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# Chemical composition of African black snails *(Archachatina marginata)* from three different habitats in Akwa Ibom State, Nigeria

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ABSTRACT

Samples of *Archachatina marginata* (African black snail) obtained from three different habitats, namely: high vegetational (HV) low vegetational (LV) and none vegetational (NV) areas in Akwa Ibom State of Nigeria were assayed for proximate composition, macro elemental content and anti-nutrient levels. The results showed significant variation ($\alpha$ =0.5) and indicated that all the samples, without regards to the habitat, were nutritive and promising source of protein, potassium, iron and calcium with negligible concentration of anti-nutrients. The variation in precentage crude protein is - HV (26.25) > LV (22.35) > NV (20.55), for potassium, (i) HV (K= 252.00) > LV (K= 210.50) > NV (K= 115.30) mg/100g, and calcium, LV (Ca = 68.30)> HV (Ca = 52.00)> NV (Ca = 48.50) mg/100g. The variation in phosphorus content was found to be similar to that of calcium while variation in iron was found to be similar to that of potassium. For sodium the variation is as follows between locations: - NV (90.20) > HV (83.50) ~ LV (82.30) mg/100g. Results of anti nutrient levels showed that (NV) snails had relatively higher levels of total oxalic acid and tannic acid, when compared with the other habitats. Hydrocyanic acid, ranged between 30.00mg/100g for NV snails to 36.10mg/100g for HV snails samples. These results are discussed in terms of available nutrients in the habitats and in relative to their dietary supplement on daily requirement. Results were compared with some lesser- known alternative sources of protein found in literature.

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## INTRODUCTION

*Archachantina marginata* is becoming highly priced delicacy and meat in many African menu. It is widely consumed in several prepared forms in southern Nigeria where they are prevalent. They are widespread in many continents as a result of human cultural migrations and are known to be adaptive to habitats where they find themselves. These habitats are capable of affecting them physically, chemically, in behaviour and otherwise [1].

Although, they are land pulmonate *gastropoda*, they are now known to be very nutritious human food [2] and are also believed to be of medicinal importance in the management of neuro-*vascular* diseased condition and high blood pressure (hypertension).

### *Physical Characteristics*

The African black snail has its shell reassembled in one piece and maybe planospinal or limphet in shape. It has a fleshy mucus-like body covered by the mantle. Its foot is only exposed when it moves, the foot viscera and tentacles aid this. During development, gastropods generally undergo torsion, which enables the mantle shell covering it to become twisted through 180° in relation to the head and foot such that the mantle cavity is placed anteriorly above the head. These characteristics are structurally and functionally homologous throughout the mollusca species. Two pseudo branched gills are retained in the African black snail. Its dark colour and long narrow shell of length about 200mm easily identify it.

A lot of studies have been carried out mainly on the breeding species of snails [2]. Most snails including African black snails become more sexually active and matured at the age of twenty-one months [2]. They breed more during rainy seasons of the year. The mode of reproduction is mainly by self-fertilization. They lay their eggs mainly in the second and third year.

The number of eggs laid varies from 37 to 300 per day and takes 10 to 30 days to develop. Most African black snails go into hibernation during the dry seasons with reduction in growth rate of snails during

this period [1,3]. Better growth have been reported for young black snails when they feed on cocoyam or cassava young leaves vis-a-vis other foliage [4]. Grains and maize chaff including pawpaw and carrot fruits have also been found to be some of the favorite food for snail breeding.

Onaca [5] and Mead [3] have reported the nutritional composition of the edible portion. Literature is equally replete with research findings on the nutritional content of different species of snail and results show that African black snails are rich in macro mineral elements like calcium (2130± 5.0) mg/100g and iron (40.10±2.5) mg/100g [6,7]. They have also found to be the best source of essential amino acids when compared with some seafood like crayfish and periwinkle.

However, snails are carriers of parasites whose diseases can be transmitted to human who eat them raw or half-cooked. Recently both fresh and terrestrial black snail has been implicated as vectors in the transmission of flukes (*trematioda)* that infect both humans and animals.

Not much work has been done on the effect of breeding environment on the chemical composition of snails hence the need for this research work.

## EXPERIMENTAL

Fresh samples of African black snails were randomly collected from three different vegetational habitats viz: (i) High vegetational (HV) thick forest around Ikot Abasi L.G.A of Akwa Ibom State, Nigeria, (ii) Low vegetational (LV) savanna bush areas around Nung Oku-Ibesikpo L.G.A., community farmland and (iii) Non-vegetational habitat which were mainly grasslands of Uyo capital city of Akwa Ibom State.

The samples were grouped according to their natural habitats and thoroughly washed with distilled water before the edible portion was removed from each shell, with the help of a nickel metal hook. The edible portion was washed with citrus lime to eliminate the slippery slime. Using a strainer, water was drained out of the samples and then dried in an oven at 60-70°C to a constant weight. Known weights of fresh representative samples from each group were used to determine the moisture content, before all the samples were ground into powdery forms and stored in airtight containers for laboratory analysis.

### *Determination of chemical composition*

#### *Crude proteins*

Semi-micro Kjeldah method was adapted as detailed in AOAC [8]. 1.0g of each was digested 50mL conc. $H_2SO_4$ containing mixed Kjeldah *catalyst* ($CuSO_4$ .$5H_2O$ & $Na_2SO_4$ 1:5) in a 500mL Kjeldah digestion flask. After satisfactory digestion on a hot plate for one hour, the digest was allow to cool and then quantitatively transferred into a 100mL standard flask and was made up to the mark with distilled water. 25mL portion of this solution was transfered into a micro Kjeldah Markham distillation apparatus and treated with 100mL - 40% NaOH solution, then heated on the same hot plate. The $NH_3$ evolved was steam-distilled into a 100mL conical flask containing 10mL of 5% boric acid solution. Two drops of double indicator was then added and was titrated with 0.1M HCl solution to purple-pink end-point. Replicate titration was carried on all samples for each habitat as reported here.

#### *Ash Content*

The percentage ash per dry matter was obtained as percentage mass of residue after organic matter of the sample had been incinerated at 500°C in a furnace for 24 hours, to a constant mass. Mean of replicate determinations is reported here for each sample group. Moisture content crude fibre content and carbohydrate were determined by method recommended by AOAC [8] and Krishna and Ranjhan [9].

### *Determination of anti – nutrients*

#### *Total oxalate* [11]

2.5g of each sample was extracted with dilute HCl + $H_2O$ (1:1). 5mL of concentrated ammonia was added to neutralize the acid and then precipitated with 5% $CaCl_2$ as calcium oxalate. This was allowed to stand overnight. The precipitate was washed with 25% $H_2SO_4$ and dissolved in water (90°C) before titrating with 0.05M $KMnO_4$ to determine the oxalate.

#### *Hydrocyanic acid* (HCN)

50g of each sample was steam-distilled into 5mL of NaOH (2.5% w/v). About 70mL was then diluted with distilled water and 5% of 20mL KI was added,

then titrated to a permanent turbidity end-point with 0.02M $AgNO_3$.

*Tannin*

Tannin was determined in each sample spectrophotometrically, using the procedure described by Burn [12]. Absorbances of coloured solution developed with vanillin in HCl were recorded at λmax = 550nm using spectronic - 20.

*Determination of Mineral Elements*

Iron and calcium were determined using an Unicam-919 Solar Atomic Absorption Spectrometer (AAS) with dual capacity of atomic absorption and flame envision characteristics. For phosphorus, a Unicam of 200 series/visible double beam spectrophotometer with monitor, was used to determine the element as coloured vanadomolybdate complex at 400nm wavelength.

Sodium and potassium were determined by flame emission photometry as described in A.O.A.C. Following the procedure in manufacture's guide manual, UNICAM SP. 900.

## RESULTS AND DISCUSSION

Results of chemical composition of African black snails, *Archachatina marginata, sampled* from three different ecological habitats labeled HV, LV and NV are presented on Table 1. The result reveals that snail samples from high vegetational environment (HV) have higher crude protein value (26.25%) when compared with those from low vegetational habitat (22.35%). Snails from Non-vegetational (NV) habitat show the least value of 20.55%. This observation may be explained in terms of availability of plant product serving as food for the snails habituating each location. It seems from this result that there is a positive correlation between food abundance in the habitat and the crude protein in the organism. Secondly, African black snails in the thick forest habitat (HV) are less affected by human activities and direct heats from the sun. They have better hideouts and resting tunnels even during dry seasons. This relatively conducive environment perhaps enhances metabolism of plant products and eventual protein accumulation in the mollusca.

Nigerians who eat African black snails as cheap alternative source of protein, unconsciously prefer snails from forest areas to those from grasslands. This preference is now borne out by the results obtained in this work, because high protein meat are usually more palatable than low protein ones.

Snails generally have lower crude fibre content when compared to fish and crabs. Crude fibre in meals aids in digestion and peristalsis. Motrram [12] has documented that rate of absorption of glucose and fat is significantly reduced by high crude fibre content in food. The result obtained in this work is as follows, NV (4.98) > HV (3.70) >LV (3.20). The reasons for this could not deciphered.

Moisture content is high in the African black snail samples studied here. The values for samples collected from high vegetational habitat (HV = 64.00%) were found to be higher than those for low vegetational habitat (LV =56.30%), and non-vegetational habitat (NV=43.32%). However these relatively high moisture content adumbrates poor safe keeping of the samples because most food items with moisture content higher than 25% are known to deteriorate after three to five days. The % carbohydrate values for all the samples as listed in Table 1 suggests that snails can also serve as supplementary source of carbohydrate. The result is similar to that of crude protein for each sample type.

**Table 1: Proximate composition of *Archachatina marginata* obtained from the three different sources**

| Parameter | HV | LV | NV |
|---|---|---|---|
| Crude protein (% ) | 26.25 | 22.35 | 20.55 |
| Crude fibre (% ) | 3.70 | 3.20 | 4.98 |
| Ash content (% ) | 75.33 | 73.20 | 70.58 |
| Carbohydrate (% ) | 63.55 | 60.55 | 52.00 |
| Moisture (% ) | 64.10 | 54.30 | 43.32 |
| HCN (mg/100g) | 36.10 | 32.00 | 30.00 |
| Phytic acid (mg/100g) | 140.30 | 100.70 | 95.50 |
| Tannic acid (mg/100g) | 190.20 | 210.10 | 312.00 |
| Total oxalate (mg/100g) | 230.05 | 350.00 | 469.03 |
| Potassium (mg/100g) | 252.0 | 210.5 | 115.3 |
| Calcium (mg/100g) | 52.0 | 63.8 | 48.5 |
| Iron (mg/100g) | 21.15 | 19.8 | 15.2 |
| Phosphorous (mg/100g) | 28.3 | 36.5 | 20.2 |
| Sodium (mg/100g) | 83.5 | 83.3 | 90.2 |

Concentrations were determined in dry weight of samples

The high value of both K and Ca is a reliable index of mineral content. The result show this order, HV (75.33%) > LV (73.20%) > NV (70.58%). The implication here is that African black snails, no matter where they are picked from are rich sources of mineral elements (Table 1).

Anti-nutrients include hydrocyanic acid, phytic acid, tannic acid and total oxalate. The level of these toxicants is below tolerable limit (TL) therefore, poses no danger of anti-nutrient intoxication for those who

eat them. Hydrocyanic acid inhibits the respiratory chain at the level of cytochrome oxidase [14]. The variation of HCN content in the three sample type is, HV (36.10± 0.15) > LV (32.00 ± 0.01) >NV (30.00 ± 0.15) mg/100g. The same observation was obtained for phytic acid; while tannin and oxalate show an opposite variation for NV having the highest value of 312.00 ± 0.01 and 189.03 ± 0.10 for tannin acid and total oxalate respectively. The high level of oxalate recorded may be attributed to prevalence of cocoyam in the urban dwellings. These leaves are rich in oxalate while cassava leaves are rich in HCN. Phytic acid are known to reduce metabolic processes within the body cells [15]. Tannins sequester protein moiety make them available to the body. Soluble oxalate can deplete available calcium by precipitating them in the form of an insoluble oxalate out of the body cell.

Results of mineral element composition showed that snails are rich sources of Ca, Fe, P, Na and K, no matter the habitat from which they are obtained. The observed variation for some of the elements is such that for potassium and iron, HV was found to be higher than LV, which is in turn higher than NV, whereas for sodium the reverse is the case. Snails from low vegetation habitat record the highest value of phosphorus and calcium. This result cannot be explicitly accounted for. However, the high value of calcium content in Non-vegetation (NV) site might be due to the fact that in urban areas there are more calcium related materials like cement, egg shells, etc the snails may breed on. HV and LV have relatively lower calcium values. The results generally show that African black snails (*Archachatina marginata*) are safe and nutritious for meat and good source of mineral elements especially calcium.

REFERENCES


1. J. K.M. Hodasi (1984). *W. Africa Rev.,* **52***:* 24-35.
2. G. A. Jollan (1959). *Feeds and Feeding.* Reston Pub. Company; Virginia U.S.A.
3. R. A. Mead (1978). *Anatomical Studies in the African Achatinidae* – A Preliminary Report. Malacologia 18 p.130.
4. S. S. Ajayi, O. O. Tewe, C. Moriaty, and M. O. Awesu (1978). *African wall. Journal.* **16**, 85-95.
5. T. R. Onaca (1971). *The Giant African Snail as a Source of Food.* London Institute of Biology. PP 50-61.
6. A.U. Mba (1980). *Nig. J. of Nutr. Sci.*, **6**, 142-147.
7. I .B Umoh and O. Bassir (1977). *Food Chem.*, **2** 315-400.
8. A.O.A.C - *Association of Official Analytical Chemist (*1975) & (1984). Official Method of Analysis 12th and 14th Ed. William Harwite & Sydney Williams (eds.). Washington D.C, U.S.A.
9. Krishna, G. and Ranjhan S. K., *Laboratory Manual for Nutrition Research.* Vikas Publishing House PVT LTD India PP 108-113.
10. W. B. Dye, (1956) . *J. Hort. Sci.*, **4**, 55-80.
11. O. U. Eka, (1977). *West African Journal of Biological and applied Chemistry* **20** (3), 24 – 30.
12. R. E. Burn (1971). *Agronomy Journal*, **16**, 511-519.
13. R. F. Motrram (1979). *Human Nutrition 3rd Ed.* Edward Amold Pub. Ltd, Great Britain. Pp 58-59, 152.
14. O. I. Oke, (1978). Lesser-Known Oil Seeds Chemical Composition Nutrition Report Int. 17: 293 – 297.
15. A. K. Goodman, (1998). *Giant African Black Snails.* AQIS Public Relations; AQIS Home PP 1-10, 20-35.