

Proximate and Mineral Compositions of Common Crab Species [*Callinectes pallidus* and *Cardisoma armatum*] of Badagry Creek, Nigeria

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Abstract

Callinectes pallidus and *Cardisoma armatum* species were obtained at Badagry creek near to Ojo, Lagos. The proximate and mineral compositions (meats and bony tissue) of *Callinectes pallidus* and *Cardisoma armatum* crabs from Badagry Creek were analyzed, the mean body weight were 145.22 ± 3.39 and 104.47 ± 2.50 respectively. Big cheliped weight, small cheliped weight, visceral weight and leg weight were not significantly different ($P < 0.05$) except carapace weight in both crabs. The proximate compositions of meat and shell of both crabs were significantly different ($P > 0.05$), both crabs were high in calcium, potassium, magnesium, and manganese. Zinc in meat of both crabs were not significantly different ($P < 0.05$), but sodium, iron and copper of meat (both crabs) were significantly different ($P > 0.05$), iron and zinc of shell of both crabs were also significantly different ($P > 0.05$). The proximate and mineral compositions of both species of crab showed highly nutritious meat to warrant introduction into the culture system of the country to further diversify the aquaculture base of the industry presently dominated by catfish.

Keywords: Crustacean; Mangrove ecosystem; Shellfish; Proximate and mineral compositions; Crabs and aquatic species

Introduction

Nigeria is among the protein and minerals deficient nations in the world. Most of the animal protein sources (cattle, goat, chicken, etc.) are inadequate and costly due to drought, disease, exorbitant cost of feeds etc. Aquatic food is a broad component with major categories, finfish and shellfish, aquatic foods most especially Sea-foods are nutritionally important in the supply of protein, especially the nine essential amino acids. The lipid content of sea foods is primarily in the form of triglycerides or triacylglycerols and is the only major source of highly unsaturated fatty acids [1]. Seafood ingests and accumulates omega-3 fatty acids through the food chain algae and phytoplankton, the primary producers of omega-3 fatty acid. Carbohydrate content in sea foods is known to be very small. Sea foods are best known as sources of fat soluble vitamins; although they are sumptuous provider of some B vitamins and little or no vitamin C. They are better known nutritionally for the dietary minerals they supply [1].

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.

Crab constitutes one of the main sources of animal protein most especially among coastal dwellers in some parts of Nigeria. Crabs have a high ash, mineral and crude fibre content [2], serves as a source of minerals consumed either wholly and partially by sick folks [3], and is often recommended for pregnant women [4]. Crab fisheries, can be capture or farmed and are found in all of the world's oceans. There are many aquatic crabs, semi-terrestrial crabs and terrestrial crabs, particularly in tropical regions [5], due to their nutritional value and abundance scoop of inquisitiveness in nutritional values of crabs are generated in recent times, however there are few detailed information on proximate and mineral nutritional value of major common crab species (*Callinectes pallidus* and *Cardisoma armatum*) dominant in the southwestern part of Nigeria precisely Badagry Creek, Nigeria. Therefore the objective of this study was to evaluate the nutrient

compositions of the two common crabs with the view of introduction to culture systems in the country.

Materials and Methods

A total amount of 120 crab samples (60 specimens each of *Callinectes pallidus* and *Cardisoma armatum*) were collected. The Crab species *Callinectes pallidus* were captured from February 2010 to July 2010 during the raining season at Badagry creek near Ojo, Lagos (Lat. $6^{\circ}27'1.08''N$; Long. $3^{\circ}12'26.90''E$) while the *Cardisoma armatum* were obtained at Ojo market very close to the creek in Ojo, Lagos which is an extension of Badagry creek [6]. The crabs were taken immediately to the laboratory in clean, partially covered bucket to allow for oxygen consumption and were identified in the laboratory according to Schneider [7]. Preliminary assessment was made which include total weight, carapace weight, leg weight and cheliped weight were taken for individual specimen while the crab meats and shell of the two crabs were collected, wrapped in separate polythene bag and refrigerated. The shell and meats were washed separately dried in the oven at $105^{\circ}C$ for 24 hours. Sampled specimens were grounded using an electric grinder after chopping with mortar and pestle. The grounded portion were weighed separately and used for chemical analysis. The chemical analysis for the proximate composition and mineral determination were carried out according to methods compiled by [8-10].

The moisture content was dried at $100^{\circ}C$ in fixed weight. Sulfuric acid added with catalyst mixture was digested with the samples in

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order to convert protein and other organic nitrogen in the sample. The percent nitrogen was calculated and converted to protein with the factor 6.25. The fat was analyzed by hydrolyzing with HCL with addition with ethanol to liberate the fat, extract from fat was washed with dilute alkali solution and filtered through sodium sulfate column, the remaining extract was retrieved. Carbohydrate was calculated using the standard equation 100% - (% protein + % fat + % ash + % moisture). All the analytical procedure was performed in replicates. For the Mineral elements determination, the samples were digested in HNO₃/HCl. Thereafter some metal parameters namely Ca, P, Mg, Na, Fe, Mn, Zn and Cu were measured by a Varian Spectra Atomic absorption spectrophotometer (AAS), Buck Scientific 210 GVP model.

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): the detailed comparison of all parameters between *Callinectes pallidus* and *Cardisoma armatum* were figured out using *t-test* and a significance level (P < 0.05) as level of significance.

Results and Discussion

Body part weight

Total weight, carapace weight, hand weight, visceral weight and leg weight of *Callinectes pallidus* and *Cardisoma armatum* are presented in Tables 1-3. Table 1 shows the Body parts of *Callinectes pallidus* and *Cardisoma armatum*. Table 2 shows the Proximate and mineral compositions of meat of *Callinectes pallidus* and *Cardisoma armatum*. Table 3 shows the Proximate and mineral compositions of shells of *Callinectes pallidus* and *Cardisoma armatum*.

The average body weight of *Callinectes pallidus* and *Cardisoma*

Parameters	<i>Callinectes pallidus</i>	<i>Cardisoma armatum</i>
Total Weight(g)	145.22±3.39 ^a	104.47±2.50 ^a
Carapace Weight(g)	17.13±0.38 ^a	13.42±1.30 ^b
Big Cheliped Weight(g)	22.44±0.94 ^a	18.59±0.60 ^a
Small Cheliped Weight(g)	17.02±0.74 ^a	9.62±0.63 ^a
Visceral Weight(g)	17.20±0.61 ^a	11.67±0.32 ^a
Leg Weight(g)	9.58±0.60 ^a	11.61±0.38 ^a

In each row, mean with a common letter are not significantly different (P>0.05)

Table 1: Body parts Measurements of *Callinectes pallidus* and *Cardisoma armatum*.

Parameters	<i>Callinectes pallidus</i>	<i>Cardisoma armatum</i>
Moisture %	53.56±0.10 ^a	51.50±0.15 ^b
Protein %	24.38±0.01 ^a	23.94±0.01 ^a
Fat %	2.09±0.06 ^a	1.65±0.15 ^b
Carbohydrate %	5.40±0.00 ^a	7.13±0.09 ^b
Ash %	13.41±0.03 ^a	14.96±0.29 ^a
Fiber %	1.16±0.20 ^a	1.14±0.02 ^a
Calcium (mg/kg)	3843.95±0.89 ^a	18901.51±0.50 ^b
Potassium(mg/kg)	1489.02±1.02 ^a	5720.01±0.96 ^b
Magnesium (mg/kg)	3842.78±1.14 ^a	26462.12±1.03 ^b
Sodium (mg/kg)	2056.01±333.00 ^a	1146.55±0.79 ^b
Iron (mg/kg)	9.30±0.22 ^a	10.50±0.37 ^a
Manganese (mg/kg)	34.43±0.44 ^a	9.33±0.07 ^b
Zinc (mg/kg)	7.87±0.12 ^a	5.83±0.11 ^a
Copper (mg/kg)	84.82±0.46 ^a	84.81±0.10 ^a

In each row, mean with a common letter are not significantly different (P>0.05)

Table 2: Proximate and Mineral Compositions of Meat of *Callinectes pallidus* and *Cardisoma armatum*.

Parameters	<i>Callinectes pallidus</i>	<i>Cardisoma armatum</i>
Moisture %	8.27±0.01 ^a	9.09±0.11 ^a
Protein %	13.41±0.03 ^a	14.96±0.29 ^a
Fat %	24.38±0.01 ^a	23.94±0.01 ^a
Carbohydrate %	1.16±0.20 ^a	1.14±0.02 ^a
Ash %	46.01±0.03 ^a	56.36±0.02 ^b
Fiber %	53.56±0.10 ^a	51.50±0.15 ^a
Calcium (mg/kg)	38161.68±0.99 ^a	15812.32±0.74 ^b
Potassium(mg/kg)	6051.07±0.90 ^a	1021.04±0.85 ^b
Magnesium (mg/kg)	57241.46±0.61 ^a	14040.89±1.31 ^a
Sodium (mg/kg)	61536.04±0.83 ^a	1672.11±0.87 ^b
Iron (mg/kg)	12.52±0.21 ^a	13.02±0.12 ^a
Manganese (mg/kg)	124.97±0.94 ^a	26.89±0.13 ^b
Zinc (mg/kg)	5.86±0.05 ^a	7.15±0.12 ^a
Copper (mg/kg)	62.73±0.65 ^a	177.55±0.74 ^b

In each row, mean with a common letter are not significantly different (P>0.05)

Table 3: Proximate and Mineral Compositions of Bony Tissues of *Callinectes pallidus* and *Cardisoma armatum*.

armatum were 145.22 ± 3.39 g and 104.47 ± 2.50 g respectively (Table 1). The present study shows a higher body weight of crabs when compared to the record from Akin-oriola et al. [3] of 139.5 ± 5.69 and 111.2 ± 5.63 for both crabs respectively. The difference may be due to different aquatic habitat of *Callinectes pallidus* as compared to the semi terrestrial habitat of *Cardisoma armatum* and available food items. The average carapace weights of *Callinectes pallidus* and *Cardisoma armatum* were 17.13 ± 0.38 g and 13.42 ± 1.30 g respectively (Table 1), with a range of 9.80-88.1 g and 7.10-25.1 g for *Callinectes pallidus* and *Cardisoma armatum* respectively. The carapace measurement recorded in this study for both crabs were higher than Skonberg and Perkins [11], the carapace weight of *Callinectes pallidus* was higher than *Cardisoma armatum* due to the rhombic broader anterior and posterior edges, along spine and teeth of *Callinectes pallidus* [3]. Lower big Cheliped weight was observed with *Cardisoma armatum* when compared to *Callinectes pallidus*, likewise the small Cheliped weight of *Callinectes pallidus* was also higher when compared with *Cardisoma armatum* these was due to the feeding habits of *Callinectes pallidus* as cannibalistic and opportunistic feeder [12]. In this study there was a little difference in the leg weight of the two crab species. The leg weight of *Cardisoma armatum* was higher than *Callinectes pallidus*, due to the flattened paddle form of *Callinectes pallidus*, [3]

Proximate composition

The moisture content in meat of *Callinectes pallidus* and *Cardisoma armatum* were 53.56 ± 0.10 and 51.50 ± 0.15 respectively mg/kg (Table 2) respectively while the bony moisture content of *Callinectes pallidus* and *Cardisoma armatum* were 8.27 ± 0.01 mg/kg and 9.09 ± 0.11 mg/kg (Table 3) respectively. The moisture content of the two crabs were lower to the values reported by Chen et al. [13] for Chinese mitten crab, *Eriocheir sinensis*, grown in pond at Jinshan district, Shanghai, China was between 76.71 ± 2.76 and 71.61 ± 1.22, this differences could be due to habitat of the species. The *Cardisoma armatum* had a higher moisture content of meat than *Callinectes pallidus*, likewise higher moisture in shell of *Cardisoma armatum* than *Callinectes pallidus* as observed by Akin-oriola et al. [3].

The protein content in meat of *Callinectes pallidus* and *Cardisoma armatum* were 24.38 ± 0.01 mg/kg and 23.94 ± 0.01 mg/kg (Table 2) respectively while some levels of proteins were recovered in the bonny

tissues of the Crabs in the amounts of 13.41 ± 0.03 mg/kg and 14.96 ± 0.29 mg/kg (Table 3) respectively. The meat and bonny tissues of crabs are therefore good nutrition and are usually consumed by humans. The meat Protein contents of the crabs are similar to that (28.14%) reported by Ojewola and Udom [14], to *Callinectes sapidus* 26.4 % [15], however higher than those published by Skonberg and Perkins [11] 17.8% (*Cancer magister*), by Kaya et al. [16] for warty crab (*Eriphia verrucosa*) 19.66%, but lower than *Callinectes sapidus* 54.2% of Akpan [17]. The protein of meat of *Callinectes pallidus* is higher than *Cardisoma armatum* and showed a significant difference between two crabs when compared.

The ash content in meat of *Callinectes pallidus* and *Cardisoma armatum* were 53.56 ± 0.10 mg/kg and 51.50 ± 0.15 mg/kg (Table 2) respectively while the ash content in bonny tissue of *Callinectes pallidus* and *Cardisoma armatum* were 46.01 ± 0.03 mg/kg and 56.36 ± 0.02 mg/kg (Table 3) respectively. The ash content in meat of the two crabs were higher than values reported for *Callinectes sapidus* 1.33% [18], 2.35% [16], 39.11% [14], for *Cancer magister* 2.6% [11]. The meat of *Callinectes pallidus* showed a higher ash content than *Cardisoma armatum* which indicates that *Callinectes pallidus* probably contains more bonny tissues. The shell of *Cardisoma armatum* showed higher ash content than *Callinectes pallidus* and these probably implies that the shell of *Cardisoma armatum* could be stronger than *Callinectes pallidus*. The shell of the two crabs *Callinectes pallidus* and *Cardisoma armatum* were however significantly different ($P < 0.05$).

The fibre content in meat of *Callinectes pallidus* and *Cardisoma armatum* were 1.16 ± 0.20 mg/kg and 1.14 ± 0.02 mg/kg (Table 2) respectively while the fibre shell content of *Callinectes pallidus* and *Cardisoma armatum* were 53.56 ± 0.10 mg/kg and 51.50 ± 0.15 mg/kg (Table 3) respectively. The crude fiber content of the two crabs shows a higher value than Warty crab (*Eriphia verrucosa*) 0.66% of Kaya et al. [16]. The meat of fiber content was lower than 8.80% of dry matter of *Callinectes pallidus* [17], lower than 1.73% of Dungeness crab (*Cancer magister*) [14]. The shell of fiber of the two crabs were higher than 15.36% of *Callinectes sapidus* [17]. The crude fibre in meat of *Callinectes pallidus* was higher than *Cardisoma armatum* and showed significant differences between the two crabs.

The fat content in meat of *Callinectes pallidus* and *Cardisoma armatum* were 2.09 ± 0.06 mg/kg and 1.65 ± 0.15 mg/kg (Table 2) respectively while the fat content in bonny part of *Callinectes pallidus* and *Cardisoma armatum* were 24.38 ± 0.01 mg/kg and 23.94 ± 0.01 mg/kg (Table 3) respectively. The value of fat of the two crabs is contrary to meat 5.4% and bonny tissue shell 3.80% of *Callinectes sapidus* of Akpan [17]. The fat of the meat is higher than values published for *Homalaspis plana* 0.11% [19], for Warty Crab (*Eriphia verrucosa*) 0.66% [16], for crab meat 0.25% [20] for *Ucides cordatus* 1.48% [21], for crab meat 0.5% [22], for *Chaceon chilensis* 0.11% [19], for *Callinectes sapidus* 0.62% [15], for *Platyanthus patagonicus* 0.42% [23]. The fat of meat in *Callinectes pallidus* was the highest when compared and showed significant difference.

The Carbohydrate content in meat of *Callinectes pallidus* and *Cardisoma armatum* were 5.40 ± 0.00 mg/kg and 7.13 ± 0.09 mg/kg (Table 2) respectively while that in bonny tissue of *Callinectes pallidus* and *Cardisoma armatum* were 1.16 ± 0.20 mg/kg and 1.14 ± 0.02 mg/kg (Table 3) respectively. The carbohydrate of both meat and shell are higher, however the Carbohydrate of meat of the *Cardisoma armatum* are higher than reported work of Akpan [17], *Callinectes sapidus* 6.6% of Carrillo-Dominguez et al. [24], red crab (*Pleuroncodes*

planipes) 5.68%, whereas the meat of both crabs are higher than works published for *Homalaspis plana* 1.93% [19]. The Carbohydrate of meat of *Cardisoma armatum* was highest when compared with *Callinectes pallidus* and showed significant difference between the two crabs. The carbohydrate of bonny parts of *Callinectes pallidus* was higher than *Cardisoma armatum*, these showed significant differences between the crabs when compared. Crabs generally are high in ash and protein in this present study.

Mineral composition

The calcium content in meat of *Callinectes pallidus* and *Cardisoma armatum* were 3843.95 ± 0.89 mg/kg and 18901.51 ± 0.50 mg/kg respectively while the calcium content of bonny tissue of *Callinectes pallidus* and *Cardisoma armatum* were 3843.95 ± 0.89 mg/kg and 18901.51 ± 0.50 mg/kg (Table 2) respectively. The value of calcium in meat and shell of *Cardisoma armatum* and *Callinectes pallidus* is in agreement with Akpan [17], higher than works reported by Ojewola and Udom [14]. It would also satisfy the recommended dietary allowance value of 13.99 mg/100g [25]. The higher calcium content of meat of *Cardisoma armatum* over *Callinectes pallidus* was perhaps due to the opportunistic feeding on leaves and invertebrate while the higher shell content of calcium of *Callinectes pallidus* was higher compared to *Cardisoma armatum* this is due to good quality of exoskeleton and cannibalistic feeding of rich mineral source from the Aquatic habitat.

The potassium (P) content of meat of *Callinectes pallidus* and *Cardisoma armatum* were 1489.02 ± 1.02 mg/kg and 5720.01 ± 0.96 mg/kg (Table 2) respectively while the shell potassium content of *Callinectes pallidus* and *Cardisoma armatum* were 6051.07 ± 0.90 mg/kg and 1021.04 ± 0.85 mg/kg (Table 3) respectively. The potassium levels of bonny tissue in the two crabs appear higher than works reported by Akpan [17].

The Magnesium content of the two crabs were higher than 123.37 mg /100g of *Ucides cordatus* [21], 64.53 mg/100g (meat) and 23.17 mg/100g for (shell) of *Callinectes sapidus* (Otwell and Koburger 1985). Magnesium level of meat of *Cardisoma armatum* and *Callinectes pallidus* showed higher value than magnesium content in bony tissues shell. Test to show significance between the two crabs shows that there was no significance between the two crabs when compared in terms of values of meat and bony tissues.

The sodium content of meat and shell of the two crabs were higher than works of Wheaton F and Lawson T [26] (*Callinectes sapidus*) for meat 486 mg /100g and *Ucides cordatus* 1410.37 mg /100g for Meat and bony tissue respectively.

The sodium content of *Callinectes pallidus* was higher than *Cardisoma armatum* when compared but showed significant difference. Sodium content of meat of *Callinectes pallidus* was higher than *Cardisoma armatum* also the bony tissues of sodium content of *Callinectes pallidus* was higher than that of *Cardisoma armatum*.

The Iron content of the two crabs appears lower than published work of Wheaton F and Lawson T [26] *Callinectes sapidus* 22 mg/100g of meat and 9.36 mg /100g of shell also of Chen et al. [21] *Ucides cordatus* 5.32 mg /100g. The iron composition of meat of *Cardisoma armatum* was higher than *Callinectes pallidus*; also iron content of bony tissue of *Callinectes pallidus* has higher iron content than *Cardisoma armatum* suggesting that semi-terrestrial animal could have high iron content than the aquatic counterpart. However, the iron content of the two crabs for both meat and bony tissues were not statistically different.

The Manganese content of the two crabs are higher than those of Chen et al. [21] *Ucides cordatus* 0.38mg /100g, Akpan [17] *Callinectes sapidus* 0.033 mg/100g, Wheaton F and Lawson T [26] *Callinectes sapidus* 6.0/100g. Manganese compositions of meat and bony tissue of *Callinectes pallidus* were higher than *Cardisoma armatum*. *Callinectes pallidus* showed higher manganese content which indicates that there is more manganese uptake in the aquatic environment; also that manganese composition in semi-terrestrial organisms like *Cardisoma armatum* is lower.

The zinc content of the two crabs of meat and bony tissue were higher than published work for *Callinectes sapidus* 0.013 mg/100 g [17] and lower than those published by Chen et al. [21] (*Callinectes sapidus*) 34.67mg /100g, by Wheaton F and Lawson T [26] (*Callinectes sapidus*) 18.8mg /100g for meat and 4.24mg/100g. *Callinectes pallidus* had higher zinc content in meat than *Cardisoma armatum*, where as *Cardisoma armatum* had a higher zinc content of bony tissue shell than *Callinectes pallidus*. Zinc has been found to be useful in prostate health of man found in both species fished in creek.

The copper content of meat of *Callinectes pallidus* and *Cardisoma armatum* were 84.82±0.46 mg/kg and 84.81±0.10 mg/kg (Table 2) respectively while the Copper content in bony tissue of *Callinectes pallidus* and *Cardisoma armatum* were 62.73 ± 0.65 mg/kg and 177.55 ± 0.74 (Table 2) mg/kg respectively. The copper content of the two crabs of meat and shell were higher than reported work of Wheaton F and Lawson T [26] *Callinectes sapidus* 4.28 mg/100 g (meat) and 9.36mg /100 g (shell), of Akpan [17] copper 0.003 mg/100 g but lower than values reported by Chen et al. [21] *Ucides cordatus* 1410.37 mg/100 g [27-29]. The copper of meat of *Callinectes pallidus* was higher than *Cardisoma armatum*. Whereas *Cardisoma armatum* had higher copper in bony tissue than *Callinectes pallidus*. The meat and bony tissue content of the two crabs based on copper content showed a higher significance which showed a higher statistical difference, but the shell showed no significance. The variation in mineral contents of the two crabs *Callinectes pallidus* and *Cardisoma armatum* showed the differences in feeding habit, ecological interaction, habit factors and stomach content.

Conclusions

Crabs are crustaceans that are not readily available to people around land locked areas, but available in high quantities in coastal areas. Both crab meat and shell (bonny tissue) are food that gives good healthy living considering their cheap status along coastal areas. This study also suggests a higher food values for both species and would therefore be desirable for culture. This will not only improve the nutritional and health status of dwellers in the coastal communities but would also provide gainful employment during the off season slake periods while diversifying the aquaculture base of the state.

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