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Microbial and Proximate Composition of Blue Crab *Callinectes sapidus* from Agbalata Market Badagry Lagos West, Nigeria

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Abstract
Blue crabs (*Callinectes sapidus*) are good sources of Omega 3- polyunsaturated fatty acids and other valuable essential food vitamins such as protein, carbohydrates and ash. However, they have been implicated in incidences of food intoxication and infection. In this study, male and female blue crabs from Agbalata market Badagry were subjected to proximate, mineral and microbial composition for 6 months within February to December 2011. The results of proximate analysis showed that female blue crabs had 20.2% protein, 77% moisture, 2.3% ash and 0.7% lipid while the males composed of 19.1% protein, 78.5% moisture, 2% ash and 0.4% lipid. It was also found that both female and male crab meat were rich in minerals especially Mn, Na, K and Zn. Statistically, there was significant differences in Mn, Na, K and Zn levels for carapace meat of male and female crabs ($p<0.05$). Na and K contents of female crabs was significantly higher ($p<0.05$) than male crabs while Mn and Zn level of the male crab was significantly higher than the female crab. The microbial composition showed a range of total viable count (TVC) 1.6×10^2 - 2.36×10^3 Cfu g^{-1}. *Salmonella* species, *Shigella* species and *E. coli* were absent in the samples. *Vibrio* species were present in almost all the samples tested, revealing *V. parahaemolyticus*, *V. damsela*, *V. mimicus*, *V. alginolyticus*. The result of the study suggests that blue crab could be an alternative dietary supplement of protein and mineral matter if well cooked to avoid food infection.

1. Introduction

Crabs are crustaceans found in nearly all parts of the world. They are beneficial in terms of its value as commercial and recreational fishery specie. Furthermore, they rank third after shrimps and lobsters for their esteemed seafood delicacy and also the value of fishery they support (Savad and Rahavan, 2001). However, it is reported that crabs make up about 20% of all marine crustaceans caught worldwide with an estimated value of 11.2 million tones of it being speculated to be consumed annually (Cohoen, 2006). In the tropics, *Callinectes* species is the most popular genus (Uaboi-Egbenni *et al*., 2010). Blue crab (*Callinectes sapidus)* is significant species of sea crab and they are common in many food components of Nigerian dishes (Adeyeye, 2008).

Ackman, (1990) reported that the shell and flesh of crab is high in its protein content compared to the mollusk. FAO/WHO/UNO, (1985) also wrote that shells and tissues of some crabs contain more than 20 different types of amino acids and crabs flesh alone can

provide all the needed amino acids for growth. Broughton *et al.* (1997) revealed that crabs are also known to be good sources for the provision of omega-3- polyunsaturated fatty acid. However, due to its calcium content, they are recommended for pregnant women (Uaboi-Egbenni *et al*., 2010).

The presence of pathogenic organisms in seafoods e.g. crabs could pose a serious threat and hazards to susceptible people through ingestion of inadequately cooked crabmeat (Okonko *et al*., 2009). Good hygiene practices should always be observed by traders and consumers of seafoods (crabs) to avoid food poisoning (Adebayo-Tayo *et al*., 2011). The microbial safety of food can be achieved by ensuring the absence of pathogenic microorganisms through bacteriological testing to ensure acceptable levels of contamination and to avoid adverse human consequences of food-borne illness (Ajao and Atere, 2009). There have been several reports on the health risks associated with consumption of contaminated crabmeats (Edema *et al.*, 2005). Crabs have been implicated in food intoxication and diseases (Uaboi-Egbenni *et al*., 2010). Silker, (1986) also reported crab implication with *Vibrio parahaemolyticus* and *Yersinia* sp. in food poisoning. Several other reports on microbial contamination of seafoods have been reported in Nigeria (Adeleye, 2008, Adebayo-Tayo *et al*., 2011, Nsofor, 2014). However, there is paucity of information on the microbial and proximate composition of the blue crab from Lagos State Nigeria.

This present study was designed to determine the microbial and proximate composition of blue crab and to have knowledge of possible microbial contaminants and nutritional value to facilitate the processing, utilization and marketing of the blue crab (*Callinectes sapidus*) sold in Agbalata market Badagry, Lagos State Nigeria for human consumption.

2. Materials and Methods

2.1. Description of the Study Area

Agbalata market Badagry is situated in a coastal town, south-west local government area in Lagos State, Nigeria. Badagry is situated between Metropolitan Lagos, and the border with Benin at Seme. As of the preliminary 2006 census results, the municipality had a population of 241,093. Its geographical coordinates are 6° 25' 0" North, 2° 53' 0" East.

2.2. Sampling

A total of 90 blue crab samples were obtained from Agbalata market Badagry, Lagos west Nigeria. Samples were collected every other month for 6 months from February 2011- December 2011. The crab samples were bought from the marketers and kept on ice in an insulated box and transported to the Nigerian Institute for Oceanography and Marine Research, Victoria Island Lagos for laboratory analysis.

2.3. Sample Preparation

Carapace meats of the crabs were removed using scalpel and other dissecting instruments under aseptic conditions. The meats were kept in sterile microbiological tubes prior to inoculation into appropriate media. All assays were conducted on triplicate samples of the homogenates.

2.4. Isolation Technique

Ten grams of each sample were aseptically weighed and homogenized in 90ml of sterile distil water. Ten- fold serial dilutions of samples were done in 1% peptone water and plated out on four different culture media; Nutrient Agar (NA) was used to determine the total viable count (TVC), Salmonella-Shigella Agar (SSA) was used to detect the presence of *Salmonella* species and *Shigella* species. Eosine Methylene Blue (EMB) Agar was used to detect the presence of *Escherichia coli*, while Thiosulphate citrate bile salt (TCBS) Agar was used to detect the presence of *Vibrio* species. The plates were incubated at 35^{o}C for 18 hours. Pour plate method of Harrigan and McCance (1976) was used for the isolation.

2.5. Proximate Composition Analysis

Crab samples were analyzed in triplicates for proximate composition. The moisture content was estimated by drying samples to constant weight at 103±2^{0}C using the oven dry method (AOAC, 1994). Lipid determination was carried out using the modified Bligh and Dyer procedure (AOAC, 1994), the ash content was determined by igniting the samples at 550^{0}C for 6 hours until the samples was completely free from carbon particles in a carbolite Sheffield LMF3 muffle furnace while the total nitrogen content was determined by the Kjeldahl method as described by Vlieg, 1984 and a factor of 6.25 was used for converting the total nitrogen to crude protein content of the crab samples.

2.6. Mineral Analysis

Mineral analysis was carried out using the method reported by Oshodi, (1992). Minerals were analyzed by dry ashing 1g of the sample at 550^{0}C in a furnace and the ash was dissolved in 10% HCl. The solution was later filtered with Whatman filter paper and made up to standard volume (i.e 100ml) with deionised water. Flame photometery method reported by AOAC, (1990) was used to determine Na and K contents of the sample using Corning 405 Flame Photometer. Mn, Fe, Mg, Zn and Cu were analyzed using Alpha 4 Atomic Absorption spectrophotometer (AAS). The analyses were performed in triplicates.

2.7. Identification of Isolates

Pure bacteria isolates were identified through their microscopic and biochemical characteristics according to the Bergey's Manual of Systematic Bacteriology (Holt and Krieg, 1994).

2.8. Statistical Analysis

Statistical analysis of results was performed with T-test using SPSS version 16.0 (SPSS, Inc., Chicago, IL, USA). A value of $P<0.05$ was considered statistically significant for comparison.

3. Results and Discussion

The results of the proximate composition of the male and female blue crabs are shown in Table 1. The moisture, ash, protein and lipid values for male and females are 78.50, 2.18, 19.18, 0.43% and 77.11, 2.30, 20.21, 0.72% respectively. High moisture content in blue crab as recorded in this study, helps in stabilization of the crab during movements, moreover, the values obtained for ash concentrations are all in agreement with the findings of Eddy *et al*. (2004) that ash contents are indicators of mineral concentration. However, in this study, blue crabs have high protein 19.1% for males and 20.2% for females, the protein content of the crab agrees with the earlier finding that crab meat can supply sufficient protein in diet and protein is among the classes of food which is essential for growth and body defense (Gates and Parker, 1992; Hopwood, 1975). The protein, lipid and water contents of female and male blue crabs were significantly ($P<0.05$) different. The ash contents of female and male crabs did not differ significantly ($P>0.05$). Protein contents of female blue crabs were significantly higher ($P<0.05$) than those found in male blue crabs, lipid contents of the females were also significantly higher ($P<0.05$) than the males while the water content of the males were significantly higher ($P<0.05$) than those found in female blue crabs in Table 2. The reason of higher protein in female could be as a result of size and age. The low lipid content as was seen in this study 0.7% for females and 0.4% for males shows that crab belong to the low fat class of food and this result is in agreement with (Broughton *et al*., 1997). Gökoğlu and Yerlikaya, 2003 reported lower percentage for protein contents for blue crabs caught from the Gulf of Antalya as 14.71%-15.0% but the lipid contents had similar range 0.64%-0.79%. Türeli *et al*. 2000 reported protein contents range of 14.3-16.8% for blue crabs caught from the Gulf of İskenderun. In another similar study, Küçükgülmez *et al*. 2006 also reported protein and lipid as 18.8-20.0%, 0.4%, respectively. The differences in proximate composition could be due to variation in sizes, seasons of catch and the physico chemical parameters of the study area.

Table 1. *Proximate composition of male and female blue crabs*

SEX	MOISTURE %	ASH (%)	PROTEIN (%)	LIPID (%)
Male	78.50a	2.18a	19.18a	0.43a
Female	77.11b	2.30b	20.21b	0.72b

* Data are expressed as mean values (n=3).Mean followed by different letter within a row are significantly different ($P < 0.05$).

The mineral compositions of the male and female crabs are shown in Table 2. The Manganese (Mn), Sodium (Na), Potassium (K), Zinc (Zn), Iron (Fe), Copper (Cu) and Calcium (Ca) reveled 13.92, 11.50, 9.24, 3.96, 3.27 and 2.44 mg/kg respectively in the male. The female recorded 12.44, 12.38, 10.16, 8.69, 4.15, 4.25 and 2.55 mg/kg respectively. It was also discovered that both male and female crabs were rich in minerals, especially Mn, Na, K, Fe and Zn. Iron in organisms is essential because of its role in the formation of haemoglobin (Mercer, 1992). Sodium and potassium ions are required for the regulation of body fluid balance (Asuquo *et al*., 2004). Zinc and Manganese are also an important component in the stability of organisms (Asuquo *et al*., 2004). Manganese (Mn) recorded the highest value of 13.92mg/kg (male) and 12.44mg/kg (female). However, the levels of Ca in the crabs were least in content showed 2.44mg/kg in male and 2.55mg/kg in female. Fe, Cu and Ca values in both female and male blue crabs were not significantly different ($P>0.05$). Na and K contents of female blue crabs were significantly higher ($P<0.05$) than those found in male blue crabs while Mn and Zn levels were lower ($p<0.05$). The concentration of minerals in blue crab meat can be influenced by a number of factors such as seasonal, biological differences (species, size, age, sex and sexual maturity), food source and physico chemical parameters. The differences in mineral contents of the crabs used in this study are in agreement with (Skonberg and Perkins, 2002; Go¨kog˘lu and Yerlikaya).

Table 2. *Mineral composition of male and female blue crabs*

SEX	Manganese (mg/kg)	Sodium (mg/kg)	Potassium (mg/kg)	Zinc (mg/kg)	Iron (mg/kg)	Copper (mg/kg)	Calcium (mg/kg)
Male	13.92a	11.50a	9.41a	9.24a	3.96a	3.27a	2.44a
Female	12.44b	12.38b	10.16b	8.69b	4.51b	4.25b	2.55b

* Data are expressed as mean(n=3).Mean values a followed by different letter within a row are significantly different ($P < 0.05$)

The results of the total viable microbial count on nutrient growth agar media reported in Table 3. A total of 24 crab samples were studied every other month for 6 months from February, 2011 to December, 2012. In the month of February, the TVC ranged from 2.0×10^2-2.36×10^2. April showed 1.6×10^2-1.9×10^3, June revealed 1.7×10^1- 1.8×10^1 and the month of August count were 1.6×10^1-2.0×10^2 , these three months had the low counts. This could be as a result of the season (Rainy season). However, months in dry season, October and December, had total viable counts of 2.21×10^1-2.36×10^3 and 2.30×10^3- 2.36×10^3 respectively. The total viable count (TVC) ranged between 1.6×10^2 to 2.36×10^3 Cfu/g. The microbial load could be as results of anthropogenic activities around the lagoon were the crabs

were caught. The microbial contamination could also be as a result of handling by the fishermen and the marketers. The SSA revealed no results, EMB also revealed absence of *E. coli* in the samples. *Vibrio* species were present in almost all the samples tested, revealing *V. parahaemolyticus*, *V. damsela*, *V. mimicus*, *V. alginolyticus*. *Vibrio* species are ubiquitous, they are naturally present in the marine environment, and are particularly resistant to high salt concentrations (Farmer *et al*., 2003).

Table 3. *Range of Total Bacterial count from Blue Crab samples from February- December 2011*

Month	Sample size (No)	TVC Range (Cfu/g)
February	4	2.0×10^2-2.36×10^2
April	4	1.6×10^2-1.9×10^3
June	4	1.7×10^1- 1.8×10^1
August	4	1.6×10^1-2.0×10^2
October	4	2.21×10^1-2.36×10^3
December	4	2.30×10^3- 2.36×10^3
Total	24	

4. Conclusion

The results of the experiment demonstrate that carapace meat of male and female blue crabs were rich in terms of protein, major and essential elements. Both crabs are excellent sources of Mn, Na, K and Zn. It is possible to infer that both male and female blue crabs could be used in the balance of human nutrition and as a supplement of protein and mineral matter. The presence of *Vibrio* species could pose a possible risk of infection, if crab meat is not properly cooked.

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