ABSTRACT

The study evaluates the dietary composition in flesh of Archachatina marginata var saturlalis and Tympanotonus fuscatus (Radula) bought from road side hawkers in Nsukka L.G.A. of Enugu State. An experimental study of the dried matter of both sampled species were carried out using proximate analysis in accordance to AOAC. The results showed that the dried matter of A. marginatavar. saturlalis flesh has protein content of (86.96 ± 0.37%), fat (7.35 ± 0.24), carbohydrates (4.56 ± 0.45) and ash (1.88 ± 0.19), moisture (1.54 ± 0.21), whereas in T. fuscatusvar. radula the carbohydrates content was observed as (21.52 ± 1.50), protein content (25.96 ± 0.56), ash (16.30 ± 1.09), fat (8.36 ± 0.29), moisture (7.86 ± 0.39) and fibre (1.53 ± 0.76). The two samples revealed high protein content in A. marginatavar. saturlalis and in T. fuscatus carbohydrate is equally high with least low value in ash and fibre respectively.

INTRODUCTION

Archachatina marginata var saturlalis (African Giant Snail) is an invertebrate belonging to the phylum Mollusca. The word ‘mollusca’ is derived from the Latin word, mollis, meaning soft (McFadden and Keeton, 2001). The African giant land snails under the class gastropods known as the largest of the molluscs. Molluscs radiate successfully into a variety of habitats, the great majority of which are aquatic, some are found mostly in shallow waters and sometimes in inter-tidal zones where they burrow into the mud in the beds of the river which serve as their habitat (Jamabo and Chinda, 2010). Maikano (2015) asserted that molluscs are generally triploblastic, coelomate and mostly bilaterally symmetrical and that, the body cavity consists of haemocoelien with soft non-segmented bodies.

In Nigeria, snail habitat ranges from the dense tropical high rainfall forest region of the south to the fringing riparian forests of the derived Guinea savannah (Odabo, 2003). A. marginatavar saturlalis are distributed all over the swamp forest zones in Africa. This snail species according to Akinmusi (2004), Ogogo (2004), and Ibom et al.,(2009) is native to Nigeria but has spread to other African countries and beyond, South East Abia and the Pacific Islands through Commerce (Olageye, 2013). Archachatina marginatavar saturlalis, are nocturnal and feed on a wide variety of feed mainly in the night, early morning, evening or on cold-rainy day. Their activity level (including their rate of feeding) fluctuates with the ambient temperature. Their meats are non-conventional wildlife protein source in Nigeria and some parts of Africa (Fagburo et al., 2006).

Tympanotonus fuscatus, the West African Mud Creeper or tropical periwinkle is a species of snail living in brackish water, a gastropod mollusc in the family Potamididae (Appleton et al., 2009). It is the only extant species in the genus Tympanotonus (Reid et al., 2008). Their shells can reach a size of about 35–100 millimeters.

Periwinkles are marine molluscs that are represented in the mangrove swamp, lagoons and estuaries by two genera Tympanotonus and Pachymelania. Tympanotonus fuscatus are shellfish dominantly found in brackish waters of the riverine areas of Nigeria where they are highly prolific. Tympanotonus fuscatus thrives better in brackish waters that are rich in organic matter and minerals (Ogogo, 2004). The tropical periwinkle (Tympanotonus fuscatus) has two varieties; the spiky shell called Tympanotonus fuscatus var radula while the smooth granulated one called Tympanotonus fuscatus var ovum. Studies have shown that both can exist within the same ecosystem but one variety is usually dominant.

According to Mba (2002), the protein contents and chemical score of the molluscs are better than the values for egg. Traditionally, snail meat has been a major ingredient in the diet of people living in the forest zone (Agbogidi and Okonta, 2011).
The meat is a highly priced delicacy in many cities in Nigeria where it is popularly called "Congo meat". Snail meat is an excellent source of animal protein in many parts of West and Central Africa (Blay et al., 2004), with protein content (20.7 %) higher than that of conventional food animals (Malik et al., 2011). The meat is also rich in iron (Agbogidi et al., 2008), potassium, phosphorous, essential amino acids and vitamins C and B complex (Baba and Adeleke, 2006; Okpeze, Omonle, Ajayi and Adebowale, 2007) and low in fat (Cobbinah et al., 2008). Obande et al. (2013) described the flesh of Archachatina marginata to have high quality food rich in protein, low in fats and a good source of iron. On the same note, Obande et al. (2013) reported that shellfishes are a good-source of protein, low fat and macro- minerals and trace elements such as copper, iron, zinc and manganese.

Apart from its excellent nutritional value, edible molluscs meat has also been reported to be of a good medicinal value (Abere and Lammed, 2008). The low cholesterol level of the meat has made it useful in the treatment of arteriosclerosis and other heart related diseases (Abere and Lammed, 2008). In Ghana, the bluish liquid obtained when the flesh is removed from the shell is believed to be good for infant development (Cobbinah et al., 2008).

In the face of the growing awareness on the various disadvantages linked to the red meat from ruminants, e.g., beef, mutton as implicated by high possession of high cholesterol that may increase the risk to various forms or heart diseases especially arteriosclerosis. There is need to look inwards on the use of acceptable and low level cholesterol meat product that could help to limit the incidence of heart diseases.

Traditionally, snail meat has been a major ingredient in the diet of people living in the rainforest zone and the mangrove swamp region of Nigeria. According to Blay et al. (2004), asserted that snails are very nutritious foodstuff of highly priced delicacy, in many cities in Nigeria. Also, Tympanotonus fuscatus meat is an excellent source of animal protein in many parts of Nigeria with high protein higher than that of conventional food animals. Their meat is also rich in iron, potassium, phosphorous, essential amino acids and vitamin C and B complex and low in fat. Apart from its excellent nutritional value, snail meat has also been reported to be of good nutritional value. 

The study evaluates the dietary composition of the flesh of Archachatina marginata (African giant snail) and Tympanotonus fuscatus (Tropical periwinkle).

**MATERIALS AND METHODS**

**Sample collection**

Archachatina marginata (Saturalis) and Tympanotonus fuscatus (Radula) were bought from hawkers at the ultra – modern market inNsukka Local Government Area of Enugu state. Nsukka is on longitude 7° 15’ E and 7°30’E and latitudes 6°34’N and 7°N respectively and is bounded on the north by Igbo-Eze local government area, on the south and southeast by Igbo-Eniti and Isi-Uzo local government area respectively; on the South-West by Uzo-Uwani local government area; and on the north–west by Kogi State. The mean daily temperature of the area is about 27°C – 28°C and the two prominent climatic seasons are the rainy season lasting from April to October. While the dry season lasting from November to March (Federal Republic of Nigeria Official Gadzette, 2007).

**Population and Sample Design**

A total number of thirty six (36) Archachatina marginata (Saturalis) and forty seven (47) Tympanotonus fuscatus (Radula) were purchased.

The samples were washed with warm water and potash to reduce the slimy substance on the Archachatina marginata (Saturalis) flesh while the Tympanotonus fuscatus (Radula) was washed with clean water. Both sampled species edible portion were oven dried at 75°C and ground to fine powder.

The mean dry weight of edible tissues of triplicate samples of each of Archachatina marginata (Saturalis) and Tympanotonus fuscatus (Radula) were grounded and packed in low density polyethylene (LDPE) bags and refrigerated for further analysis. Both sampled species were then carried to the Product Development Research Programme and Soil Science Department of the Institute of Agricultural Research (I.A.R.), Ahmadu Bello University, Zaria for analysis.

**Procedures for proximate analysis of Archachatina marginata (Saturalis) and Tympanotonus fuscatus (Radula) dry weight (edible portion)**

A proximate analysis was determination by prescribed methods of moisture ash, crude protein, crude lipid and nitrogen free extract. The samples were analysed in triplicate by standard methods (AOAC, 2005).

**Determination of moisture content**

Aluminium or plastic dishes were washed and dried to a constant weight in an air oven at 100°C. They were later removed and cooled in a dessicator and weighed (W1). 2 grams of grounded (powdered) samples were placed in the weighted moisture dish (W2). The crucible containing the samples were kept in an oven at 100°C for about 3 hours, removed and cooled in the dessicator and weighed (W3). 

The moisture was calculated as:

\[
\text{% moisture} = \frac{W2-W3}{W2-W1} \times 100
\]

**Determination of Ash content**

Crucibles were cleaned and dried in the oven. After drying, they were cooled in the dessicator and weighed (W1). 2 grams of the grounded samples (powdered) were placed in the crucible and weighed (W2). They were transferred into furnace for 550°C, then removed, cooled in the dessicator and weighed (W3).

The ash was calculated as:

\[
\text{% of Ash} = \frac{W3- W1}{W2- W1} \times 100
\]
Determination of fiber content
3 grams of the samples were placed in a beaker containing 1.2 ml of conc. Tetraoxosulphate (vi) and (H₂SO₄) per 100 ml of solution and boiled for about 30 minutes, the solution was filtered and washed with hot water. The residue was transferred to a beaker containing 1.2 gram of NaOH per 100 ml solution, and boiled for 30 minutes, the residue was again washed with hot water and dried in an oven and weighed (C₂), the weighed samples were incinerated in a furnace for about 550°C. remove and allow to cool, and weigh (C₃)/
The crude fiber was calculated as:
\[
\% \text{ fiber} = \frac{C_2 - C_3}{W} \times 100
\]

Determination of lipid (Fat)
250 ml clean boiling flask was dry in an oven and later transferred into a dessicator and allowed to cool 2 grams of samples are weighed into a labeled filter paper. The boiling flask is then filled with about 300 ml of petroleum ether. The soxhlet apparatus was assembled and allowed to reflux for about 8 hours. Then after, the flask containing the sample solution was removed and transferred to an oven to dry. It was then transferred from the oven into a dessicator and allowed to cool and finally weighed.
Lipid was calculated as:
\[
\% \text{ fat} = \frac{\text{weight of fat}}{\text{weight of sample}} \times 100
\]

Determination of protein
Digestion
2 grams of samples were weighed and put into a Kjeldahl flask. One tablet of catalyst (copper) and 25 ml cone tetraoxosulphate (VI) acid was added to the sample in the kjeldahl flask.

The solution was then transferred to the fume cupboard where it was heated until it assumes a green colour and any black particle showing at the mouth and neck of the flask was washed with distilled water. After cooling, the digest was transferred with several washing into 250 ml with distilled water.

Distillation
The Marichan distillation apparatus was steamed before use under the condenser, 100 ml containing 5 ml of boric indicator was used. 5 ml of the digest was pipetted into the body of the apparatus via the small funnel aperture and then washed with distilled water followed by 5 ml of 60% NaOH solution. The solution was steam again for about 5-7 minutes to collect enough ammonium sulphate. Finally, the receiving flask was removed and the tip of the condenser was washed down in the flask.

Titration
Solution was titrated in the receiving flask using N/100(0.01 N) hydrochloric acid. The nitrogen content was calculated and protein content as well.

Determination of carbohydrate
By difference: Carbohydrate content is obtained by calculation having estimated all other fractions by proximate analysis. i.e = 100 – (% moisture + % Ash + % protein + % fat).

DATA ANALYSIS
Data from the proximate analysis was subjected to statistical analysis: mean and standard deviation and represented in a histogram, standard error of measurement (SEM) and student t-test. Analyses were carried out using Microsoft Excel 2007 (Microsoft Inc.) and SPSS Version 20.
RESULTS AND DISCUSSION

The results of the mean proximate composition of the sampled snails are presented in figure 1.

Figure 1 shows high crude protein content of \((86.96 \pm 0.37)\) in Archachatina marginata var. Saturalis \((86.96 \pm 0.37)\) than Tympanotonus fuscatus \((25.96 \pm 0.56)\) higher than other nutritional contents. The lowest nutritional composition was recorded in the fibre content for Tympanotonus fuscatus \((1.53 \pm 0.76)\) and moisture content for Archachatina marginata \((1.54 \pm 0.23)\).

The present study showed an ash content of \(1.88 \pm 0.19\) for Archachatina marginata and Tympanotonus fuscatus \((16.30 \pm 1.09)\). The latter result is higher than the result \(10.16 \pm 0.09\) obtained by (Ehigiator and Oterai, 2012) while the value for Archachatina marginata is similar to what was observed by (Wosu, 2003) for dried meat. The differences in values indicate that Tympanotonus fuscatus absorbs less water than the Archachatina marginata.

The moisture content of \(1.54 \pm 0.23\) in Archachatina marginata and \(7.86 \pm 0.39\) Tympanotonus fuscatus dried weight respectively differs completely from the fresh flesh recorded by Wosu (2003) for aquatic snails as 73.7% and \(10.37 \pm 0.08\) reported by (Ehigiator and Oterai, 2012).

The protein content of \(86.96 \pm 0.37\) in A. marginata is higher while in T. fuscatus \(25.96 \pm 0.56\) was obtained. The value obtained for A. marginata is higher than the result by Malik et al. (2011) and Wosu (2003) as 20.7% Archachatina marginata. In Tympanotonus fuscatus, Ehgiator and Oterai (2012) results reveals \(68.46 \pm 0.26\), which is equally higher than what was obtained in the present study. However, their findings are centered on percentage wet basis. The present results also supported Wosu (2003) findings that on dry matter based Archachatina marginata meat had higher protein content than

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**Fig. 1:** Comparative proximate composition of dried flesh of Archachatina marginata var. saturalis and Tympanotonus fuscatus var. radula
the *Tympanotonus fuscatus*. Based on these variations, it simply means that *Archachatina marginata* is a good source of protein and could be used to complement the cereal sources of protein making good their relative deficiency of lysine Ludorff and Meyer in Cagiltay et al. (2011) are of the view that factors like collection method and location, season and sexual condition are important factors for the nutritional compositions.

The fat content in *Archachatina marginata* of 7.35 ± 0.24 is lower than that of the *Tympanotonus fuscatus* of 8.36 ± 0.29. The results obtained were higher than those reported by Wosu (2003) which was between the range of 1.21 – 1.64% for land snails while the value for *Tympanotonus fuscatus* shows similarity with the result 7.68 ± 0.24 obtained by (Ehigiator and Oterai, 2012). The values obtained from the present study is higher than the fat contents in the dried flesh of *Archachatina marginata* 2.44% and *Tympanotonus fuscatus* of 1.32% as observed by (Ehigiator and Oterai, 2012). Comparing the present studies result with other animal food; it was noted that the fat contents of *Archachatina marginata* and *Tympanotonus fuscatus* are higher than 1.0% for egg white and yolk in small amount, whole cow milk of 3.8% and goat milk of 4.8% but lower than the meat of chicken (12.6%), turkey of 20.2%, dried fish of 21.0%, lamb of 27.7%, beef 22.0% and relatively very high in pork of 45.0%. These shows that *Archachatina marginata* and *Tympanotonus fuscatus* have a low fat content making the meat a good antidote for hypertensive patient and those that have fat related diseases like arteriosclerosis (Abere and Lameed, 2008). Variations in the fat contents between species could be due to the location and origin of species (Lee et al., 2004).

The result of the t-test for the proximate analysis between *Archachatina marginata var. saturalis* and *Tympanotonus fuscatus var. radula* dried flesh are presented in table 1.

<table>
<thead>
<tr>
<th>Species</th>
<th>N</th>
<th>Mean</th>
<th>S. D.</th>
<th>Df</th>
<th>t-value</th>
<th>Level of significance</th>
</tr>
</thead>
<tbody>
<tr>
<td>A. Marginata</td>
<td>6</td>
<td>17.89</td>
<td>33.90</td>
<td></td>
<td>10</td>
<td>0.95</td>
</tr>
<tr>
<td>T. fuscatus</td>
<td>6</td>
<td>16.92</td>
<td>14.69</td>
<td></td>
<td>0.95</td>
<td>0.05</td>
</tr>
</tbody>
</table>

The mean proximate composition of *Archachatina marginata var. saturalis* (M = 17.89, SD = 33.90, N = 6) was not significantly different (p > 0.05) from *Tympanotonus fuscatus var. radula* (M = 16.92, SD = 14.69, N = 6) dried flesh.

Table 1 shows the caloric values for crude protein, lipid and carbohydrates. In *A. marginata*, crude protein has the highest value (478.28) followed by lipid (69.83) and carbohydrates (18.7) whereas in *T. fuscatus* crude protein (142.78) then lipid

<table>
<thead>
<tr>
<th>Parameters</th>
<th>A. Marginata kcal/g</th>
<th>T. fuscatus kcal/g</th>
<th>df</th>
<th>t-value</th>
<th>Level of significance</th>
</tr>
</thead>
<tbody>
<tr>
<td>Crude Protein</td>
<td>478.28</td>
<td>142.78</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Lipid</td>
<td>69.83</td>
<td>79.42</td>
<td>4</td>
<td>0.59</td>
<td>0.05</td>
</tr>
<tr>
<td>Carbohydrates</td>
<td>18.7</td>
<td>88.23</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Table 2: Caloric values for Crude Protein, Lipid and Carbohydrates in *Archachatina marginata var. saturalis* and *Tympanotonus fuscatus var. radula*

The results of the caloric values for crude protein, lipid and carbohydrates *Archachatina marginata var. saturalis* and *Tympanotonus fuscatus var. radula* are presented in table 2.
CONCLUSION
The proximate composition of Archachatina marginata var. saturalis and Tymanotonus fuscatus var. radula revealed crude protein (86.96 ± 0.37) has the highest percentage composition in Archachatina marginata var. saturalis while in Tymanotonus fuscatus var. radula the percentage composition of crude protein is 25.96 ± 0.56. The result showed that there is no significant different (p > 0.05) in the proximate composition of dried flesh of Archachatina marginata var saturalis and Tymanotonus fuscatus var. radula. Archachatina marginata and Tymanotonus fuscatus are invertebrates belonging to the class gastropoda. Their edible parts (meat) serve as luxury food for human consumption and has medicinal effect, used in the treatment of heart related diseases like arteriosclerosis because of their low fat contents. The present study also reveals that the species meat is a good source of protein and can be used as a substitute for fish which has a higher protein contents. Edible snail and periwinkle meat should be incorporated into our diet as their meat provides an alternative source of protein which is higher than the conventional red meat.

REFERENCES


APPENDIX I

Caloric value

The caloric values of the lipid, crude protein and carbohydrate were calculated using standard conversion factors (Winberg, 1971) as follows:

i. Lipid caloric value = amount of lipid g/100g x 9.5kcal/g.

ii. Protein caloric value = amount of protein g/100g x 5.5kcal/g.

iii. Carbohydrate caloric value = carbohydrate values x 4.1kcal/g

iv. Total calory = Lipid x protein x carbohydrate value (kcal/g )