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The Proximate and Mineral Composition of Two Edible Crabs *Callinectes amnicola* and *Uca tangeri* (Crustecea: Decapoda) of The Cross River, Nigeria

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Abstract: This study was conducted to assess the nutritional qualities of the flesh and shell of *Uca tangeri* and *Callinectes amnicola* of the Cross River, Nigeria. Specimens of *C. amnicola* used for this study *were* bought from fishermen at the beach of the Cross River behind the University of Calabar, Calabar, Nigeria. These specimens were subjected to proximate analysis using the methods recommended by the Association of Analytic Chemist (AOAC) and with the aid of the Spectrophometer for the determination of the mineral contents of species. The moisture content of the specimens was high giving 72.31±0.96% and 74.54±0.03% for the flesh of *U. tangeri* and *C. amnicola* respectively while the moisture determined in the shell of *C. amnicola* was 33.60±0.15%. The crude protein content of the flesh of both species were significant (p>0.05) with the protein level of *U. tangeri* being higher than that determined in *C. amnicola*. But the total protein level of *C. amnicola* (flesh and carcass) was 25±3.55 which was higher than that measured in *U. tangeri* by 2.23%. Other parameters which were measured in *C. amnicola* were higher and showed significant differences (p>0.05) between themselves. The organisms are rich in minerals although significant differences could be established; there were significant differences between the minerals content of *U. tangeri* and the flesh and shell of *C. amnicola* (p>0.05).

Key words: Food, Cross river, edible crabs, *Uca tangeri, Callinectes amnicola*

INTRODUCTION

Literature information is scarce on the food value of most edible crabs in West Africa despite the food richness of these gastropods. Most persons rate the fish higher in preference to the crabs which are considered inferior and food for the low income earners/poor. However, it is reported that the crabs make up about 20% of all marine crustaceans caught worldwide; with an estimated 11.2 million tones of it being speculated to be consumed annually (Donaldson and Cullenberg, 1999; Andrea Cohen, 2006). Over 100 species of crabs are known world wide with two species readily known to exist with economic value in West Africa; the mud crabs (*Uca tangeri*) found in estuaries and mangrove. *C. amnicola* are freshwater crab species inhabiting cracks and holes when fully matured and as small individuals are found under rocks in the littoral zone. They are highly exploited but only their flesh are consumed. *U. tangeri* is highly valued and the most consumed crab of high demand in West Africa (Jadamec *et al.*, 1999, Enzenross *et al.*, 2001; Ojewole and Udom, 2005).

It is in literature that the shell and the flesh of *U. tangeri* is highly proteinous compared to other mollusk with protein ranging between 17.1 gm/100 gm to 21.31 gm/100 gm (Ackman, 1990). It is reported too that the shells and tissues of some crabs contained more than 20 different types of amino acids and that crabs meat can provide all the needed amino acids for growth (FAO/WHO/UNO, 1985). Other food components except fat are high in the crab species (Exler *et al.*, 2002; Neal and Wilson, 2005; Abulude *et al.*, 2006). The fatty acid components of these gastropods is reported to constitute the best among the aquatics and most desired for development (Cikrikci, 1995).

Although most food sources for the humans are provided from land animals, recently crabs have been successfully used as another better source of food nutrients to man compared to land animals (Fasakin and Merce, 1992). The crabs are also known to be good sources for the provision of Omega 3-polyunsaturated fatty acids and other valuable essential foods such as protein, carbohydrate, ash and energy (Broughton *et al.*, 1997). Crabs are also prominent sources for the provision of essential macro and micro elements such as potassium, phosphorus, calcium, magnesium copper, iron manganese and zinc. Crabs contain fewer calories than beef and pork and poultry (Carter and Chung, 1999). A 100 gm portion of crab is reported to contain 0.7 gm saturated fat and 76 calories while 100 gm of beef contained 66.9 gm and 225 calories (Carter

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and Chung, 1999). This study provides data on the quality of food nutrients in crabs of the Cross River, Nigeria. It is expected that the results of this study will stimulate awareness concerning the nutritional value of these gastropods and the need to use them as food for humans, food supplements and suitable alternative for fish meals in animal feed production.

MATERIALS AND METHODS

The specimens of *Uca tangeri* and *Callinectes amnicola* used for this study were purchased from the fishermen who landed at the fish market beach behind the University of Calabar, Calabar, Nigeria. The fishermen, on arrival at this beach sale their multi species wares whole sale to fish mammies from where the samples were purchased. This beach is located along the Great Kwa River, behind the University of Calabar, Calabar, Nigeria, at latitude 04° 15.9´ N and longitude 08°20´ E.

In the laboratory, the specimens were washed thoroughly to exclude contaminants. The flesh and the shell of *C. amnicola* were separated and dried separately in ventilated electrically heated ovens at 75°C for 72 h ensuring complete dryness. *U. tangeri* flesh could not be separated from its shell; for this reason whole specimen was dried for analysis.

The proximate compositions of the samples were determined using the methods recommended by the Association of Analytic Chemist (AOAC, 2000). Protein was analyzed by the use of Micro-Kjeldahl apparatus and moisture by difference in weight between wet weight of sample and weight of sample after drying. Fat was determined by Soxhlet extraction while the ash content was calculated after samples were ignited at 550°C.

The mineral composition of the samples were determine by Spectrophometry using different wavelengths as follows: for Iron at wavelength 420 nm, Calcium at 48 nm, Sodium at 380 nm, Nitrate 320 nm while Phosphates Magnesium and Copper were read at 420 nm, 568 nm and 62 nm respectively. These results were expressed in mg/100 gm of specimen respectively.

Student t-test was applied to compare the results statistically (Sokal and Rohlf, 1969).

RESULTS

The proximate and mineral composition of the flesh and shell of *U. tangeri* and *C. amnicola* are presented in Tables 1 and 2.

Moisture content: The moisture content in the shell and flesh of *C. amnicola* which was within the range of 33.60-74.54% was significantly different ($p>0.01$). This was also different from the data obtained from *U. tangeri* which was 72.31%. Moisture was low in the shell of *C. amnicola* but high and significantly different in the flesh of both species ($p>0.05$) (Table 1).

Crude protein content: The protein content of *C. amnicola* was approximately four times lower in the shell than in its flesh and significantly lower in the flesh and shell of *U. tangeri* ($p>0.05$) The protein content in the species ranged between 5.23% in the shell and 23.16% in their flesh.

Ash content: The total ash content in *U. tangeri* was similar to that measured in the flesh of *C. amnicola* ($p<0.05$). But a comparison of the ash from both species showed that the shell contained approximately 50 times more ash than the flesh of both species (Table 1).

Carbohydrate content: The carbohydrate content in the shell of *C. amnicola* was 60.12% approximately 20 times higher than that which was determined in the *U. tangeri* and in the flesh of *C. amnicola* (Table 1). The carbohydrate in the flesh of *C. amnicola* and in the shell of *U. tangeri* were not significantly different ($p<0.01$).

Fat content: Fat in the species was 0.22% in *U. tangeri* and 0.01% and 0.45% in the flesh and shell of *C. amnicola*. The shell of this species lacked fat. The fat content in *U. tangeri* and *C. amnicola* were significantly different ($p>0.05$).

Table 1: Proximate composition of *U. tangeri* (whole body) and *C. amnicola* (shell and flesh) of the Cross River, Nigeria

Food component	*U. tangeri* (%)	*C. amnicola* (shell) (%)	*C. amnicola* (flesh) (%)
Protein	23.16±0.05	5.23±0.01	20.12±0.01
Carbohydrate	3.01±0.05	60.12±0.12	2.92±0.07
Fat	0.22±0.01	0.01±0.00	0.45±0.02
Ash	1.40±0.01	50.87±0.01	1.84±0.07
Moisture	72.31±0.96	33.60±0.15	74.54±0.03
Fiber	0.07±0.01	0.05±0.01	0.10±0.02
Energy (kcal)	106.73±0.46	261.57±0.77	96.35±0.08

Table 2: Mineral composition of *U. tangeri* and *C. amnicola* (mg/100 gm) of the Cross River, Nigeria

Minerals	Fe^{2+}	Ca^{2+}	Na^{+}	K^{+}	NO^{3+}	P	Mg^{+}	Cu^{2+}
U. tangeri	156	718	630	606	102	79	767	85
**C. amnicola* (S)	171	564	260	200	36	24	125	7
*C. amnicola (F)	98	402	441	361	52	50	180	8

Where S and F represents shell and flesh of the species

Calorific energy: The shell of *C. amnicola* showed significantly higher energy value than that measured in its flesh and in *U. tangeri*. Calorific energy was 2.3 times and 4 times lower in the former and later than that obtained from the shell of *C. amnicola*.

Fiber content: The value of fiber in *U. tangeri* (flesh and shell) and *C. amnicola* (shell) were similar ($p>0.05$) but were significantly different from the value determined in the flesh of *C. amnicola* ($p>0.01$).

Mineral composition: In this study, the concentration of the minerals in *U. tangeri* (whole organism) tends to be higher than in the other organism (Table 2). However, the combined concentration of these minerals in the shell and flesh (pooled data) of *C. amnicola* was higher than that measured in *U. tangeri* (whole organism) (Table 2). Also, the concentration of iron in the flesh of *C. amnicola* was lower than in the other samples (Table 2). The concentration of minerals in the shell of *C. amnicola was* lower than that determined in the other samples.

Copper was exceptionally high in *U. tangeri* (85 mg/100 gm) than in the *C. amnicola* (flesh and shell-7 mg/100 gm and 8 mg/100 gm respectively. The mineral components of the two species were significantly different in concentration ($p>0.05$). The concentration of the minerals was higher in *U. tangeri* (combined shell and flesh) than in the other organism comparing the flesh and shell separately. However, the pooled data in terms of the weight of the minerals in *C. amnicola* showed that the species is richer in minerals than *U. tangeri* (Table 2).

DISCUSSION

Proximate composition: The moisture content in the flesh of *C. amnicola* and *U. tangeri* were higher than that in the shell of *C. amnicola*. High moisture contents in organisms are considered as an advantage because of its contribution in the stabilization of the organisms during movements (Eddy *et al*., 2004).

The crude protein content of these organisms ranged from 23.16±0.05% in *U. tangeri* and from 5.23±0.01% to 20.13% in the shell and flesh of *C. amnicola* respectively. This crude value of protein in *U. tangeri* of the Cross River, Nigeria is different from 17.1±0.01% earlier reported for the same species from Oron creek, Nigeria (Ojewole and Udom, 2005). These differences may relate to the geographical location of Oron Creek from the population of the species in the Cross River. The high content of crude protein in *U. tangeri* and *C. amnicola* further support earlier findings that crab meat can supply sufficient protein and energy in diet and that its protein is essential for growth and body defense (Gates and Parker, 1992; Hopwood, 1975). Proteins from crabs are reported to be useful in the transportation of gas, building of organ components and in water and metabolic regulation of organisms (Ackman and McLeod, 1989).

The range of crude fat measured in this study from the two species. Table 1 show that these organisms belong to the low fat class; Compared to the values of fat (0.06±0.2%) given by Exler *et al*. (2002) for animals in that category. However, crabs are generally reported to show low calories than beef, pork and the poultry (Broughton *et al*., 1997).

The ash content of species is an indication of the mineral concentration in the organisms (Eddy *et al*., 2004; FAO, 2005). The ash content of the samples were 1.4±0.17, 50.87±0.01 and 1.84±0.02% (Table 1) with the shell of *C. amnicola* showing the highest concentration. These values as reported for the species from Oron Creek is lower giving 2.2±0.1%. This dissimilarity could most probably relate to the size of the species investigated for the separates studies or seasonal conditions at the time of study.

The fiber contents in the flesh of *C. amnicola* was low while that from its shell was high (Table 1) Fiber is regarded as essential nutrients as it is responsible for the absorption of water as well as in the provision of assistance to food matter during transit in the alimentary system (Krzynowek *et al*., 1982). It is also speculated that the fiber content in crabs is more efficient in the reduction of constipation in human consumers than other known sources of fiber (Lee *et al*., 1993).

Carbohydrate in *C. amnicola* was thirty times higher in the shell than in its flesh. The implication of this high concentration of carbohydrate in the shell of this species is that the animal would yield a lot of glucose, galactose, fructose and mannose when digested than that which could be obtained from its flesh; these sugars are energy producers (FAO, 2005). This also suggests that the shells of this organism should not be discarded completely as it is presently practiced. The high energy content of 106.73±0.4 - 96.5±0.08 kcals (Table 1) indicate a function of high protein and carbohydrate in the species. The shell exhibited higher energy values than the flesh whose energy value cannot be ignored, implying that the crabs are relatively high energy food source (Table 1).

Mineral composition: The species of this study showed high values of Mg^{2+}, Ca^{2+}, Fe^{2+} and NO_3^-. The value of iron was exceptionally higher in the shell of *C. amnicola* than that measured in *U. tangeri* and *C. amnicola* flesh (Table 2). These results are contrary to that reported in literature for *C. amnicola* in which its iron content is higher. In that study, the sizes of the species are not reported and we presume that size could be the reason for the differences Literature asserts that size differences could affect the food concentration in species (Ackman and McLeod, 1989). Iron in organisms is essential because of its contribution in the formation of haemoglobin, myglobin and hemenzymes (Mercer, 1992).

Calcium as an essential mineral was high in all specimens studied for this report. These suggest that a crab sample can provide a significant proportion of calcium and other essential minerals if consumed appropriately. Calcium is important to humans because of its contribution in blood clotting, muscle contraction, bone and teeth formation/repairs and in some enzymatic metabolic processes (NRC, 1989). Sodium was high in *U. tangeri* than in *C. amnicola*; the high content of this important mineral in *U. tangeri* is due to the fact that whole specimen was involved in analysis since specimen was too soft for shell to be separated from flesh. The combine concentration of sodium from both shell and flesh of *C. amnicola* showed that it contained more sodium than *U. tangeri* (Table 2). However, because it is possible to consume *U. tangeri* whole than *C. amnicola*, it appears that sodium from *Uca tangeri* could easily be available to consumers in higher concentration than that from the consumable parts of the later. This mineral is essential in the regulation of P^H, osmotic pressure, water balance, nerve impulse transmission and active transport of glucose/amino acids (Asuquo *et al*., 2004). Potassium concentration in *U. tangeri* was higher than that measured in *C. amnicola*. The value of potassium obtained from *C. amnicola* flesh was comparable to the value reported for *C. amnicola* from Oron Creek and Ishiet River respectively. Potassium is known to be widely distributed in crabs; it is primarily an intracellular cation bonded to protein and alongside with sodium exerts tremendous influence on the protein molecule it is bonded to. The intake of potassium is necessary because it contributes to normal P^H stability in organisms (Ackman and McLeod, 1989).

Although sodium seems to be predominant in the organisms of this study, its concentration revealed that *U. tangeri* and *C. amnicola* were equally rich in other elements such as calcium, potassium, magnesium, copper and iron. The high mineral contents in these crabs is an indication/affirmation that crabs generally are essential sea foods for healthy functioning of the body and could be good supplements in food for those with their deficiencies. It could as well be recommended for use as additives in animal feed production and a possibly replacement to fish meal. In areas where crabs are not accepted for food, they could be completely used to replace fish meal in animal feed production.

Conclusion: The two crab species contain sufficient nutrients and minerals that are beneficial to humans as food and in farmed animal nutrition. It could especially serve as supplements to patients deficient in them if taken appropriately. It could also be concluded that the concentration of minerals in these species are within WHO recommended safe limits for elements in aquatic organisms. The consumption of these sea foods should be preferred to the catfishes and mackerel earlier reported with high copper concentration (Asuquo *et al*., 2004; WHO, 1998; USDA, 2010; Udo and Arazu, 2011). It could also be observed that it is easier to obtain complete nutrients from *U. tangeri* than from *C. amnicola* because the former could be consumed whole while in the later' only it flesh is available in most cases for human consumption.

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