Quality Analysis Of Freshwater Crab *Cardisoma Armatum* And Marine Blue Crab *Callinectes Amnicola* Collected From Yaba, Lagos Nigeria

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ABSTRACT: The proximate compositions (Protein, carbohydrate, lipids, moisture, fibre and ash content) of freshwater crabs (*Cardisoma armatum*) and marine crab (*Callinectes amnicola*), mineral contents and anti-nutrient factors were determined. The crabs' samples were collected from Yaba, Lagos State, Nigeria. Samples were separated into sexes and each sex separated into walking legs exoskeleton and tissues. The samples were analysed according to the standard methods of AOAC. The protein, fibre and carbohydrate were found to be higher in both male and female of the two crab species. But *C.amnicola* samples are richer in protein, fibre and carbohydrate than *C.armatum*. Sodium, Potassium, Calcium, and Phosphorus are predominant elements in both male and female *C.armatum* and *C.armnicola*. Copper was not detected in any of the two crabs' samples. The anti-nutrients: tannin, phytin and oxalate were recorded in the two species of crabs but not as high as to impair the nutritional qualities of the crabs. The proximate composition, mineral content, and low anti-nutrient values will make *C.armatum* and *C.amnicola* the best substitutes to catfishes and mackerel where they could not be afforded.

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1 INTRODUCTION

Crabs are part of the basic components of the ecosystem and they are consumed as food in many countries. Over 100 species of crabs are known worldwide with nine species common to West African countries especially Nigeria. Among these species are the land crab *Cardisoma armatum*, the big fisted swim crab *Callinectes amnicola* and *Callinectes latmanus*. These three species are the edible ones (Abby-Kalio 1982, Hart and Chindah,1998).Crabs mostly occur at the mouth of estuaries and along the course of many main rivers (Oyekanmi, 1984). Crabs constitute a nuisance by damaging set nets in water, feeds on fish, aquatic vegetation, mollusks, crustaceans, and annelids. They also serve as preys to mammals, birds and fishes but they constitute one of the most important members of estuarine food chain (Hall *et.al*. 2006). Because of the abundance of crabs as estuarine macro invertebrates and support valuable commercial and recreational fishes along the Atlantic and Gulf coasts (Guillory and Perret, 1988). Recreational fishermen seek enormous interest in this animal and many Physiologist have used crabs as experimental animals because it is readily available, economic viable, hardiness and complex life cycle (Smallegange and Van Der Meer 2003).

Utilization of both freshwater and marine resources for human consumption has increased tremendously worldwide. Aquatic food products, including crustacean shellfish, have been landed for their health promoting characteristics. Shellfish are nutritionally valuable source of various mineral and high quality proteins (King *et. al.* 1990, Skonberg and Perkins, 2002, USDA 2003). Crabs are known to be prominent sources for the provision of essential macro and micro element such as Potassium, Phosphorus, Calcium, Magnesium, Copper, Iron, Manganese and Zinc. They contain fewer calories than beef and pork and poultry (Carter and Ching, 1999, Al-Mohanna and Subrahmanyann, 2001).

The nutritional status and chemical composition of different species of crabs has been dealt with extensively in various part of the world (Natan *et. al.* 2003, Kucukgulmez *et. al.* 2006, Omotoso,2005, Adeyeye *e.tal.*2010, Moronkola *et.al.*, 2011 and Jimmy and Arazu, 2012). But information on the comparative study of the proximate composition and mineral contents of *Callinectes amnicola* and *Cardisoma armatum* is scanty. Therefore the comparative nutritional status and mineral composition of these two important species of crabs will provide necessary information on which of the two species will best serve as food and food supplements for humans. Notwithstanding both will serve as suitable alternatives for fishmeal in animal production in Nigeria.

2 MATERIALS AND METHODS

The healthy species of marine crabs (*Callinectes amnicola*) and freshwater crab of *Cardisoma armatum* were purchased from artisanal fishermen at the riverside in Yaba, Lagos, Nigeria. The species were separated and transported to the Postgraduate laboratory, Zoology Department of Ekiti State University, Ado-Ekiti, Ekiti-State for analyses. The crab samples were rinsed very well with tap water in the laboratory and sorted into sexes. The selected crab samples were separated into three parts which are walking legs (left and right), Exoskeleton and abdomen tissues.

Proximate analysis

The moisture content of the two species of crabs was determined by drying the various parts in an oven at 105^0C until a constant weight was obtained as described by AOAC (2000).

Crude protein contents were determined by converting the nitrogen content determined by Kjeldahl's method (N x 6.25) as described by AOAC (2000). Crude fat contents were determined the acid hydrolysis Soxhlet system. Ash contents were determined by dry ashing in a furnace oven at 600^0C for 10hrs. The carbohydrate contents were estimated by subtracting the sum of the weight of protein, fibre, ether extract and ash from the total dry matter and reported as Nitrogen-free extractives (NFE by differences). All determinations were both in triplicates. Student T-test was applied to compare the results statistically (Sokai and Rohif 1969).

Anti-nutritional Analysis

The tannin content was determined by the qualitative method of Markkar and Goodchild (1996). The estimation of phytin-phosphorus (phytin-p) was by Colometric procedure of Wheeler and Ferrel (1971) as modified by Reddy *et. al.* 1978. Phytic Acid was calculates by multiplying Phytin-P by factor of 3.55 as cited by Enuyiugha and Oladunjoye (2001). Oxalate content was determined according to the procedure of Day and Underwood (1986).

Mineral Content determination

The samples for mineral content determination were digested in HNO3/ H2O2.The samples element such as Calcium, Potassium, Sodium, Iron, Magnesium, Phosphorus and Zinc were determined by Spectrophotometer using different wave length.

3 RESULTS

The proximate and mineral compositions of the body parts of males and females freshwater crabs (*Cardisoma amnicola*) and_marine crabs *Callinectes amnicola*_from Yaba, Lagos are presented in tables 1-6. The anti- nutrients compositions of males and females freshwater and marine crabs are shown in table 7-9.

Crude protein content:- The protein content of the walking legs of freshwater *C.armatum* and marine *C.amnicola* ranged between 29.19 ± 0.02 from the female left legs of *C. amnicola* to 50.02†0.47 of the females right legs of *C. amnicola*. The right walking legs of *C. armatium* and *C.amnicola* are not significantly different from each other (P≤ 0.05) but different from the values of protein content of other walking legs (Table 1). Also, the value of protein content of the exoskeleton of the male *C. amnicola* (30.78±0.04%) is significantly different from other (P≤ 0.05)(Table 2).The protein content (18.78±0.04%) of the tissue of the female *C. armatum* is significantly different from other values as shown in table 3.

Fat content:- Fat in *C. amnicola* female left and right walking legs are 1.16±0.05% and 1.12±0.02%. These values are significantly different from the values of male *C.amnicola* and both male and female *C. armatum* (Table1). Also the value of the exoskeleton of the female *C. amnicola* (2.82±0.08%) was significantly different from the values of male and female *C. armatum*_and also male *C. amnicola*.(Table 2). The mean values of male and female *C. armatum and C. amnicola* are not significantly different from each other except in the male of *C.amnicola* (Table 3).

Moisture content:- The moisture content percentage which ranged between 4.31±0.02% and 12.13±0.02% in the walking legs of male and female of the two species are significant different from each other and from the rest of the values.

(Table1). Also the moisture content of the male *C. amnicola* (11.42±0.003%) exoskeleton is significantly different from the rest of the mean values of the rest of the samples on exoskeleton (Table 2).The mean percentage of the tissue of *C. armatum* and *C. amnicola* ranged from 6.18±0.68% and 13.42±0.02%. The mean values are significantly different from each other (P≤0.05) (Table 3).

Fibre content:- The values of fibre of the walking legs of male and female *C._armatum* are not similar to each other but the values are significantly different from the mean values of fibre of male and female *C. amnicola* walking legs(Table 1). Table 2 shows that the mean values of fibre of male and female *C. armatum* exoskeleton (11.84±0.04% and 11.81±0.01% respectively) are similar but significantly different from 10.84±0.03 and 12.89±o.44% recorded on male and female *C. amnicola* exoskeleton (Table 2).The mean value recorded on male *C. armatum* tissue was 12.18±0.03%, this value is significantly different from the rest of values recorded for *C. armatum* and *C. amnicola* (Table 3).

Ash content:- The total ash content on male and female *C. armatum* and *C._amnicola* walking legs are similar statistically except in the right walking legs of the female_*C. armatum* with 6.09±0.03% and left walking legs of *C. amnicola* with 4.12±0.18%. The ash content values are not significantly different from each other in *C. armatum* and *C. amnicola* exoskeleton except in the female *C.*

*amnicola*_(2.04±0.07%). (Table 2).The ash content of the female tissue of *C. armatum* was not similar to the other values on the ash content of the tissue (Table 3).

Carbohydrate content:- The carbohydrate content in the walking legs of both freshwater crabs *C. armatum* and marine species *C. amnicola* are the same statistically except in the right walking leg of the male and female *C. amnicola* (Table 1). The mean value of carbohydrate recorded on the exoskeleton of the two species corresponding to the value obtained on their walking legs (Table 2). The percentage of carbohydrate from the tissue of the female *C. armatum* is significantly different from the other (P≤0.05) (Table 3).

Mineral composition: Sodium, Potassium, Calcium, Magnesium, Zinc, Manganese and Phosphorus were higher in the walking legs of male and female *C. armatum*_than in the walking legs of male and female *C. amnicola* but Iron values were more in the male and female of *C.*_*amnicola* (Table 4).

The values of Sodium, Potassium and Calcium recorded on the exoskeleton of *C. armatum* are more than values recorded in the exoskeleton of both male and female of *C. amnicola*. While the values of Magnesium, Zinc, Iron, Manganese and Phosphorus obtained on the exoskeleton *C. amnicola* are more than the values obtained on the exoskeleton of male and female *C. armatum* (Table 5).

The values of mineral composition on the internal tissue of both male and female *C. amnicola* are more than the values of the tissues of male and female *C.armatum* (Table 6). Copper was not found in samples of the walking legs, exoskeleton and tissue of both *C. armatum* and *C. amnicola*.

Anti- nutrient composition:- The result of anti- nutrient composition on the walking legs exoskeleton and internal tissue of the male and female *C. armatum and C. amnicola* are presented in tables 7-9. The phytin contents of the samples are higher than tannin and oxalate in both male and female of *C. armatum* and *C. amnicola*. The values of phytin ranged from 2.90mg/g in female tissue of *C. amnicola* (Table 9) to 12.99mg/g recorded in the right walking legs of *C. armatum* (Table 7).

4 DISCUSSION

Proximate Composition:- The chemical composition analyses of the body parts of *C. armatum* and *C. amnicola*_revealed variable protein contents. The protein content of the walking legs and internal tissues of *C. armatum* were lower than the protein content of the walking leg and internal tissue of *C. amnicola*. But the protein content of the exoskeleton of *C. armatum* is more than the protein content of exoskeleton of the *C. amnicola*. The protein content reported on the walking legs of *C. amnicola* (29.19±0.02%-48.33± 0.08%) are higher than 19.233±0.066 reported on the walking legs of the same species by Moronkola *et. al.* (2011) but correspond to 19.555±0.07% reported by Kucukgulmez *et. al*. (2006) on *Callinectes sapidus.*

The crude protein reported on the internal tissue of male and female *C. amnicola* (68.16± 0.02 and 65.91±0.04% respectively) are greatly varied from 28.000±0.071% and 25.12±0.01% reported on the flesh of the same species by Jimmy and Arazu (2012) and Moronkola *et. al*. 2011 respectively. Also, the protein content obtained on the walking legs and exoskeleton of *C. armatum* (35.88±0.64 – 37.60±0.02 and 39.63±0.14 – 40.64±0.041) correlates with the crude protein content of 33.30±1.20% obtained by Omotoso (2005) on the same species. The higher protein content of *C. armatum* and *C. amnicola*_shows that they are good sources of protein. The protein content of the crabs could have been supported by the sizes at the time of collections, lack of pollution and other environmental factors, food availability, e.t.c. The protein is known to be essential for the sustenance of life and exists in larger quantity of all nutrient as a component of human body (Okuzumi and Fujii, 2000). The increase in the demand of good quality animal protein for the exploding population has lead to effective and increase in exploitation of aquatic resources. It was noted that acceptability and easy digestibility of fish proteins make it very valuable in combating protein malformation, especially in children. The higher protein content of these species of crabs shows that the two crabs can be used to augment the daily protein requirements of human. It can also be blended and used in the feeding of infants to hasten their growth and development. Proteins from crabs are known to be useful in the transportation of gas, building of organ components, water and metabolic regulation of organisms (Ackman and Mcleod, 1989).

The quantity of fat determined in this study for both the freshwater and marine crabs is very low. The fat contents confirmed that both *C. armatum* and *C.amnicola* belong to low fat class. Crabs have been reported to show low calories than pork, beef and the poultry (Broughton *et. al*., 1992). Fats are noted to be highly efficient sources of energy and they contain more than twice the energy of carbohydrate and proteins. Fats serve as source of metabolic energy, but also indispensable in maintaining cellular integrity. Female of *C. amnicola* had higher percentage of fat hence serves as higher food reservoir along with protein. The percentage storage of fat in both crabs is subject to periodic fluctuations influenced by environmental variables like temperature (Nagabhushaman and Farooqui, 1982).

The moisture content recorded on the walking leg exoskeleton and internal tissue of *C. amnicola* are higher than that of *C. armatum* but lower than the range of 65.951±0.049 – 70.31±0.045 recorded by Moronkola *et. al*., (2011). The range of values of moisture content recorded for *C. armatum* (3.49±0.01% - 6.63±0.13%) (Table 1-3) in this study were lower than 9.60±0.00% recorded by Omotoso, (2005) on the same species. High moisture contents in organisms are considered as an advantage because of its contribution in the stabilization of the organism during movements (Eddy *et. al.* 2004).

The fibre content and the walking legs, exoskeleton and internal tissues of *C. armatum* and *C. amnicola* are very high. The values are higher than 6.686±0.074% and 8.31±0.01% reported by Moronkola *et. al.* (2011) and Omotoso (2005) on *C. amnicola* and *C. armatum* respectively. This is an added advantage because fibre is responsible for the assumption of water as well as provision of assistance to food matter during transit in the alimentary system. It was also speculated that, the fibre content in crabs is more efficient in the reduction of constipation in human consumers than other known sources of fibre (Lee *et. al.* 1993, Krzynowek *et. al*. 1983)

The ash content of *C. amnicola* and *C. armatum* is an indication of mineral concentration in the organism. (Eddy et al 2004, FAO 2005). The ash contents obtained on the two species were very low but higher than what Moronkola (2011) reported on *C. amnicola* (1.04±0.017) but lower than what Omotoso (2005) reported on *C. armatum* (42.23±0.02%). The different in ash content of these same species could be related to their sizes at the time of collection and seasonal changes of the environment.

Carbohydrate percentages available in *C.amnicola* and *C.armatum* walking legs and exoskeleton are higher than percentages some authors reported on this two species. Although the content of internal tissues was very low, the implication of this is that the two crabs will yield a lot of glucose, galactose, fructose and mannose when digested than what could be obtained from consumption of some other organisms. These sugars in these crabs are energy producers (FAO, 2005). This also suggests that the walking legs and exoskeleton may be discarded and consume the internal tissues.

Mineral composition:- The two species of crabs (*C. armatum* and *C. amnicola*) used in this study show high value of Sodium, Potassium, Calcium, Magnesium and Phosphorus. The value of Zinc was very low in *C.armatum* exoskeleton and tissue while in *C.amnicola*, Zinc was a bit higher in the three tested parts i.e. walking legs, exoskeleton and tissue. The value of iron was also low in *C.armatum* exoskeleton. Copper was not detected in any of the species samples. Both marine and freshwater are excellence sources of minerals particularly Calcium, Iron, Zinc, Potassium and Phosphorus (Gokoglu and Yerlikaya 2003, Nacz *et. al*. 2004 and Sifa *et. al.* 2000). Ash is left out after complete combustion of fish and crabs. It gives a measure of total mineral content. The fish and shellfish can absorb minerals directly from aquatic environment through gills and body surfaces. The minerals serve as components of bone / exoskeleton, soft tissues as co-factors and co-activators of various enzymes important in human nutrition. Calcium, Phosphorus, Magnesium and the electrolyte (Sodium and Potassium) are considered to be macro element and Iron, Zinc, Manganese and Copper are considered as trace elements that are required for normal functioning of the body for instance, the more soluble minerals such as Sodium, Potassium, Calcium and Phosphorus are evolved in the maintenance of acid base balance and membrane potential. The Calcium and Phosphorus account for 70 – 80% of minerals in the skeleton of fish (Nair and Mathew, 2000). The phosphorus (adenosine phosphate) acts as a key substance for energy release and present in phospholipids.

Iron is an important mineral found in the respiratory pigment of an organism especially fish. It serves as a carrier of oxygen to the tissues from the lungs by red blood cells haemoglobin, as a transport medium for electrons within cells and as an integrated part of important enzyme system in various tissues. Adequate Iron in the diet is very important for decreasing incidence of anemia, which is considered a major health problem. Iron deficiency occurs when the demand for Iron is high e.g in growth, high menstrual loss, and pregnancy and intake is quantitatively inadequate or contains elements that rendered the Iron unavailable for absorption (Camara *et. al*., 2005).

Calcium and Phosphorus are necessary to maintain an optional bone development with more of both minerals being required during childhood and growing stages to prevent rickets and osteomalacia. Calcium is also important in its contribution to blood clotting, muscle contraction, teeth formations and repairs and some metabolic process (NRC 1989). Zinc is known to be involved in most metabolic pathways in plants, animals and humans (Hambidge, 2000). Sodium was very high in both *C.armatum* and *C.amnicola*. It is essential in the regulation of pH, osmotic pressure,water balance and nerve impulse transmission and active transport of glucose/amino acids (Asuquo *et. al.* 2004, Ackman and Macleod, 1989). The high mineral contents in *C.armatum* and *C.amnicola* are a confirmation that these species of crabs are essentially good for human healthy functioning of their body and they could be good supplements for their deficiencies. These crabs could as well be recommended for fish farmers/others as additives in fish/animal feed production and possible replacement to fish meal.

Table 1: Proximate composition of the walking legs of *Cardisoma armatum* and *Callinectes amnicola* collected from Yaba, Lagos State, Nigeria.

	Male				Female			
	Freshwater		Marine		Freshwater		Marine	
	Right	Left	Right	Left	Right	Left	Right	Left
Protein	37.60±0.02^{a}	35.64±0.03^{a}	48.33±0.08^{b}	39.50±0.01^{a}	35.88±0.64^{a}	36.80±0.45^{a}	50.02±0.47^{b}	29.19±0.02^{c}
Fat	1.63±0.03^{a}	2.53±0.04^{b}	1.12±0.02^{c}	1.16±0.05^{c}	1.72±0.02^{a}	1.63±0.04^{a}	1.68±0.04^{a}	2.90±0.04^{b}
Moisture	4.67±0.03^{a}	4.31±0.02^{b}	11.17±0.02^{a}	11.17±0.55^{c}	4.71±0.02^{a}	4.94±0.01^{a}	11.31±0.08^{a}	12.13±0.02^{c}
Fibre	9.01±0.01^{a}	10.40±0.01^{b}	12.44±0.04^{c}	12.16±0.02^{c}	11.30±0.01^{b}	11.10±0.02^{b}	9.96±0.04^{b}	9.02±0.05^{a}
Ash	5.84±0.02^{a}	5.68±0.04^{a}	5.37±0.03^{a}	4.70±0.02^{a}	6.09±0.03^{b}	4.50±0.01^{a}	5.13±0.11^{a}	4.12±0.18^{c}
Carbohydrate	41.26±0.02^{a}	41.40±0.00^{a}	21.59±0.09^{b}	30.52±0.54^{a}	39.40±0.42^{a}	41.97±0.61^{a}	21.74±0.60^{b}	42.66±0.19^{a}

Mean value ± SD followed by different letter within a column are significantly different ($P \leq 0.05$).

Table 2: Proximate composition of Exoskeleton *Cardisoma armatum* and *Callinectes amnicola* collected from Yaba, Lagos State, Nigeria.

	Male		Female	
	Freshwater	Marine	Freshwater	Marine
Protein	39.63±0.14^{a}	30.78±0.04^{b}	40.64±0.04^{a}	41.41±0.25^{a}
Fat	1.94±0.02^{a}	1.15±0.07^{b}	2.29±0.02^{a}	2.82±0.08^{c}
Moisture	3.49±0.01^{a}	11.42±0.03^{b}	3.77±0.03^{a}	8.80±0.33^{a}
Fibre	11.84±0.04^{a}	10.84±0.03^{b}	11.81±0.01^{a}	12.89±0.44^{c}
Ash	7.82±0.04^{a}	6.66±0.02^{a}	6.18±0.02^{a}	2.04±0.07^{b}
Carbohydrate	35.29±0.00^{a}	39.15±0.00^{b}	35.31±0.5^{a}	32.6±0.56^{c}

Mean value ± SD followed by different letter within a column are significantly different ($P \leq 0.05$)

Table 3: Proximate composition of male and female *Cardisoma armatum* and *Callinectes amnicola* collected from Yaba, Lagos State, Nigeria.

	Male		Female	
	Freshwater	Marine	Freshwater	Marine
Protein	67.68±0.13^{a}	68.16±0.02^{a}	18.78±0.04^{b}	65.91±0.04^{a}
Fat	3.00±0.01^{a}	1.13±0.03^{b}	2.49±0.02^{a}	3.29±0.02^{a}
Moisture	6.18±0.68^{a}	13.42±0.02^{b}	6.63±0.13^{a}	9.90±0.31^{a}
Fibre	12.18±0.03^{b}	10.26±0.06^{a}	10.62±0.01^{a}	10.52±0.02^{a}
Ash	3.65±0.04^{a}	3.67±0.02^{a}	8.82±0.02^{b}	1.71±0.02^{a}
Carbohydrate	7.32±0.06^{a}	3.37±0.08^{b}	52.68±0.09^{b}	8.67±0.31^{a}

Mean value ± SD followed by different letter within a column are significantly different ($P \leq 0.05$)

Table 4: Mineral composition of male and female walking legs of *Cardisoma armatum* and *Callinectes amnicola* collected from Yaba, Lagos State, Nigeria.

	Male				Female			
	Freshwater		Marine		Freshwater		Marine	
	Right	Left	Right	Left	Right	Left	Right	Left
Na	340.23	392.64	130.45	121.32	279.00	378.67	135.26	132.43
K	446.62	345.22	101.22	95.48	223.20	230.87	121.42	101.26
Ca	415.32	387.84	51.65	45.73	389.51	375.42	49.68	51.57
Mg	128.54	109.55	81.21	73.48	121.32	111.51	74.59	82.36
Zn	39.49	38.42	35.67	35.43	35.73	35.68	42.33	40.54
Fe	68.54	70.42	70.08	71.42	71.53	70.32	79.84	82.37
Cu	ND	ND	ND	ND	ND	ND	ND	ND
Mn	0.55	0.43	0.41	0.32	0.39	0.45	0.55	0.39
P	3.9.68	357.50	291.42	288.95	338.54	335.66	367.85	376.85

Table 5: Mineral composition of male and female exoskeleton of *Cardisoma armatum* and *Callinectes amnicola* collected from Yaba, Lagos State, Nigeria.

	Male		Female	
	Freshwater	Marine	Freshwater	Marine
Na	348.95	115.27	343.93	342.11
K	150.29	96.41	133.85	135.38
Ca	215.68	43.54	27.68	39.61
Mg	37.59	80.22	26.43	28.45
Zn	10.78	37.36	9.56	32.42
Fe	8.55	69.83	6.33	33.24
Cu	ND	ND	ND	ND
Mn	0.38	0.38	0.55	0.53
P	256.88	305.11	187.43	273.54

Table 5: Mineral composition of the internal tissue of male and female *Cardisoma armatum* and *Callinectes amnicola* collected from Yaba, Lagos State, Nigeria.

	Male		Female	
	Freshwater	Marine	Freshwater	Marine
Na	421.77	583.17	451.26	396.54
K	442.86	375.66	539.17	175.11
Ca	84.66	223.42	68.73	43.72
Mg	73.54	108.35	45.38	30.28
Zn	8.25	45.78	10.55	27.59
Fe	69.43	81.37	70.41	35.67
Cu	ND	ND	ND	ND
Mn	0.41	0.50	0.48	0.44
P	175.66	278.95	164.39	163.42

Table 7: Anti- Nutrient composition of male and female walking legs *Cardisoma armatum* and *Callinectes amnicola* collected from Yaba, Lagos State, Nigeria.

	Male				Female			
Constituents	Freshwater		Marine		Freshwater		Marine	
	Right	Left	Right	Left	Right	Left	Right	Left
Tannin content (mg/1000g)	0.06	0.07	0.12	0.05	0.06	0.07	0.12	0.08
Phytin phosphorous (mg/g)	12.99	7.02	5.45	5.69	12.25	12.75	3.66	4.99
Oxalate content (mg/g)	0.26	0.43	0.34	0.54	0.66	0.59	0.34	0.59

Table 8: Anti- Nutrient composition of the exoskeleton male and female *Cardisoma armatum* and *Callinectes amnicola* collected from Yaba, Lagos State, Nigeria

	Male		Female	
Constituents	Freshwater	Marine	Freshwater	Marine
Tannin content	0.03	0.13	0.07	0.06
Phytin phosphorous	9.83	8.28	12.75	8.28
Oxalate	0.39	0.25	0.59	0.68

Table 9: Anti- Nutrient composition of the internal tissue of male and female *Cardisoma armatum* and *Callinectes amnicola* collected from Yaba, Lagos State, Nigeria.

	Male		Female	
Constituents	Freshwater	Marine	Freshwater	Marine
Tannin content	0.01	0.19	0.01	0.11
Phytin phosphorous	13.16	4.53	7.75	2.90
Oxalate	0.74	0.41	1.26	0.61

The anti-nutrient compositions of *C.armatum* and *C.amnicola* showed that the phytin was present but in low dose while oxalate and tannin are negligible. The value of phytin, tannin and oxalate reported in this research work are lower than what Aiyesanmi and Oguntokun (1989) reported on *Diodea reflexa* seed (151.80±0.20mg/100g and 318.40±0.30mg/100g on tannins and phytic acid respectively). Omotoso (2005) reported 1.10±0.10mg/100g on phytic acid and 4.10±o.15mg/100g oxalate in *C.armatum*. He did not observe phytin which was recorded in this two species under study. The lower value of phytin, tannin and oxalate in these two species suggests that the impairments of the nutritive value of the two crabs are somehow negligible.

CONCLUSION

C.armatum and *C.amnicola* contain sufficient nutrients and minerals that are beneficial to humans as food and in farmed animals' nutrition. They can as well be used as supplements to patients especially those with deficiency in one or more minerals if taking appropriately. It can be concluded that concentration of minerals in these two species are within WHO recommended safe limits for elements in aquatic organisms. The consumption of this freshwater crabs (*C.armatum*) and marine crabs (*C.amnicola*) could therefore serve as alternatives to cat fishes and mackerel where they are not available.

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