



**COMPARATIVE STUDY OF PROXIMATE COMPOSITION OF PERIWINKLE  
(*TYMPANOTONUS FUSCATUS*) AND LAND SNAIL (*ARCHACHATINA MARGINATA*)**

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**Abstract**

Land snail (*Archachatina marginata*) and periwinkle (*Tympanotonus fuscatus*), are mollusk rich in protein, low in fat and high in minerals. They serve as meat especially in West Africa. This study comparatively assessed the proximate composition of land snail and periwinkle. Samples were bought in a popular market in Calabar and were processed and analyzed in the department of biochemistry laboratory, UNICROSS. Data from laboratory investigation were subjected to statistical interpretation using the independent T-test at a confidence limit of ( $P < 0.05$ ). Result showed moisture to be  $5.60 \pm 0.3$  (periwinkle) and  $7.20 \pm 0.13$  (land snail), ash  $36.0 \pm 0.11$  (periwinkle) and  $14.50 \pm 0.02$  (land snail), crude fiber  $33.0 \pm 0.09$  (periwinkle) and  $50.00 \pm 0.41$  (Land snail), crude lipid  $3.20 \pm 0.14$  (periwinkle) and  $3.60 \pm 0.36$  (land snail). Crude protein  $9.62 \pm 0.05$  (Periwinkle) and  $10.50 \pm 0.26$  (land snail), carbohydrate  $12.80 \pm 0.17$  (periwinkle) and  $14.20 \pm 0.33$  (land snail). The percentage moisture, crude fiber, crude lipid, crude protein and carbohydrate were significantly higher in land snail than in periwinkle suggesting that land snail has high nutritional value than periwinkle. It was recommended that meat from mollusk should be encourage in our diet because of its high protein content, low fat, high mineral and fiber content hence, ameliorating conditions such as hypercholesterolemia, diabetes mellitus, high blood pressure.

**Keywords:** Land snail (*Archachatina marginata*), periwinkle (*Tympanotonus fuscatus*), Poximae composition

**1.0 Introduction**

*Archachatina marginata* var *saturalis* (African Giant Snail) is a type of invertebrate that belongs to the phylum Mollusca. The name "mollusca" comes from the Latin word *mollis*, meaning soft (McFadden and Keeton, 2001). These African giant land snails, classified as gastropods, are the largest mollusks.

Mollusks have successfully adapted to a variety of habitats, mainly aquatic, with some species found in shallow waters or intertidal zones, where they burrow into mud for shelter (Jamabo and Chinda, 2010). According to Maikano, (2015), mollusks are triploblastic, coelomate, mostly bilaterally symmetrical, and have a body cavity filled

with haemocoel, with soft, unsegmented bodies. In Nigeria, their habitat spans from the dense tropical forests in the south to riparian forests in the Guinea savannah (Odaibo, 2003). *A. marginata var saturalis* is native to Nigeria but is now found across Africa and even in the Pacific Islands due to trade (Olaleye, 2013). These snails are nocturnal and primarily feed during the night, early morning, or during cooler weather. Their activity and feeding rates vary with the surrounding temperature. In parts of Nigeria and Africa, their meat is a non-traditional source of protein (Fagbuaro *et al.*, 2006).

*Tympanotonus fuscatus*, also known as the West African Mud Creeper or tropical periwinkle, is a snail species that lives in brackish waters and belongs to the family Potamididae (Appleton *et al.*, 2009). It is the only living species of its genus *Tympanotonus* (Reid *et al.*, 2008), with shell sizes ranging between 35 and 100 millimeters. These marine mollusks inhabit mangroves, lagoons, and estuaries and are represented by the genera *Tympanotonus* and *Pachymelania*. *T. fuscatus* thrives in brackish waters rich in organic matter and minerals (Ogogo, 2004). This species has two varieties: *Tympanotonus fuscatus var radula*, with spiky shells, and *Tympanotonus fuscatus var ovum*, with smooth shells. Studies suggest that both varieties can coexist within the same environment, but one usually dominates.

Mba (2002), states that snails offer higher protein content and chemical scores than eggs. Snail meat is a common part of the diet in Nigeria's forest regions (Agbogidi and Okonta, 2011), where it is considered a

delicacy known as "Congo meat." Its protein content (20.7%) surpasses that of more common livestock (Malik *et al.*, 2011). Snail meat is also rich in iron (Agbogidi *et al.*, 2008), potassium, phosphorus, essential amino acids, and vitamins C and B complex (Baba and Adeleke, 2006; Okpeze *et al.*, 2007), while being low in fat (Cobbinah *et al.*, 2008). *Archachatina marginata* is recognized for its high-quality protein and low-fat content, making it a good source of iron (Obande *et al.*, 2013).

Besides its nutritional benefits, mollusk meat is known for its medicinal properties (Abere and Lammed, 2008). Due to its low cholesterol levels, snail meat is used in the treatment of arteriosclerosis and other heart-related conditions (Abere and Lammed, 2008). In Ghana, the bluish liquid obtained from the snail's body is believed to support infant development (Cobbinah *et al.*, 2008). As people become more aware of the health risks linked to red meat consumption, such as high cholesterol leading to heart disease, there is a growing interest in alternative low-cholesterol protein sources like snails. This study seeks to provide a comparative analysis of the proximate composition of periwinkle (*Tympanotonus fuscatus*) and land snail, (*Archachatina marginata*) thereby adding to the body of knowledge on the nutritional profiles of edible mollusks and potentially informing consumers and the food industry.

## 2.0 Materials and methods

### 2.1 Sampling and sample preparation

The periwinkle (*Tympanotonus fuscatus*) and land snail (*Archachatina marginata*) samples used for the analysis were obtained

from a major market (Watt market) in Calabar metropolis. The purchased samples were taken to the department of biochemistry Laboratory University of Cross River Calabar, Nigeria.

The purchased periwinkle and land snail were deshelled rinsed with distilled water and dried in an oven at a temperature of 40<sup>0</sup>c for 24hrs. The dried samples were homogenized using acid proof ceramic mortar and pestle and were stored in an air tight container prior to analysis.

### 2.2 Proximate composition

The proximate composition was determined according to the methods outlined by the Association of Official Analytical Chemists (AOAC, 2000). The following parameters were analyzed:

$$\text{Percentage moisture} = \frac{w_2 - w_3}{w_2 - w_1} \times 100$$

Where w<sub>1</sub>= initial weight of crucible, w<sub>2</sub>= weight of crucible + sample, w<sub>3</sub>= final weight of crucible + sample.

### 2.4 Ash content determination

The crucible for ash determination was ignited at 55<sup>0</sup>c for about 24 hours and was allowed to cool before the weight was taken. 2g of the sample was weighed into the crucible and placed in a hot oven of about 100<sup>0</sup>c for 24 hours after which it was transferred to a muffle furnace and the

### 2.3 Moisture content

Moisture content was determined using the air oven method. The moisture dish was first, weighed and recorded. About 10g of the sample was weighed into the crucible. The sample was placed in an oven and heated at a temperature of 105<sup>0</sup>c for 2 hours until a constant weight is obtained. After 2 hours the sample was removed from the oven and transferred to a desiccator where it was cooled before the weight was taken. Thereafter, the sample was reheated for 1 hour until a constant weight was achieved. The moisture content was calculated by using the formular:

temperature increased stepwise at 550<sup>0</sup>c ± 5<sup>0</sup>c. The temperature was maintained for 8 hours until the sample turned white. The percentage ash content was calculated using the formular

$$\text{Percentage Ash Content} = \frac{\text{weight of ash}}{\text{Weight of sample}} \times 100$$

### 2.5 Crude protein determination

**REAGENT:** Concentrated sulphuric acid, mixed indicator (a) bromocresol green

(0.1% in 95% alcohol) and (b) methyl red (0.1 in 95% alcohol) mix 10ml of a with 2ml of b, boric acid solution (2%), sodium

hydroxide (40%), digestion mixture: standard hydrochloric acid (0.1N)

## 2.6 Procedure:

**Digestion:** 1g of homogenized sample was weighed into clean and dry digestion flask taking care to see that no sample particles adhere to the sides of the flask. This was followed by adding 20ml of conc sulphuric acid and was gently mixed. 10g of anhydrous sodium sulphate and 1g of copper sulphate was mixed together and 3g of this was introduced into the flask. Also anti-bumping chips were added into the mixture. The sodium sulphate and copper sulphate mixture acted as the kjeldahl catalyst. The entire mixture was gently boiled in the kjeldahl flask in a fume cupboard until charred particles disappear and clear green solution was obtained. The digested sample was allowed to cool before distilled water was added. The digest was carefully shaken upon the addition of distilled water since the reaction is exothermic and after the digest has attained room temperature, it was transferred into a 100ml volumetric flask. The digestion flask was washed several times with small portion of distilled water and the washings were transferred into the same volumetric flask. The mixture was shaken carefully and the volume was made up to the mark and shaken again in order to achieve uniform concentration.

**Distillation and titration:** 10ml of 2% boric acid was measured into a 250ml beaker flask and 3 drops of mixed indicator was added. The flask was placed under the condenser ensuring that the end of the condenser is dipped into the boric acid solution. 30ml of 40% NaOH was added to the 10ml of the digest in the distilling portion. The heating

system was switched on and the mixture heated for 25 minutes. The distillate was titrated with 0.1N HCL until the end point (light pink) was achieved.

## Calculation:

$$\%N_2 = \frac{\text{Titre} \times 0.00014 \times 100}{\text{Weight of sample}}$$

$$\% \text{ Protein} = \% \text{ nitrogen} \times 6.25$$

## 2.7 Crude fat content

This was carried out by gravimetric method. 10g sample was weighed into a thimble and apparatus set up. The lipid contained in the dry sample was exhaustively extracted with organic solvent (petroleum ether) for 3 hours. The organic solvent was distilled off and the flask re-weighed. The percentage lipid was calculated thus:

$$\% \text{Lipid} = \frac{\text{weight of lipid}}{\text{weight of sample}} \times 100$$

## 2.8 Crude fiber

**Reagent:** H<sub>2</sub>SO<sub>4</sub>, KOH, N-Octanol as an antifoam and anhydrous acetone.

**Procedure:** 2g of the homogenized sample was weighed into a crucible and H<sub>2</sub>SO<sub>4</sub> was added up to the 150ml notch after pre-heating by the hot plate in order to reduce the time required for boiling. This was followed by adding 3 drops of n-octanol as an antifoam agent. The mixture was boiled for 30 minutes and connected to a vacuum for draining H<sub>2</sub>SO<sub>4</sub>. The residue was washed three times with de-ionized water. After draining the last wash, 150ml of pre-heated KOH and 5 drops of antifoam was

added. It was also boiled for 30 minutes after which it was filtered and washed as described above. The last washing with cold de-ionized water was aimed to cool the crucible and then the crucible content was washed three times with 25ml of acetone. The residues were transferred to an oven and dried at 105<sup>0</sup>C cooled in a desiccator and the weight taken (w<sub>1</sub>). The weighed sample was thereafter incinerated in a muffle furnace at a temperature of 550<sup>0</sup>c for 2 hours, cooled in a desiccator and the weight taken.

$$\text{Crude fiber} = \frac{W_1 - W_2}{\text{Weight of sample}} \times 100$$

Where:

W<sub>1</sub> = Weight of crucible + sample after oven drying

W<sub>2</sub> = Final weight of crucible + sample after incineration

### 2.9 Carbohydrate determination

This was obtained by subtracting the values obtained for moisture, ash, fat, protein and fiber from 100. The formula is given thus:

$$\% \text{ carbohydrate} = 100 - (\% \text{moisture} + \% \text{ash} + \% \text{crude fiber} + \% \text{crude protein})$$

### 3.0 Statistical analysis

Descriptive statistics were carried out on the proximate composition of the periwinkle (*Tympanotonus fuscatus*) and land snail (*Archachatina marginata*) samples. Independent T-test were used to establish significant difference between mean proximate parameters of the periwinkle (*Tympanotonus fuscatus*) and land snail (*Archachatina marginata*) samples at

(P<0.05) using the Microsoft excel package of 2019.

### 4.0 Results

The mean percentage proximate composition of periwinkle and land snail is shown in table 1. The result showed the moisture content of periwinkle and land snail to be 5.60±0.3 and 7.20±0.13% respectively There was a significant difference when the moisture content of land snail was compared to periwinkle (P<0.05).

The percentage ash content of periwinkle and land snail was 36.0±0.11 and 14.50±0.02% respectively. The percentage ash content of periwinkle differs significantly when compared to periwinkle (P<0.05).

The percentage crude fiber of periwinkle and land snail was 33.0±0.09 and 50.00<sup>a</sup>±0.41% respectively. The percentage crude fiber content of land snail differs significantly when compared to periwinkle (P<0.05).

The percentage crude lipids of periwinkle and land snail were 3.20±0.14 and 3.60<sup>a</sup>±0.36% respectively. The percentage crude lipid of land snail differs significantly when compared to periwinkle (P<0.05).

The percentage crude proteins of periwinkle and land snail were 9.62±0.05 and 10.50±0.26% respectively. The percentage crude lipid of land snails differs significantly when compared to periwinkle (P<0.05).

The percentage carbohydrates of periwinkle and land snail were 12.80±0.17 and 14.20<sup>a</sup>±0.33% respectively. The percentage carbohydrate of land snail was significantly higher than periwinkle (P<0.05).

**Table 1: Mean proximate composition of periwinkle (*Tympanotonus fuscatus*) and land snail (*Archachatina marginata*)**

NUTRIENTS	PERIWINKLE	LAND SNAIL
Moisture (%)	5.60 <sup>b</sup> ±0.3	7.20 <sup>a</sup> ±0.13
Ash (%)	36.0 <sup>a</sup> ±0.11	14.50 <sup>b</sup> ±0.02
Crude Fiber (%)	33.0 <sup>b</sup> ±0.09	50.00 <sup>a</sup> ±0.41
Crude Lipids (%)	3.20 <sup>b</sup> ±0.14	3.60 <sup>a</sup> ±0.36
Crude Protein (%)	9.62 <sup>b</sup> ±0.05	10.50 <sup>a</sup> ±0.26
Carbohydrate (%)	12.80 <sup>b</sup> ±0.17	14.20 <sup>a</sup> ±0.33

Values are expressed in mean ± STD of triplicate determinations. Values with different superscript differ significantly (P<0.05)

## 5.0 Discussion

Periwinkle and land snails are important protein source and other vital nutrients required by humans. The study assessed the proximate composition of periwinkle and land snail. Result showed moisture content of the land snail to be significantly higher than periwinkle. This could be attributed to the differences in mass of the mollusk and the intensity of heat applied during sample preparation. The outcome of this study was lower than the values reported by Ngobidi *et al.*, (2024) in *Archachatina marginata* and *Archatina fulica*. Moisture removal by heat generally improve the digestibility of foods, increases concentration of nutrients and can make some nutrients more available (Garba *et al.*, 2019). Also, Drying is known to reduce moisture to improve the shelf-life of foods and increase dry matter (Wachap 2005).

The ash content of periwinkle was significantly higher than land snail. This is an indication that the periwinkle meat is high in minerals. The increased ash content in periwinkle meat may be attributed to the bioaccumulation of certain minerals from the environment inhabited by periwinkle (Ogungbenle, *et al.*, 2012). The percentage ash content obtained in this study was higher than the value reported by Ogungbenle, *et al.*,(2012) in *Typanotonus fuscatus var radula* meat and that reported by Akinjogunla *et al.*, (2017) in *Crassostrea gasar*. The ash content is an index of the number and amount of mineral element present in a food sample. Minerals such as calcium, phosphorus, magnesium and iron contribute to ash content (Oyewole *et al.*, 2024). The presence of ash in the periwinkle and land snails underscores its nutritional value and potential contribution to overall dietary mineral intake.

The crude fiber content of land snail was significantly higher than periwinkle. The increased crude fiber content of the snail could be attributed to the age of the snail, temperature of the environment and food availability. The high fiber content in the snail and periwinkle sample suggests that they are rich sources for fibers. The findings from this study were higher than the value reported by Paiko *et al.*, (2016) in *Helix aspersa* *Pila globose* and *Archatina fulica*. Fiber taken as part of diet cleanses the digestive tract by removing potential carcinogens from the body and hence prevents the absorption of excess cholesterol. Fiber also adds bulk to food and reduces the intake of excess starchy food which is the characteristics of the diet of the indigenes in this locality and hence guards against metabolic conditions such as hypertension and diabetes mellitus.

The crude lipid in land snail showed a significant increase when compared to periwinkle. This finding could be attributed to body mass of the snail as compared to periwinkle. The values reported in this study was lower than the values reported by Ngobidi *et al.*, (2024) in *Archatina fulica* and *Archachatina marginata* but agrees with the values reported for *Helix aspersa* and *Pila globose* by Paiko *et al.*, (2016). The low lipid contents of the periwinkle and land snails make them a good diet for low fat food required individuals and hence an anti-hypertensive remedies (Paiko *et al.*, 2016). Fats are needed to keep cell membranes functioning properly, to insulate body organs against shock, to keep body temperature stable and to maintain healthy skin and hair.

The crude protein content of snail was significantly higher than periwinkle. The differences could be attributed to food availability and the age of the snail (Ogbe *et al.*, 2022). The values reported in this study, were lower than the values reported by Oyewole *et al.*, (2024) in smoked snail meat but agrees with the values reported by Paiko *et al.*, (2016) in *Pomacea specie*, *Archatina fulica* and *Helix aspersa*. The values reported in this study shows that the mollusk, most especially the land snail is a rich source of protein. This finding could be attributed to the fact that snail meat is basically made up of muscle and also the fact that proteins are indispensable constituents of every living cell. They form an essential component of both the nucleus and cell protoplasm and are found in most extracellular animal tissue fluid. Proteins are known among other functions, to repair worn out tissues.

The carbohydrate content of the land snail showed increased value as compared to periwinkle. This could be attributed to availability of food, feeding pattern and the age of the snail. The values reported in this study were higher than the values reported by Engmann *et al.*, (2013). Carbohydrate is needed by animals for energy.

## 5.0 Conclusion

Land snail although may have the highest percentage composition of most nutrients, periwinkle also contain appreciable amount of nutrients especially ash which is an indication of total mineral content. These mollusks should be utilized for its rich source of vital nutrients needed by man for healthy living.

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