Comparative Proximate and Selected Mineral Analysis of Two Edible Land Snail Species (*Archachatina Marginata and Archatina Fulica*)

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Received:- 01 May 2024/ Revised:- 09 May 2024/ Accepted:- 17 May 2024/ Published: 31-05-2024

Abstract— *Comparative proximate and selected mineral analysis of two edible land snails (Archachatina Marginata, Achatina fulica were carried out using standard methods. Proximate analysis of the snail meat revealed that that moisture was slightly higher in A. marginata (58.90+0.01^a) and least in A. fulica (58.58+0.01^a) which was not significantly different from each other. The fat content of A. marginata (8.72+0.01^a) was slightly low and slight high in A. fulica (8.920.01^a) which is also not significant. The value for the ash was not significantly different in A. marginata (2.31+0.01^a) when compared to A. fulica (2.71+0.01^a) which was least. The protein content of A. marginata (26.62+0.02^a) was lower compared to A. fulica (27.40+0.02^a) which is also not significant. While, the carbohydrate content of A. marginata (3.45+0.01^a) was higher compared to A. fulica (3.250.01^a) meat which is also not significant. The result of the mineral analysis showed that A. marginata recorded highest value (mg/100 g) in Ca (1.77±0.07), Se (2.26± 0.14), Pb (2.73±2.81) and Zn (22.85± 0.15). While A. fulica the least values of 1.6±0.02, 1.86±0.08, 0.72±0.03 and 22.08±0.25 respectively. The values across species for all the minerals analyzed were not significantly different ($p<0.05$) from one another. The result indicates that the two edible land snail species (A. marginata and A. fulica) are nutritionally rich in protein and mineral nutrients which can be obtained at minimal cost. Hence, consumption for both the young and old should be encouraged as an alternative source of essential nutrients.*

Keywords— Proximate, Mineral, Land Snails, Protein.

I. INTRODUCTION

Snails are members of mullusca phylum, like slugs, oysters, squids and cuttle-fish; they live widely spread across fresh water, seas and land. Land based species prefer moist areas. They can be seen commonly through spring and autumn where rainfall is abundant (Robert, 2009).

African giant land snails (*Achatina fulica*) and edible garden snails (*Helix aspersa*) are among the various species of snails in the Southern and other parts of Guinea savannah in Nigeria where the atmospheric weather conditions and vegetation are favorable for their survival (odaibo, 1997). These creatures enjoy moist environment and are found easily at night. Snails generally exhibit sluggish movement over short distances which are dependent upon the temperature, food and nature of the soil (Ebenso, 2002; Ebenso and Okafor, 2002; Ebenso, 2003B). During their movement these invertebrates produce unpleasant odor via deposition of their saliva and feaces on the plants which distastes man and even herbivores from feeding on these contaminated plants (Ahmed and Nabil, 2012).

Snail meat has been reported to be highly nutritious because it is rich in the essential amino acids, vitamins and minerals but low in fats and cholesterol. It is also reported that the land snail meat is very rich in protein which could be as high as 14.52% (Yusuf and Oseni, 2004). Other values like 12.87% and 12.2 g/100g of protein have been reported for the garden and apple snails respectively. However, the nutritional composition of snail might vary depending on its feeding habits, species and sexual conditions.

There are different breed of edible land nails found in Nigeria. The two giant land snails common to Nigeria are *Archachatina marginata* and *Archachatina archachatina*. Archachatina marginata has definite shell coloration and it is wider at the posterior end compared to others. The foot is usually dark brown in colour. It is the most common breed found in western Nigeria. *A. achatina* has a brown shell with conspicuous zigzag streaks and a narrow apex. The foot is grey in colour. *A. fulica* is of small size and the fleshy part could be whitish o dark brown. It as low economic value compared to the two giant land snails. It is also known as garden snails. The mineral composition of snail meat varies also depending on their diet, species and environment where they are found. However, therefore, this study focused on the comparative proximate composition and selected mineral analyses of *Archatina fulica and Achatina marginata*.

II. MATERIALS AND METHODS

2.1 Collection of Samples:

Two different species of life snails *Archatina marginata* and *archatina fulica* were purchased from a snail farm in Afikpo, Afikpo North Local government Area of Ebonyi state. A total of ten (10) snails, five (5) each of *Archatina marginata* and *archatina fulica* species was used for this study. The Snails was identified and authenticated by a Zoologist, in Science Laboratory Technology Department, Akanu Ibiam Federal Polytechnic Unwana.

2.2 Preparation of sample:

The giant African Land Snails was washed with clean water to remove dirt and dust particles on the shells. The shells were knocked open at the apex. The inner content (i.e. fleshy body) of the snails was separated from the shells by a mechanical means involving the use of a spirally coiled rod inserted to remove the fleshy body. The fleshy body was oven dried at 90^{o}C. It was crushed and sieved using 0.4mm mesh (Gary, 2004). This was used for the digestion and proximate determinations

2.3 Digestion of snail sample:

One gram of the sample was weight into a 200cm Kjeldehl mask and 20ml of digestion mixture (1:1 mixture of 8M HCl: 8 $MHNO_3$) was added. The mixture was allowed to stand for 24 hours before digestion was done under reflux for 45 minutes. The sample was heated a little to remove the brown fumes of NO_2. The solution was then allowed to cool and made up to 50cm3 with distilled water and then stored in a treated polythene bottle for AAS analysis (Onianwa, 2001).

2.4 Proximate Analysis:

The moisture content was determined according to standard methods of AOAC (2010). Ash determination was carried out according to the method described in AOAC (2010). Crude protein was determined using the Kjeldahl methods of AOAC (2010). The fat content was determined using soxhlet extraction method according to AOAC (2010). The carbohydrate was done by difference according to oyenuga 1968, as follows % Carbohydrates = 100- (% moisture+ %fat+ %ash+ %protein+ crude fibre).

2.5 Mineral Composition Determination:

Major element such as Zn, Se, Cu, Cr, Cd was carried out using Atomic Absorption Spectrophotometer (AAS) as previously done by Usunobun and Okolie (2015).

A 0.5 g mashed sample was weighed into a 100ml pyrex connicall flask. 5ml of thee wet acid digestion reagent (H_2SO_4-selenium-salicylic acid) wsa added and allowed to stand at ambient temperature for about 16 hours. The sample was placed on a digestion clock, and heated at 20^{o}C for about two hours. The sample was removed from the block and about 5ml of conc perchloric acid added then placed back on the digestion stand, temperature rained to about 80^{o}C-150^{o}C. The digestion continued until a profuse white perchloric fumes emerged showing a clear digest indicating the completion of the digestion. The sample was removed from the hot plate, allowed to cool and made up in a 100ml volumetric flask with distilled water. The digest was used for the determination of Zn, Se, Cu, Cr and Cd using Atomic Absorption Spectrophotometer (AAS).

2.6 Statistical Analysis:

All the values obtained from proximate and selected mineral analysis of the two edible land snail species was statistically analyzed using one factor randomized design ANOVA as described by Mahoney (1986).

III. RESULTS

TABLE 1
THE RESULT OF THE PROXIMATE COMPOSITION OF THE SNAIL

Proximate compounds (%)	***A. marginata***	***A. fulica***
Moisture	58.90+0.01	58.58+0.01
Fat	8.72+0.01	8.920.01
Ash	2.31+0.01	2.71+0.01
Protein	26.62+0.02	27.40+0.02
Carbohydrate	3.45+0.01	3.250.01

Values are expressed as mean ± standard deviation of the triplicates. [a,b] Means along the same row with different superscripts are significantly different (p<0.05).

As shown in table 1, above, the proximate composition of the snail meat revealed that moisture was slightly higher in *A. marginata* (58.90+0.01) and least in *A. fulica* (58.58+0.01) without significance. The fat content of *A. marginata* (8.72+0.01) was slightly lower without significance than *A. fulica* (8.920.01). The value for the ash was slightly lower in *A. marginata* (2.31+0.01) when compared to *A. fulica* (2.71+0.01). The protein content of *A. marginata* (26.62+0.02) was lower compared to *A. fulica* (27.40+0.02) which is also not significant. While, the carbohydrate content of *A. marginata* (3.45+0.01) was higher compared to *A. fulica* (3.25+0.01) meat which is also not significant.

TABLE 2
THE RESULT OF THE SELECTED MINERAL ANALYSIS IN THE SNAILS

Mineral (Mg/100g)	***Archachatina maarginata***	***Archatina fulica***
Cu	6.27±0.18	6.58±0.20
Ca	1.77±0.07	1.6±0.02
Se	2.26± 0.14	1.86±0.08
Pb	0.73±0.08	0.72±0.03
Cd	0.01±0.00	0.01±0.00
Zn	22.85± 0.15	22.08±0.25

Values are expressed as mean ± standard deviation of the triplicates. [a,b] Means along the same row with different superscripts are significantly different (p<0.05).

The results of the mineral analysis showed that *A. marginata* recorded highest value (mg/100 g) in Ca (1.77±0.07), Se (2.26± 0.14), Pb (2.73±2.81) and Zn (22.85± 0.15). While A. fulica the least values of 1.6±0.02, 1.86±0.08, 0.72±0.03 and 22.08±0.25 respectively. The values across species for all the minerals analyzed were not significantly different ($p<0.05$) from one another

IV. DISCUSSION

It indicates that *A. marginata* contains crude protein of 26.62% which is slightly lower than that of *A. fulica* 27.40%. However, the crude protein value of both *A. marginata* and *A. fulica* is higher than other livestock meat like mutton, duck and chicken which have protein contents of 16.9, 18.6 and 20.5% respectively (Ogungbenle, and Omowole, 2012). The fat (8.72%) content obtained from *A. marginata* is also lower than 8.92% of *A. fulica*. The fat content obtained from *A. marginata* and *A. fulica* is also lower than 9.6% for egg, 21.4% for mutton and 23.0% for duck products respectively (Babalola and Akinsoyinu, 2009). However, the present result is higher than that of periwinkle (1.32%) and *Oryctes rhinoceros* larva (0.55 – 0.68%) (Okaraonye and Ikewuchi, 2009). The low fat content makes *A. marginata* and *A. fulica* meat an ideal diet for hypertensive patients and those that have fat related diseases like arteriosclerosis (Ugonna et al., 2020). The moisture content of *A. marginata* (58.90%)

is slightly higher than that of *A. fulica* (58.58%). These values were significantly lower than the values (73.67% and 79.28%), reported by Ogungbenle and Omowole (2012) for *A. marginata* and *A. fulica* respectively and also lower than the value reported by Wosu (2003) and Eneji *et al*., (2008) for snail meat. The ash content which is an indication of the rich minerals contents that are beneficial to man of *A. marginata* 2.31% is higher than 2.71% of *A. fulica*, however, this is significantly lower than that of periwinkle (9.56%) and *Oryctes rhinoceros* larva (12.70- 15.25%) (Okaraonye and Ikewuchi, 2009). The Carbohydrate content of *A. marginata* (3.45%) is slightly higher than 3.25% of *A. fulica*. This value is very low when compare to the values of 24.81 – 30.95% reported by Soniran *et al*. (2013) for Snail meat. Hence Snail meat (*A. marginata* and *A. fulica*) could be said to be a poor source of carbohydrate.

The result of the selected Minerals analysis of the two edible snails is shown in table 4.2 the result indicate that Snails meat are rich in calcium. A value of 1.77±0.07mg/ 100 g gotten for AM is a pointer to this. Calcium is involved in calcification of bones and teeth. Its shortage therefore can affect the structure of bones which become weakened. Calcium ions are needed for blood clotting and successful functioning of nerves and muscles (Fox and Cameron, 1980). The high content of calcium in the two species of the edible land snail investigated suggests that consumption of snail can increase the calcium in the body and contribute tremendously to the blood clotting process. Zinc is needed in the body to help the pancreas produce insulin, to allow insulin to work more effectively and to protect insulin receptors on cells Okaka and Okaka, 2001). Therefore the presence of zinc in the snail meat could mean that it can play valuable roles in the management of diabetes, which results from insulin malfunction. Magnesium ions are known hormone activators in type 2 diabetes their presence in the studied plants can be beneficial in managing this disease. This results is also in agreement with other previous work of Uboh et al. (2010) and Fagbuaro et al. (2006), who reported that the concentration of calcium and zinc were consistently high in different species of snail. Also, the mineral composition of the two species of the edible land snail can compare favourably with the mineral contents of some lean domestic livestock meats (Aganga *et al.,* 2003). Copper is an important essential elements that helps in interconversion of the major neurotransmitters, dopamine, noradrenaline, and adrenaline, and in pigment production. Zinc-Cu interaction has shown hypothesis of ischemic heart disease, which proposes that decreased Cu intake with excessive Zn may play an etiologic role in cardiac deaths in both animals and man (Akan *et al.,* 2010; Davies *et al.,* 2013). Copper deficiency results in kinky and steely hair syndrome in humans and abnormal wool in sheep (Ugonna *et al.,* 2020). Cadmium is considered as the most non-essential and highly toxic heavy metal. It is the heavy metal which is situated in between of zinc and mercury in the periodic table, having similar behavior to zinc. It is usually found as the impurity in zinc or lead deposits and therefore, it is primarily produced as the by-product of zinc or lead smelting. These important minerals found in this study shows that snail is a good source of minerals which are vital for healthy growth of the body, helping muscles, nerves and proper metabolism of body, therefore should be incorporated in the diets of man and its animals particularly the growing ones.

Cadmium possess various usuful applications such as in electroplating, batteries, plastics, paint pigments, television screens, cosmetics, galvanizing steel and metal coatings. It is also known to enter naturally through volcanic eruptions, river transport, weathering and human activities like, smelting, mining, incineration wastes and manufacturing of fertilizers. Primary exposure sources of cadmium include food and tobacco smoking. The crops are able to accumulate the cadmium levels due to the high rates of soil-to-plant transfer via cation exchange and intracellular transport. Therefore, consumption of staple foods such as rice, wheat and other leafy vegetables significantly contribute to the human cadmium exposure. Also, consumption of sea foods such as fishes, oysters, molluscs, crustaceans also lead to the human exposure (Jhumi and Pammi, 2017). Chronic exposure to the metal can lead to kidney disorders, anemia, emphysema, anosmia (loss of sense and smell), cardiovascular diseases, renal problems, and hypertension (Akan *et al.,* 2010; Davies *et al.,* 2013).Therefore, the low Cd level in the two species of the edible land snail can be consider to b save for consumption. Lead, like cadmium has been reported not to have any known function in human biochemistry or physiology, and do not occur naturally in living organisms (Collin et al., 2018). Hence dietary intakes of these metals, even at very low concentrations can be very harmful because they bioaccumulate. From our finding, *A. marginata* accumulate more lead (0.73±0.08mg/100g) than *A. fulica* (0.72±0.03mg/100g) this shows that, consumption of *A. fulica* meat is relatively safer than *A. marginata* in terms of lead toxicity. In conclusion, from the present study, the two species of snail (*A. marginata* and *A. fulica*) are nutritionally rich in protein and mineral nutrients which can be obtained at minimal cost, considering the high cost and associated high fat content risk of beef, poultry and other higher meat proteins. Hence, consumption of the two species of giant land snails should be encouraged for both the young and old, as an alternative source of essential nutrients at a lower cost.

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