including protein moisture, fat, and ash are good indicators of physiological condition of an organism. The greater the protein and lipid content represents higher the energy density [6]. However, quantities of these constituents vary considerably within and between species, size, sexual condition, feeding season and physical activity [7, 8].
The current study was aimed to establish information on the proximate and mineral composition of *A. gabonensis* and *M. felicinum* from River Benue (Makurdi) and River Niger (Ganaja).

2. Materials and Methods
2.1 Study area
The study covered the Lower River Benue (Makurdi) and River Niger (Ganaja,). The Lower River Benue, Makurdi, is located on latitude 7˚ 55' and 7 56' North of equator and longitude

8˚20' and 8˚ 40' East of the Greenwich meridian. River Benue is the major tributary of the Niger River and it is approximately 1,400 km long almost entirely navigable during the rainy months. As a result, it is an important transportation route in the regions through which it flows. It rises in the Adamawa Plateau of northern Cameroon, from where it flows west, and through the town of Garoua and Lagdo Reservoir, into Nigeria south of the Mandara mountains, and through Jimeta, Ibi and Makurdi before meeting the Niger at Lokoja. The river's largest tributary is the Mayo Kebbi, which connects it with the Logone River (part of the Lake Chad basin system) during floods. Other tributaries are Taraba River and River Katsina Ala. River Benue divides the Makurdi town into the North- and South-bank. The river overflows its banks during the rainy season (May-October), but decreases drastically in volume leaving tiny islands in the middle of the river during the dry season (November-April).

River Niger, Ganaja, is located between latitude 7º 45 N and 8º 12 N and longitude 6º 39 E and longitude7º 00E. The River Niger is the principal river of western Africa, extending about 4180km (2600mi). Its drainage basin is 2,117,700km in area. Its source is in Guinea Highlands in Southeastern Guinea. It runs in a crescent through Mali, Niger on the border with Benin and then through a massive delta known as Niger Delta or the oil Rivers, into the Gulf of Guinea in Atlantic Ocean. The Niger is the third-longest river in Africa, exceeded only by the Nile and the Congo River. Its main tributary is the River Benue.

2.2 Sample collection

Samples of *A. gabonensis* and *M. felicinum* were collected fortnightly from August 2016 to May 2018 from River Benue (Makurdi) and River Niger (Ganaja). Mixed sizes of healthy samples of *A. gabonensis* and *M. felicinum* were collected from the two landing sites with the help of artisanal fishermen. The fishermen used combination of gill nets and trap the prawns. The specimens were immediately preserved in ice packed cooler and transferred to the laboratory, where they were thoroughly washed off impurity before researching on them.

2.3 Proximate and mineral composition

The moisture content was dried at 100 ºC in fixed weight. Sampled specimens were grounded using an electric grinder after chopping with mortar and pestle. The grounded portion were weighed separately and used for proximate analysis. Proximate composition was determined according to the method of [9]. This includes determination of Ash content, ether extract crude protein, moisture content, crude fiber and nitrogen free extract. All determinations were performed in triplicates.

Minerals (Na, Zn, Fe Cu, Mg, Ca, K and Mn) were also determined using Varian Spectra Atomic absorption spectrophotometer (AAS), Buck Scientific 210 GVP model.

2.4 Statistical Analysis

The data was statistically evaluated using SPSS 12.0 statistical software and Microsoft office EXCEL 2010; the results were expressed as mean ± standard error (SE).

3. Results

The result of the proximate and mineral composition of *Macrobrachium felicinum* from Lokoja and Makurdi is presented in Table 1. The result showed that protein content was higher in dry season than rainy season for *Macrobrachium felicinum* from both Lokoja and Makurdi. Crude fiber ranged between 7.14% and 7.34% was higher during the rainy season than the dry season, showing no significant difference between. The ash content ranged between 12.89% and 15.76%. The Ether extract for both locations was low and it varied from 2.98% and 3.50%, showing a significant difference in dry and rainy season at Lokoja. The results of the mineral analysis showed that Potassium was highest compared to other mineral content and Zinc having the lowest. The magnesium content from both Lokoja and Makurdi species show no significantly different (P>0.05) from each other. The magnesium concentration varied between 0.88 – 0.95mg/100g.

The result of the proximate and mineral composition of *Atya gabonensis* from Lokoja and Makurdi is presented in Table 2. The result showed that protein content was higher in dry season than rainy season for *Atya gabonensis* from Lokoja and higher in rainy season than dry season for *Atya gabonensis* from Makurdi. Crude fibre ranged between 10.13% and 12.84%, and was higher in Lokoja (12.45%) than in Makurdi (10.19), showing a significant difference. The ash content ranged between 23.23% and 29.76%. The Ether extract for both locations was low and it varied from 3.26% and 3.73%, with no significant difference. The results of the mineral analysis showed that Potassium was highest compared to other mineral content and Copper having the lowest. The magnesium content both from Lokoja and Makurdi species shows no significantly different (P>0.05) from each other. The Manganese concentration varied between 0.26 – 0.29mg/100g.

The result of the proximate and mineral composition of *Macrobrachium felicinum* and *Atya gabonensis* from Lokoja and Makurdi is presented in Table 3. The result showed the comparison between the proximate and mineral composition of *Atya gabonensis* and *Macrobrachium felicinum* from Makurdi and Lokoja. The protein content for both *Atya gabonensis* and *Macrobrachium felicinum* shows that it was high when compared with other nutrient composition. There was a significant difference between the protein content of *Atya gabonensis* and *Macrobrachium felicinum*, with *Macrobrachium felicium* being higher (64.67%) than *Atya gabonensis* (49.89%). There was a significant difference crude fiber of *Atya gabonensis and Macrobrachium felicinum* which was higher in *Atya gabonensis than Macrobrachium felicinum*. The ash content was higher in *Atya gabonensis* (25.93%) *than Macrobrachium felicinum* (14.25%). There was no significant difference between ether extract in *Macrobrachium felicinum* and *Atya gabonensis.* The results of the mineral analysis showed that Potassium was highest compared to other mineral content and Copper having the lowest. The magnesium content of *Macrobrachium felicinum* and *Atya gabonensis* shows a significantly difference (P>0.05) from each other. The Manganese concentration varied between 0.25 – 0.27mg/100g, with a significant difference.

Table 1: Proximate (%) and mineral content (mg/100g) of *Macrobrachium felicinum*

	Ganaja		Makurdi		Ganaja vs Makurdi	
	Dry	**Raining**	**Dry**	**Raining**	**Lokoja**	**Makurdi**
Moisture Content	9.11± 0.15	8.32± 0.24	8.79± 0.46	8.88± 0.41	8.72± 0.26	8.83± 0.25
Ash	12.89±0.1[b]	15.26± 0.30[a]	13.13± 1.12	15.76± 0.50	14.07±0.69	14.44± 0.91
Ether Extract	2.98± 0.04[b]	3.50± 0.05[a]	3.11± 0.25	3.36± 0.03	3.24± 0.15	3.23± 0.13
Crude fibre	7.29± 0.05	7.34± 0.09	7.14± 0.12	7.26± 0.06	7.31± 0.04	7.20± 0.06
Crude Protein	65.69±0.1[a]	63.83± 0.12[b]	66.42± 0.45	62.75± 0.82	64.76±0.54	64.58± 1.13
NFE	2.06± 0.06[a]	1.78± 0.03[b]	1.42± 0.08[b]	2.00± 0.00[a]	1.92± 0.08	1.71± 0.17
Sodium	0.07±0.006	0.08± 0.002	0.08± 0.002	0.08± 0.001	0.07±0.004	0.08± 0.001
Zinc	0.02±0.001	0.02± 0.0003	0.02± 0.001	0.02± 0.004	0.02±0.002	0.02± 0.002
Iron	0.06±0.002	0.06± 0.004	0.06± 0.004	0.06± 0.00	0.06±0.002	0.06± 0.002
Copper	0.001±0.00	0.001± 0.00	0.001± 0.00	0.001± 0.00	0.001±0.00	0.001± 0.00
Magnesium	0.88± 0.02	0.95± 0.02	0.95± 0.03	0.90± 0.05	0.91± 0.02	0.92± 0.03
Calcium	0.89±0.009	0.86± 0.003	0.86± 0.008	0.89± 0.02	0.88±0.00[a]	0.87± 0.01
Potassium	2.56± 0.04	2.44± 0.02	2.44± 0.02	2.51± 0.01	2.49± 0.04	2.47± 0.02
Manganese	0.25±0.002	0.26± 0.01	0.25± 0.00	0.25± 0.00	0.25±0.004	0.25± 0.002

Means within the same row with different superscripts are significantly different at $P<0.05$

Table 2: Proximate (%) and mineral content (mg/100g) of *Atya gabonensis*

	Ganaja		Makurdi		Ganaja vs Makurdi	
	Dry	**Raining**	**Dry**	**Raining**	**Dry**	**Makurdi**
Moisture Content	8.89± 0.81	9.41± 0.15	6.05± 0.29	5.68± 0.48	9.15±0.38[a]	5.87± 0.25[b]
Ash	23.23±1.19	23.61± 0.10	27.13± 1.11	29.76± 0.50	23.42±0.4[b]	28.44±0.91[a]
Ether Extract	3.53± 0.52	3.73± 0.22	3.26± 0.25	3.51± 0.03	3.63± 0.24	3.38± 0.13
Crude fibre	12.07±0.99	12.84± 0.58	10.13± 0.12	10.25± 0.06	12.45±0.5[a]	10.19±0.0[b]
Crude Protein	50.91±0.31	49.00± 0.50	51.73± 0.45	67.91± 0.97	49.95±0.60	49.82± 1.19
NFE	1.38± 0.21	1.41± 0.11	1.71± 0.25	2.63± 0.35	1.39± 0.09	2.17± 0.32
Sodium	2.09± 0.04	2.23± 0.03	2.07± 0.01	2.18± 0.03	2.16± 0.04	2.12± 0.04
Zinc	0.02±0.003	0.02± 0.003	0.02± 0.003	0.02± 0.003	0.02±0.002	0.02± 0.002
Iron	0.06± 0.05	0.09± 0.006	0.05± 0.04	0.09± 0.01	0.07± 0.02	0.07± 0.02
Copper	0.001±0.00	0.001± 0.00	0.001± 0.00	0.001± 0.00	0.001±0.00	0.001± 0.00
Magnesium	0.79± 0.02	0.73± 0.03	0.81± 0.01	0.78± 0.02	0.76± 0.02	0.79± 0.01
Calcium	0.91±0.00[a]	0.86± 0.005[b]	0.93± 0.02	0.86± 0.004	0.88± 0.02	0.89± 0.02
Potassium	2.79± 0.23	2.59± 0.05	2.83± 0.19	2.57± 0.03	2.69± 0.11	2.70± 0.11
Manganese	0.29± 0.02	0.27± 0.02	0.26± 0.01	0.26± 0.003	0.28± 0.01	0.26± 0.003

Means within the same row with different superscripts are significantly different at $P<0.05$

Table 3: Proximate (%) and mineral content (mg/100g) of *Macrobrachium felicinum* and *Atya gabonensis* in Ganaja and Makurdi

	M. felicinum	***A.gabonensis***
Moisture Content	8.77± 0.17	7.51± 0.65
Ash	14.25± 0.53[b]	25.93± 1.06[a]
Ether Extract	3.24± 0.09	3.51± 0.13
Crude fibre	7.26± 0.04[b]	11.32± 0.49[a]
Crude Protein	64.67± 0.58[a]	49.89± 0.62[b]
NFE	1.81± 0.09	1.78± 0.21
Sodium	0.08± 0.002[b]	2.14± 0.03[a]
Zinc	0.02± 0.001	0.02± 0.001
Iron	0.06± 0.001	0.07± 0.01
Copper	0.001± 0.00	0.001± 0.00
Magnesium	0.92± 0.02[a]	0.78± 0.01[b]
Calcium	0.88± 0.007	0.89± 0.01
Potassium	2.48± 0.02[b]	2.69± 0.07[a]
Manganese	0.25± 0.002[b]	0.27± 0.006[a]

Means within the same row with different superscripts are significantly different at $P<0.05$

4. Discussion

Crustaceans are generally known to constitute important nutritional components in the average diets of a vast population in both developing and developed countries, particularly where high animal proteins are either unaffordable or unavailable [10].

According to [11], prawn is valuable in the diet because it provides good quality protein, vitamin A and D, as well as several important dietary minerals especially calcium and iron. The proximate composition of *M. felicinum* and *A. gabonensis* showed that the protein content was 64.67% and 49.89% respectively, which disagrees with74.24% observed by [12] for *M. rosenbergii*. Also the protein content disagrees with [13, 14] that reported that the protein composition might be up to 90%. The ash content reported in this study for *M. felicinum* (14.25%) disagreed with [15], who reported 25.33% from *M. vollenhovenii* and 22.67% obtained from *M. macrobrahion*, but agrees with [16] who reported 14.38% from *M. vollenhovenii A. gabonensis* (25.93%) agreed with [15].

The ether extract for this studies 3.25% and 3.51% for *M. felicium* and *A. gabonensis* respectively disagreed with 1.70% reported by [17] for *M. rosenbergii*. The ether extract was lower compared to reports of [18] of 6.87-7.68% from *M. vollenhovenii* and *T. fuscatus*, [19] for *Pomecia palludosa*, a gastropod and *Ergeria radiata*, a clam which ranged from 6.03-7.60% and that recorded by [20] which ranged from 6.2-7.6%. Lipids are highly efficient as sources of energy and they contain twice the energy of carbohydrates and proteins [21]. As a general rule, they act as major food reserve along with protein and are subject to periodic fluctuations influenced by environmental variables like temperature [22].

The fiber contents of *M. felicinum* and *A. gabonensis* were 7.26% and 11.32% which is considerable higher than 0.40-0.54% and 0.28-0.32% reported by [15, 23] respectively. According to [24], handling and process of freezing and

thawing negatively impacts the firmness of prawn tissue, which results in a loss of integrity of muscle fibers [25, 26].

The ash content recorded from this study for *M. felicinum* disagreed with [15] who earlier reported 25.33% from *M. vollenhovenii* and 22.67% obtained from *M. macrobrahion* but ash content of *A. gabonensis* agreed with [15]. High level of ash has been observed in the exoskeleton of prawns found in Lagos Lagoon [27]. The high ash values of the species are not surprising as crustaceans have shells and these shells contain more ash than any other type of fish [28]. The high ash content is of significance in measuring the mineral content of the species as the amount of ash shows the richness of the food in terms of element composition.

The values of the mineral components of *M. felicinum* and *A. gabonensis* were below the [29] acceptable level of element in aquatic organisms. If the values are higher, it is dangerous to health [30].

5. Conclusion

M. felicinum and *A. gabonensis* are good sources of protein and Ash, thereby, it can be used as substitute for fish, meat, plant protein and animal protein for feed formulation for animals and children because they compare favorably with the protein content of other conventional feed-stuff.

6. References

1. Ravichandran S, Rameshkumar G, Prince AR. Biochemical composition of shell and flesh of the Indian white shrimp *Penaeus indicus* (H. milne Edwards 1837). American-Eurasian J Scientific Research. 2009; 4(3):191-194.
2. Ragab MKI, Aiad ASE. Chemical quality of whole, beheaded and peeled frozen shrimp. Mansoura Veterinary and Medicine J. 2009; XI(2):37-53.
3. Yanar Y, Celik M. Seasonal amino acid profiles and mineral contents of green tiger shrimp (*Penaeus semisulcatus* De Haan, 1844) and speckled shrimp (*Metapenaeus monocrecos* Fabricus, (1789) from the Eastern Mediterranean Sea. Food Chemistry. 2006; 94:33-36.
4. Sriket PS, Benjakul W, Visessanguan, Kijroongrojana K Comparative studies on chemical composition and thermal properties of black tiger prawn (*Penaeus monodon*) and white prawn (*Penaeus vannamei*) meats. Food Chem. 2007b; 103:1199-1207.
5. Wua XY, Yang YF. Heavy metal (Pb, Co, Cd, Cr, Cu, Fe, Mn and Zn) Concentrations in harvest-size white prawn *Litopenaeus vannamei* tissues from aquaculture and wild source. J Food Comp Anal. 2011; 24:62-65.
6. Dempson IB, Schwarz CJ, Sbears M, Furey G. Comparative proximate body composition of Atlantic salmon with emphasis on parr from fluvial and lacustrine habitats. J Fish Biol. 2004; 64:1257-1271.
7. Rosa R, Nunes ML. Biochemical composition of deep-sea decapods crustaceans with two different benthic life strategies of the Portuguese South Coast. Deep-sea Res. 2003; 50:119-130.
8. Nargis R. Seasonal variation in the chemical composition of body flesh of koi fish *Anabas testudineus* (Block) (Anabantidae, Perciformes). Bangladesh J Scientific and Industrial Res. 2006; 41:219-226.
9. AOAC. Association of Official Analytical Chemist. Official Methods of Analysis, 18th Edition. AOAC. Arlington, VA, 2007.
10. Fasakin EA, Bello-Olusoji OA, Oyekanmi FB. Nutritional value of flesh and water composition of some processed important crustaceans in Nigeria. Applied Tropical Agriculture. 2000; 5(2):148-153.
11. Abulude FO, Lawal LO, Ehikhamen G, Adesanya WO, Ashafa SL. Distribution of microminerals in four prawns from the coastal area of Ondo State, Nigeria. Journal of Fisheries International. 2006; 1(2-4):70-72.
12. Reddy BS, Reddy, KVS. Proximate composition of the freshwater prawn *Macrobrachium rosenbergii* in cultured and frozen stage from Nellore Coast, India. International Food Research Journal. 2014; 21(4):1707-1710.
13. Gomez GH, Nakagawa, Kasanara S. Effect of dietery protein/starch ratios and energy level on growth of the giant freshwater prawn *Macrobrachium rosenbergii*. Nippon Suisan Gakkaishi. 1988; 54:1401-1407.
14. Habashy MM. Growth and body composition of juvenile freshwater prawn *Macrobrachium rosenbergii*, fed different dietary protein/ starch ratio. National Institute of Oceanography and Fisheries, Fish Research Station El-Qanatar El-Khairya, Cairo, Egypt, 2009.
15. Ehigiator FAR, Nwangwu IM. Comparative studies of the proximate composition of three body parts of two freshwater prawns species from Ovia River, Edo State, Nigeria. Australian J Basic and Applied Sci. 2011; 5:2899-2903.
16. Asiru RA, Fafioye OO. Proximate Composition of the Giant River Prawns, *Macrobrachium vollenhovenii* from River Osun, Southwestern Nigeria. J Fisheries Livest Prod. 2018; 6:285.
17. Anwarul I, Shuvagato M, Shuva B, Shanzida I, Mohajira B. A comparative analysis of the proximate composition of wild and cultured prawn (*Macrobrachium rosenbergii*) and shrimp (*Penaeus monodon*). International Journal of Fisheries and Aquatic Studies, 2017.
18. Ehigiator FAR, Oterai EA. Chemical composition and amino acidprofile of a Caridean prawn (*Macrobrachium vollenhovenii*) from Ovia River and tropical periwinkle (*Tympanotonus fuscatus*) from Benin River Edo state Nigeria. IJRRAS. 2012; 11:162-167.
19. Bassey SCO, Eteng MU, Eyong EU, Ofem OE, Akunyoung EO. Comparative nutritional and biochemical evaluation of *Ergeria radiata* (clams) and *Pomecia palludosa* (gastropods). Res J Agric and Biol. Sci. 2011; 7:98-104.
20. Balasubramania CP, Suseelan C. Biochemical composition of the deep water crab, *Charybdis smithii*. Indian J Fish. 2001; 48:333-335.
21. Okuzumi M, Fujii T. Nutritional and functional properties of squid and cuttle fish. National Cooperative Association of Squid Processors California. 2000, 223.
22. Nagabhushanan R, Farooqui VM. Mobilization of protein, glycogen, and lipid during ovarian maturation in mature crabs *Scylla serrate*. Indian J Mar Sci. 1982; 11:184-189.
23. Bukola CA, Abiodun AO, Adeniyi AO, Damilola OA. Bacteriological and proximate analysis of periwinkles from two creeks in Nigeria. World Appl Sci J 2006; 1:87-91.
24. Sriket PS, Benjakul W, Visessanguan, Kijroongrojana K. Comparative studies on the effect of freeze-thawing process on the physicochemical properties and microstructures of black tiger shrimp (*Penaeus monodon*) and white shrimp (*Penaeus vannamei*) muscle. Food

Chem. 2007a; 104:113-121.
25. Babu KK, Arnadurai D, Rajagopal S. Bursa spinosa-A megastropod fit for human consumption. Advance J Food Science and Technology. 2010; 2:79-83.
26. Kharat PS, Ghoble LB, Kale RS, Ghoble BC. Impact of TBCC on total protein content in Freshwater prawn, *Macrobrachium istnensis*. Middle East J Scientific Research. 2009; 4:180-184.
27. Adeyeye EI. Bio-concentration of macro and trace minerals in four prawns living in Lagos lagoon. Pak J Sci Ind Res. 2000; 43:367-373.
28. Jike-Wai O, Deekae SN. Chemical and mineral compositions of commercially important Shellfish in Rivers State, Nigeria. Am-Euras. J Agric and Environ Sci. 2011; 10:752-754.
29. Adeyeye EI, Adebiora HO, Awodola OJ. Comparability and chemical composition and functional properties of shell and flesh of *Penaeus notabilis.* Pakistan Journal of Nutrition. 2008; 7(6):741-747.
30. Asuquo FE, Ewa-Oboho I, Asuquo EF, Udo PJ. Fish species used as bioindicators for heavy Metal and hydrocarbon contamination for Cross River, Nigeria. The Environmentalist. 2004: 24:29-37.