

Alkali and Heavy Metal Contaminants of Some Selected Edible Arthropods in South Western Nigeria

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Abstract: Some selected edible arthropods were analyzed for their alkali and heavy metal contaminants. *Macrobrachium vollenhovenii* [African River prawn], *Macrobrachium macrobrachium*, [Brackish River prawn] *Callinectes* spp. *Cirina forda*, *Rhynchophorus phoenicis*, *Anaphe* spp, *Anapleptes trifasciata*, *Macrotermes* spp., *Zonocerus variegatus*, *Apis mellifera* and *Brachytypes* spp. The highest level of nickel was found in *Callinectes* spp. (1.49ppm), followed by *M. macrobrachium* (0.36ppm) and *A. trifasciata* (0.34ppm). The level of Lead ranged from (0.03- 0.10ppm). *Callinectes* spp., *M. macrobrachium* and *A. trifasciata* have the highest cadmium (0.07, 0.05 and 0.03ppm) respectively. *Callinectes* spp. has the highest zinc content (1.63ppm), followed by *M. macrobrachium* (0.88) and *A. trifasciata* (0.79ppm). Sodium content ranged from (10.56-21.44ppm). *Callinectes* sp has the highest value for all the heavy metals may be due to ecological or metabolic factor but none of the values for each metal reached a toxic level, the alkali and heavy metal status of these arthropods must be checked from time to time, if there is any significant increase in the trace metal level of these arthropods as anthropogenic activities get sophisticated day by day.

Key words: Alkali • Heavy metal • Edible and Arthropods

INTRODUCTION

According to [1] insects have played an important part in the history of human nutrition in Africa, Asia and Latin America. Ordinarily Arthropods are not used as emergency food towards starvation, but are included as a planned supplements of the diet throughout the year or when seasonally available. There has been a new upsurge of interest in insects as food during the past few years. One factor that may be responsible is an increasing awareness in the western world that insects are traditionally and nutritionally important food for many non-European cultures [2].

Increased prides in ethnic roots and traditions have increased concern about environment and over-use of pesticides and better communication among scientist who are interested in the subjects have other factors responsible. Also [2] stated that edible insects might be closer now than ever before to acceptance in the western world as a resource that should be considered in trying to meet the world's present and future food needs.

In the early 1980's annual sales of *Mopanie caterpillars* entering commerce were estimated by the

South Africa Bureau of standards to be 1600 tons not including those privately collected and consumed [3, 4] reported that the sale of beef was seriously affected when *Mopanie caterpillars* (*Gonimbrasia belina*) west wood] were in season.

Hundreds of tonnes of *Mopanie* are currently exported annually from Botswana and South Africa to Zambia and Zimbabwe. In the North Africa, a similar caterpillar trade involving other species exists. Caterpillar and meat play the same role in the human body and has few caterpillars are regulars in the village but meat is a stranger [5] with references to *Mumpa caterpillar* which feed on *Julbernardia paniculata* and several areas of Zimbabwe, another common tree in the *Miombo* woodland, Zambia, it was noted that in several areas of Zimbabwe, some families make a fairly good living from selling caterpillars [6]. Not only that insects are sold widely in the village market of the developing world, but many of the favourites makes their way up to urban markets and restaurants.

White magney "worm" (larva of the hesperiid) and ahuahutle or 'Mexican caviar' eggs of several species (aquatic hemiptera) are two other insects that are found

in urban restaurants of Mexico and were formerly exported to the United States and Europe. Because of over-collection Magney larvae has reduced in number/occurrence, while ahuahutle is reduced because of urban pollution of alkaline lakes. At present, Asian insects are being exported to Asian community food shops in the United States these are the giant water bug (*Lethocerus indicus* L&S) from Thailand [7]. [3] also reported that *Mopanie caterpillar* can to a large degree, supplement the predominantly cereal diet with many of the protective nutrients. According to [8], caterpillar of *Usta terpsichore* in Angola is a rich source of iron, copper, zinc thiamin and vitamin B₁ and B₂ which gives about 100% daily requirement of these minerals.

Heavy Metals: Heavy metals refer to heavy metallic chemical element that has a relatively high density and is toxic or poisonous at low concentration [9]. We have lots of examples of heavy metals but according to [9]; it include Mercury (Hg), Cadmium (Ca), Arsenic (As), Chromium (Cr), Copper (Cu), Lead (Pb) etc.

These heavy metals come in contact with our bodies via food, drinking water and air. They are dangerous, because they tend to bio-accumulate (increase in concentration of a chemical in a biological organism over time) [9].

Effect of Some Heavy Metals in the Environment (Cd, Pd, & Hg)

Cadmium (Cd): In human, long-term exposure is associated with renal disfunction, which also leads to obstructive lung disease and has been linked to lung cancer. It causes bone defect (Osteomalacia, Osteoporosis}, anemia in human and animals [10]. According to [9], this heavy metals lead to increase in blood pressure (Hypertension) and effect on the myocardium in animals.

Lead (Pb): In a study conducted by [10], It is said to cause several health effects at relatively low level of exposure. While [9] stated that; it cause problem in the synthesis of haemoglobin. It also passes through the placenta and damages the central nervous system, increasing the risk for premature birth or birth weight.

Mercury (Hg): Inorganic mercury poisoning is associated with tremors, gingivitis and congenital mal-formation. While monomethyl / mercury causes damage to the brain and the central nervous system, also foetal and postnatal exposure can result to abortion [9].

Despite the importance associated with the edible arthropods bioaccumulated heavy metals in this arthropods especially the aquatic ones are passed on along the food chain which eventually accumulates in the body of the consumer as reported by [11] which later can reach toxic level.

The lead accumulation level of *Macrobrachium spp.* of lower Volta river in Ghana was 4.36Ng/g which was more than who tolerable limits [12] and that from Niger Delta, Nigeria was slightly higher than the tolerable limits as well [13] which was 0.48Ng/g.

Penaeus spp. from Lagos lagoon, Nigeria [14], Ghana [15] and Cameroon [16] were reported to be edible as all the heavy metals were far below the tolerable level for consumption but lead in *Crassostera spp.* of the Lagos lagoon was slightly higher than the tolerable level [14]. Also the studies of heavy metal concentration in some fishes from Ogba River showed that already, organisms in that river accumulated more than tolerable level for human consumption [14].

Objectives:

- To determine alkali and heavy metal contaminant present in these selected edible arthropods.
- To know if these selected edible arthropod are good and safe source of nourishment consequent upon the contaminant level that may be found.

MATERIALS AND METHODS

Sampling Methods: The selected edible arthropods, crayfish, crabs and some insects (*Rhynochophorus phoenicis*, *Anapleptes trifaciata*) were brought from different markets in Epe, Itokin, Abigi, Ologbun and Ibiade while others edible insects were collected using entomological nets and by hands from different parts of Lagos, Ogun, Oyo and Ondo state (South-western Nigeria.). They were then separated based on the morphological character [shape and colour] and preserved in 70% Alcohol. While some were immediately identified and preserved (oven dried) at 60°C - 70°C to avoid spoilage.

Identification: All the insects sampled were taken to the entomological laboratory of Olabisi Onabanjo University, Ago-Iwoye, Nigeria for identification while the non-insects samples were taken to the Aqua culturist for Identification at the University of Ibadan, Nigeria.

Table 1: Some Selected Edible Arthropods in Southwestern Nigeria

S/N	Order	Family	Scientific Name	English Name	Local Name	Consumption Stage
1	Decapoda	Potunidae	<i>Macrobrachium vollenhovenii</i>	African river prawn	Ede	Adult
2	Decapoda	Potunidae	<i>Macrobrachium macrobrachium</i>	Brackich river prawn	Ede	Adult
3	Decapoda	Paleomonidae	<i>Callinectes sp</i>	Crab	Akan	Adult
4	Lepidoptera	Saturniidae	<i>Cirina forda</i>	Caterpillar		Larvae
5	Coleoptera	Curculionidae	<i>Rhynchophorus phoenicis</i>	Snout beetle	Itun	Larvae
6	Lepidoptera	Notodontidae	<i>Anaphe sp</i>	Caterpillars	Munimuni	Larvae
7	Coleoptera	Scarabaeidae	<i>Analeptes trifaciata</i>	Rhinoceros beetles	Ipe	Larvae
8	Isopteran	Termitidae	<i>Macrotermes bellicosus</i>	Termites	Esunsun	Winged,Adults,Queen
9	Orthoptera	Pyrgomorphidae	<i>Zonocerus variegatus</i>	Grasshopper	Tata	Adults
10	Hymenoptera	Apidae	<i>Apis mellifera</i>	Honey bee	Oyin	Egg, larvae, pupae & honey
11	Orthoptera	Gryllidae	<i>Brachytypes sp</i>	Crickets	Ire	Adults

Table 2: Result of the Alkali and Heavy Metal Analysis from Some Selected Edible Arthropods in South Western Nigeria

Arthropods	Ni (ppm)	Pb (ppm)	Cd (ppm)	Zn (ppm)	Cu (ppm)	Na (ppm)
<i>Callinectes spp</i>	1.49	0.10	0.07	1.63	0.54	21.44
<i>Rhynchophorus phoenicis</i>	0.12	0.03	0.02	0.11	0.12	11.03
<i>Anapleptes trifaciata</i>	0.34	0.06	0.03	0.79	0.26	10.71
<i>Macrobrachium vollenhovenii</i>	0.28	0.05	0.02	0.56	0.15	10.56
<i>Macrobrachium macrobrachium</i>	0.36	0.08	0.05	0.88	0.20	18.28

Chemical Analysis: The fresh selected edible arthropods were oven dried and later blended into powdery forms. 20g of each in the powdered forms were packed into a cellophane bags and labeled into three replicates each, for each sample. The labelled samples with codes were taken to IITA laboratories (International institutes of Tropical Agriculture) at Ibadan for the determination of alkali and heavy metal contaminants.

RESULTS

Table 2 shows that *Callinectes* spp has the highest nickel content (1.49), Lead (0.10), Cadmium (0.05). Zinc (1.63), Copper (0.54) and Sodium (21.44), while *Rhynchophorus phoenicis* has the lowest of this result except for sodium also *Macrobrachium vollenhovenii* has equal results with *Rhynchophorus phoenicis* in term of cadmium content and lowest in the sodium content in the table above.

DISCUSSION

Insects are important as source of nutrients, which ramify the whole classes of food. They are high in protein and contain much less fat than red meat such as beef. They are also good source of vitamins and minerals such as phosphorus and iron [9].

However, in the heavy metals analysis, *Macrobrachium* accumulates between 0.05-0.08 ppm of Pb, 0.02-0.05 of Cd, 0.56-0.88 of Zn and 0.15-0.20 of Cu compared with the analysis of Niger Delta counterparts by [13], lead was 2.47, sodium 0.04, zinc 14.1 and 8.5 for copper. The sharp differences between these values may be due to the high population level by petroleum products around Niger delta. The result is also very low compare to that from volta river in Ghana recorded by [12] which was thought to be caused by high Agro-chemical contaminants. *Callinectes* spp which have the highest values of heavy metals (1.49-Ni, 0.01-Pb, 0.07-Cd, 1.63-Zn and 0.54-Cu) it still very low compared to the study of heavy metal concentration by [17] in *Melapterurus eletricus* and *Chrisychytes nigrodigitatus* in Benin city of Nigeria and that of [13] in the Niger Delta of Nigeria, [12] in Ghana, (18) in Zimbabwe and [19] in Egypt.

These differences in accumulated value may be due to less agrochemical usage by farmers around the Epe lagoon and less industrial activities around Epe town as a whole, which are the major sources of heavy metal contaminants in water habitat. Despite the fact that *callinectes spp* in this analysis was gotten from a lagoon, the alkali metal was still low compare with most report including that of [20] and [21]. on different organisms in aquatic environment. This also can be due to the reason given above as metal content in water bodies are increased with industrial and agricultural activities.

CONCLUSION

Hypertensive patients can also be advised to embark on the consumption of arthropods as they have low sodium values. *Callinectes* spp has virtually the highest value of metal, which may be due to ecological and metabolic factor of the organism [22] or other factors. However, the whole value of heavy metals are acceptable for consumption of man adequate check should be maintained against the risk of this metals in these arthropods by checking industrial and agricultural activities around the Lagoon where they are harvested.

Arthropods especially insects are traditional food in most cultures as proposed by [23], there should be "industrialization" of edible insects. They can also be reared in large quantities and sold to the populace that regards them as delicacies. They even have a very high profitable biomass, by forming a whole new class of food made to order for low-input small business and small-farm production. Thus it is suggested that a rapid industrialization of arthropods both terrestrial and aquatic approach should be collectively embarked upon by both private and government sectors.

Government should encourage its use as food in Nigeria, because it will not only meet our growing nutritional needs, but also serve as a source of income and provide job opportunities for the populace. Conclusively, the alkali metal status of this arthropods especially *Callinectes* spp, *M. vollenhovenii* and *M. macrobranchium* must be checked from time to time in order to asses any significant increase in the trace metal level of these arthropods as human activities get sophisticated day by day especially in the era of technological advancement.

REFERENCES

1. Bodenheimer, F.S., 1951. Insect as human food, W. Junk, Pub., The Hague, pp: 352.
2. De foliart, G.R., 1991. Insect fatty acids; similar to those of poultry and fish in their degree of unsaturated but higher in the poly- unsaturated. Food Insects News Let., 4(1): 1-4.
3. Dreyer, J.J. and A.S. Wehmeyer, 1982. On the value of *Mopanie* worms Afr. J. Sci., 78: 33-35.
4. Quin, P.J., 1959. Food and feeding Habits of the pedi, Wit waters and University. Johannesburg, Republic of South Africa, pp: 278.
5. Muyay, T., 1981. Les Insects comme Aliments de P. Homme. Pubn. Ser. II Vol. 69 CEEBA, Bandundu, Zaire, pp: 177.
6. Chavunduka, D.M., 1975. Insect as the source of protein to the African Rhodesian. Sci. News, 9: 217-220
7. Perberton, R.W., 1988. The use of the Thai giant water bug. *Lethocerus indicus* (Hemiptera: Belostomatidae) as human food in California. Pa Pacif. Entomol., 64: 81-82.
8. Olivera, J.F.S., D.E. Carvalho, J.P de Sousa and M.M. Simao, 1976. The nutritional value of four species of insects consumed in Angola. Ecol. Food Nutr., 5: 91-97.
9. Anonymous, 2006. Lenntech water treatment & air purification organization. http://www.Lenntech.com/heavy_metal.htm.
10. Sherpard, 2002. Issue of the Autism Asperger's Digest, pp: 52.
11. Ajayi, S.O. and O. Osibanjo, 1981. Pollution studies in Nigerian rivers. ii, Water quality of Some Nigerian rivers. Environ. Pollut. (B), 2: 87-95.
12. Biney, C.A., 1991. The distributor of trace metals in the kpong headpond and lower volta river, Ghana. In perspectives in aquatic exotoxicology, edited by N.K. Shastree.delhi. India, Narendra Publ. House.
13. Kakulu, S.E., O. Osibanjo and S.O. Ajayi, 1987. Trace metal content of fish and shellfishes of the Niger Delta areas of Nigeria. Environ. Int., 13: 247-51.
14. Okoye, B.C.O., 1991. Heavy metals and organism in the Lagos lagoon. Inter. J. Environ. Stud, 37: 285-92.
15. Institute of Aquatic Biology (IOAB), 1990. Summary of Trace metal analysis WACAF/2 Phase1 (1985-89). Accra, Institute of Aquatic Biology, pp: 19.
16. Mbome, I.L., 1988. Heavy metals in marine organisms from Limbe and Douala, reported presented to second workshop of participants in the joint FAO/IOC/WHO/IAEA/UNEP project on the pollution in the marine environment of the west and central African region (WACAF/2-First Phase), Accra, Ghana, 1-17 June 1988. Paris, IOC of Unesco.
17. Obasohan, E.E., J.A.O. Oronsaye and E.E. Obano, 2006. Heavy metal concentrations in *Malapterurus electricus* and *Chrysichthys nigrodigitatus* from Ogba River in Benin City, Nigeria, African J. Biotechnol., 5(10): 974-982.
18. Greichus, Y., 1977. Insecticides, polychlorinated biphenyls and metals in African lake, Ecosystems. 1. Haertsbeespoort Dam, Transvaal and Voelwei Dam, Cape Province, Republic of South Africa. Ach. Enviro. Contam. Toxicol., 6: 371-83.

19. Saad, M.A.H., 1985. Influence of pollution on lake Mariut. Egypt. Rev. Int. Oceanogra. Med., 79(80): 33-77.
20. Trivedy, R.K., 2002. Pollution and biomonitoring of India Rivers Published by Enviro. Media. Karad, India.
21. Sahu, B.K. and D.S. Ratha, 1987. Factor analysis of geochemical data of marine sediments from the Thane creek area, Bombab, Proc. Nat. Sympo. Role of Earth Sciences in Environment. I.I.T Bombay, pp: 93-101.
22. Goyer, R.A., 1991. Toxic effects metals in; casarett and Doull's Toxicology; Basic science of poison. 4th edition, pp: 1033.
23. Conconi, J.O.R.E., 1982. Los insectos. comofuente de proteinaen el fururo. editorial limusa, Mexico, pp: 144.