ELEMENTAL CONCENTRATION AND SIZE RELATIONSHIP IN AFRICAN CUTTLEFISH *Sepia bertheloti*, FROM THE COASTAL WATERS OFF QUA IBOE RIVER, NIGERIA

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ABSTRACT

Ten specimens of African cuttlefish, Sepia bertheloti, from the coastal waters off Qua Iboe River, Southeast Nigeria, were analyzed for the relationship between the concentration of the elements and the size of the species. Energy Dispersive X-ray fluorescence technique was employed to determine the elemental composition of the species. Eleven elements were identified in the body of cuttlefish. These were Chlorine, Strontium, Potassium, Calcium, Bromine, Iron, Copper, Zinc, Manganese, Nickel and Selenium. Of these elements, the concentration of calcium, potassium. Copper and strontium had a positive correlation with the weight, while the concentrations of manganese, nickel, chlorine, iron were negatively correlated with their weights. However only manganese had a significantly negative correlation ($p<0.05$). Bromine and zinc had no correlation with the weights of the species. There also existed a significant positive correlation between Ca and K, Se and Ni, Cu, Br and Zn and St and K. We conclude that African cuttlefish, irrespective of size is a rich source of nutritional elements and is especially recommended for pregnant women and for all age groups.

Keywords: cuttlefish, size, elemental concentration, nutrition, Nigerian coastal waters
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INTRODUCTION.

African cuttlefish, *Sepia bertheloti* is a member of the class Cephalopoda, a group of marine animals, which include octopus, squid, cuttlefish and chambered nautilus. Cuttlefish, just like squid, possesses eight arms and two tentacles. Adult cuttlefish measures up to 13cm mantle length as females while the males may measure up to 17.5 cm mantle length. Mantle length refers to the length of the main body area above the eyes, excluding the arms and the tentacles (King 1995).

The order Sepiidae possesses an internal shell called cuttlebone made up of calcium carbonate just like the shell of periwinkle and snails. The basic colouring in cuttlefish varies although it typically displays a mottled black or brown colour. African cuttlefish, *Sepia bertheloti* is mottled dark and white. Like chameleon, colour changes are possible in cuttlefish. This is due to three types of structures contained within its skin called chromatophores, leucophores and iridophores. These structures are filled with coloured ink, which can be expanded and contracted to communicate to others or as camouflage against the background. These structures allow the cuttlefish to reflect a myriad of colours and change the texture of their skin (Roper et al 1984).

African cuttlefish occurs along the continental waters of West Africa to the southern-most point of Africa (Boletzky, 1983). It is a valued food species among the coastal communities of Nigeria particularly off the Cross River and Qua Iboe River estuaries. Most people prefer it as a delicacy. It is caught by bottom trawls and also occurs as by-catch in bottom trawls together with other cuttlefish (Schneider 1990). The species is benthic and can be captured in the sub-littoral depth of about 20-140m.

Cephalopods including cuttlefish and squids support the largest catches of all molluscan fisheries with an annual world landing approaching 2 million tons (King 1995). Akpan *et al* (2007) identified eleven nutritional elements in the species to include, Calcium, Potassium, Chlorine, Strontium, Bromine, Manganese, Nickel, Copper, Iron, Zinc and Selenium. Apart from this, there is no other documented evidence of this species in Nigerian coastal waters even though it is unique in the diet of the coastal dwellers. As a follow up to Akpan, *et al* (2007), we report on the relationship between the weight of the species and the concentration of the elements identified.

MATERIALS AND METHODS.

The cuttlefish samples were collected from the trawl fisheries in the Gulf of Guinea coastal waters off Qua Iboe River Southeast of Nigeria. The samples were weighed with electronic balance to the nearest 0.1g. They were then thoroughly washed with double distilled water and sun-dried to a constant weight. The dried samples were homogenized by grinding in an agar mortar. Three sub-samples (0.3 g) of each cuttlefish sample were pressed into thick pellets of 13 mm diameter in Spec-Caps without binders.

The elemental analysis of the samples was performed using the Energy Dispersive X-ray Fluorescence (EXDRF) spectrometer after the method of Akpan, *et al* (2007). Each sample pellet was irradiated for 1000 seconds at fixed condition of 25 kV and 50μA. the spectral data analysis was done with the AXIL fitting programme contained in the QXAS software package supplied by the International Atomic Energy Agency, Vienna (IAEA 1996).

RESULTS

Elemental composition of cuttlefish:

The following elements were identified in African cuttlefish, *Sepia bertheloti:* chlorine, potassium, calcium, manganese, iron, nickel, copper, zinc, selenium, bromine and strontium. Of theses elements, the following occur in very high proportion in that order: Chlorine, strontium, potassium, calcium, and bromine. Iron, copper, zinc and manganese occurred as medium elements while nickel and selenium occurred as trace elements. Fig 1 shows the relative composition of the elements in the body of cuttlefish in ppm body weight.

Weight element concentration relationship

A correlation analysis using spearman correlation reveals that there is some level of correlation between the elements and weight of the species. A correlation was established between the various elements and the weight of the cuttlefish. As shown ib Fig. 2a, there was a significant negative correlation between the concentration of manganese and the weight of the cuttlefish (P=0.05, r^2 -0.662, n=10). The concentration of the following elements also showed a negative correlation with the weight of the specimens: chlorine (P= -0.05, r^2= -0.272, n=10), iron (P=- 0.05, r^2=-0.366, n=10), nickel (P= 0.05, r^2 = -0.270, n=10). As shown by the results, the correlation was however not significant at 0.05 level of significance.

There were positive correlations between the concentration of the following elements and the weights of the cuttlefish: Potassium (P= 0.05, r^2= 0.326, n=10), calcium (P= 0.05, r^2 = 0.408, n=10), Copper (P= 0.05, r^2 = 0.373, n=10), Strontium (P= 0.05, r^2 = 0.304, n=10), Selenium (P= 0.05, r^2 = 0.231, n=10). Fig urc 2b shows the correlation between weight of cuttlefish and copper concentration. Again as shown, these positive correlations were not significant. There appear to be no correlation between the concentrations of zinc and bromine and the weight of the cuttlefish.

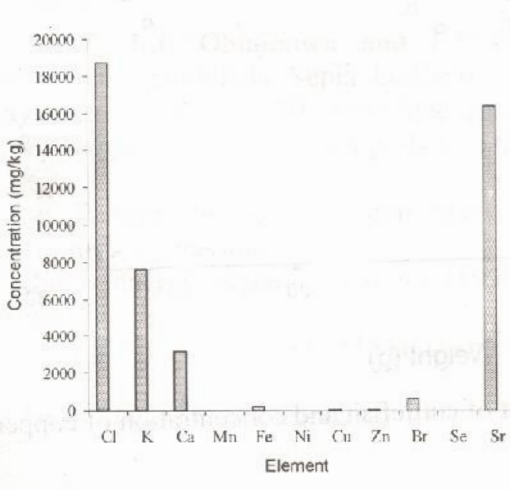

Fig 1: Mean concentration of elements in cuttlefish

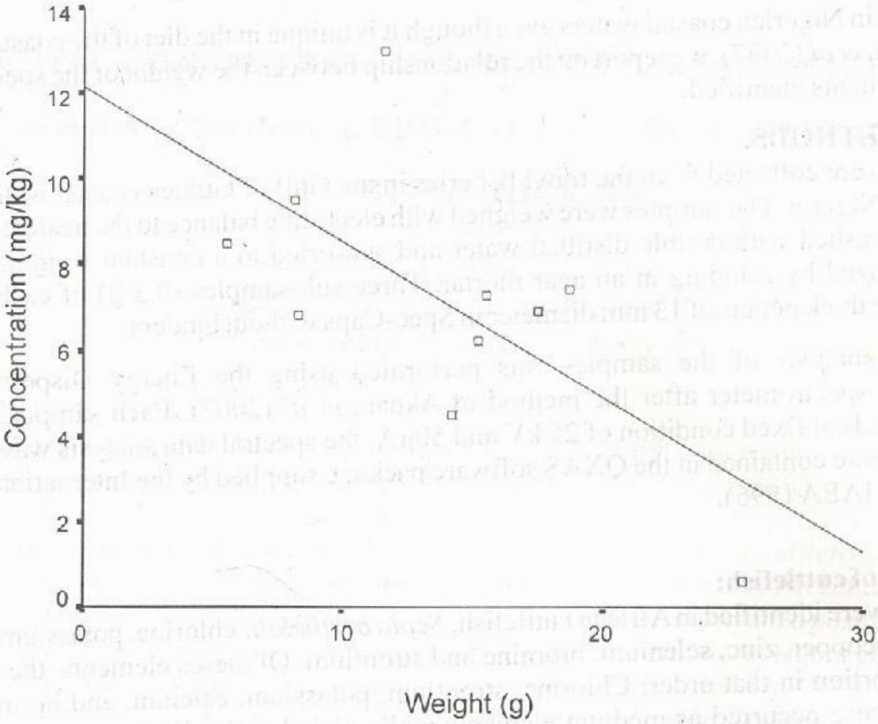

Fig 2 a: Negative correlation between weight of cuttlefish and manganese concentration ($p<0.05$, r^2= 0.66, n=10)

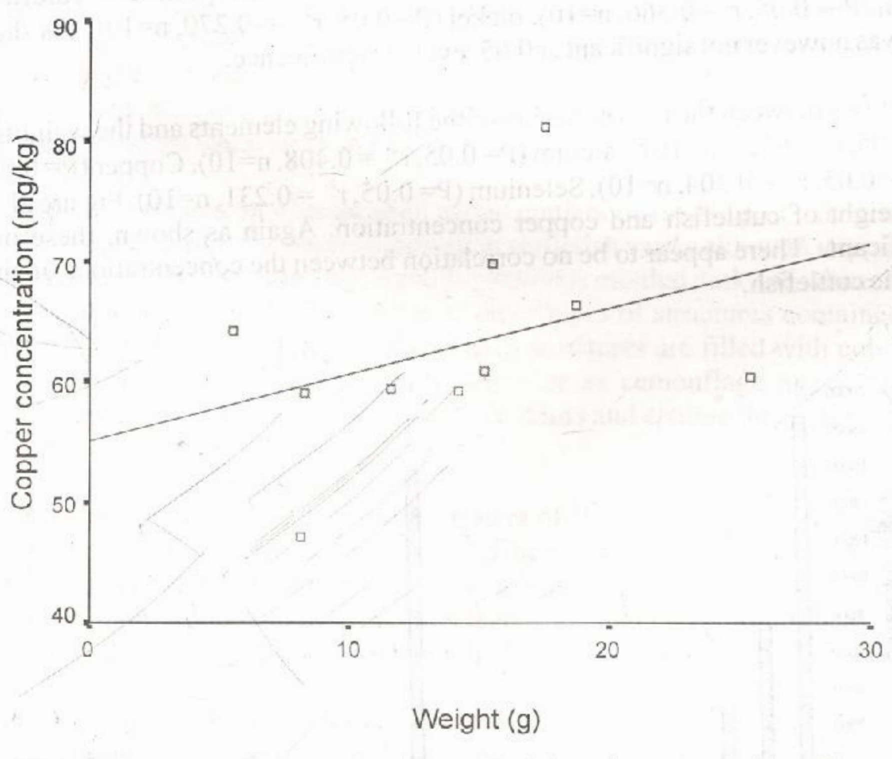

Fig 2b: Positive correlation between weight of cuttlefish and concentration of copper ($p> 0.05$, $r2= 0.37$, n=10)

DISCUSSION

According to Akpan et al (2007), the presence of the four major elements shown above, chlorine, strontium, potassium and calcium, are of nutritional significance. These elements play major roles in the structural and functional composition of humans, Nelson (1987) Tolonen(1990),Higdon (2004) and the curing of certain ailments (Levander 1997).

The positive correlations between the weight of cuttlefish and the concentration of calcium means that as the animal grows bigger the calcium deposit is also higher. This is because the major component of the cuttlebone is calcium carbonate. The cuttlebone becomes larger as the animal grows bigger. The high presence of calcium is characteristic of the mollusk since calcium is a major component of their shells. The cuttlebone, which is the internal shell of cuttlefish, is purely of calcium carbonate in composition (King 1995).

The higher concentration of calcium, potassium, strontium, and selenium in bigger species means that patients who are deficient in these elements should eat more of the bigger cuttlefish in their diet than the younger ones.

Conversely, the negatively correlation between the concentration of manganese and the weight of the species shows that as the animal grows bigger the concentration of the spices becomes lower. In this case, young cuttlefish are richer in manganese than older ones. Patients who are deficient in manganese should eat more of the younger cuttlefish than the older ones. This is applicable to patients who are deficient in iron, nickel and chlorine.The lack of correlation between the concentrations of bromine and zinc shows that cuttlefish whether older ones or younger ones can be eaten without any fear of deficiency of the two elements.
The presence of selenium, nickel, zinc and copper and their subsequent correlation in cuttlefish is of very significant interest. A combination of these four elements in their varying degrees and shades may be responsible for dark metallic appearance of the fresh specimen of the species. One of the allotropic forms of Selenium is a dark grey or black solid with metallic luster. Selenium when distilled is of a reddish- brown colour, when reduced to powder is red, when fused in a mass it is of a lead grey colour and metallic luster. These properties of selenium are probably responsible for the mottled dark or grey appearance of the cuttlefish. It is this property that conveys the camouflaging capability of the species in different backgrounds, which of course is a strong adaptation for protection.

Generally, all the elements identified in African cuttlefish are of very significant importance in the diet of man. We strongly recommend cuttlefish meals for all age groups but more especially for pregnant women, nursing mothers and growing children.

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