NUTRIENT CONTENT AND PALATABILITY OF BLACK AND WHITE SNAILS OF *Archachatina marginata saturalis* IN THE SWAMP FOREST ZONE OF NIGERIA

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ABSTRACT

Increased consumption of conventional animal protein has pushed costs beyond affordable levels. Land snails are an alternative non-conventional animal protein source in sub-Saharan, Africa, but consumer preferences differ due to pigmentation or colour differences of black and white snails. During February, 2013 to May 2013, a study was conducted at the University of Calabar to determine the proximate and mineral composition as well as palatability of white and black snails of *Archachatina marginata* saturalis. One hundred each of black and white snails were randomly collected from the bushes around Calabar. Fifteen (15) each were randomly selected, shelled, deslimed by washing in ethanol, cut into pieces and oven dried at 70^0c for proximate and mineral composition analyses. Ten snails were randomly picked from each colour type, washed, deslimed, cooked in water with a pinch of salt for palatability test determination. Eight respondents were randomly picked for palatability test. Data were assessed by Likert scale ranking from 1-4 with a minimum level of acceptance of 2.5. . Results gave significantly higher ash (4.83 and 3.93 %) and carbohydrate (39.73 and 27.69 %) but lower crude protein (52.27 and 64.44 %, $P < 0.05$ t-test) in white versus black snails respectively . For palatability, black and white snails were statistically similar ($P > 0.05$ t-test) for juiciness (2.8), flavour (2.9), tenderness (2.5) and aroma (3.0). However, black snails ranked significantly higher ($P < 0.05$ t-test) than white snails with respect to chewability (2.9 and 2.2 respectively) while white snails had higher colour ranking (2.7) over black snails (2.5). White snails had lower mineral composition (CA^{++} 8640.17 and 4800.33mg/100g, Fe^{++} 69.95 and 46.43mg/100g; K^{+} 4073.97 and 4163.98mg/100g; Mg^{++} 1728.02 and 1000.00mg/100g; Na^{+} 138.07 and 139.00mg/100g and P^{++} 374.98 and 375.09mg/100g) for than black snails respectively. It was recommended that better methods of preparation should be adopted to make the white snails more palatable and acceptable.

Key words: Nutrient content, palatability, Black and white snails, *Archachatina marginata saturalis*, swamp forest zone, Nigeria.

Introduction

The need for increased animal protein consumption by the rural and urban Nigerian populace in the face of rising inflation has resulted in the increase in the cost of conventional animal protein (Agbogidi *et al*, 2008). Population expansion also implies that many people require protein in their diet due to the important role it plays in human wellbeing especially in the hormonal and enzymatic activities and improvement of the defense mechanism of the body (Ademolu *et al*., 2004).

The land snails, particularly the *Archachatina marginata saturalis* provide alternative and non conventional animal protein source in Nigeria and some other parts of Africa. Its meat has become a highly relished delicacy in some parts of Nigeria where it constitutes an important component of the food of numerous rural dwellers, especially in the rainforest zone (Akinnusi, 2004). Snails have been reported to be rich in protein hence can compare favourably with crude protein content in beef, broiler meat, goat meat, mutton and pork (Adomosun *et al*., 1999).

Several authors have reported on the nutritional benefit of snails generally (Adomosun *et al*, 1999, Omole *et al*, 1999, Anamayi *et al*, 2005 and the giant African snail in particular (Adomosun *et al*, 1999, Omole and Kehinde, 2005; Ejidike, 2002 and Akintomide 2004). A number of authors have attested to the meat being tasty, tender and highly nutritious (Mead, 1961, Akintomide, 2004, Ogogo, 2008 and Okon, 2012) as well as a vital ingredient in traditional medicine for many ailments (Ejidike *et al*, 2002, Ogogo, 2008).

Information on the comparative nutritive content and palatability of the two most common and readily available black and white subspecies of *Archachatina marginata saturalis* in Nigeria is scanty.

The giant African land snail *(Archachatina marginata saturalis* occurs mostly in the swamp forest zone of southern Nigeria. There are two colour types found in this region: The white and black foot types. The two snail types are however abundant in this ecozones especially during the rainy season when the snails break their dormancy and come out to breed. The black colour type is widely accepted for food in areas where it occurs. The white albino type is however rejected by most snail eaters.

There seems to be no good reason for such rejection other than the pigmentation of the foot. This leads to a reduction of the number snails available for sale thus making the black colour sails scarce and very expensive. They are also heavily harvested and threatened with extinction.

This work was undertaken in order to determine the nutrient content and palatability of the two snail types and comparing them with each other. This was with a view to ascertaining the differences if any between the two colour types and make recommendations for greater utilization of the white snail type for food or other purposes.

Methodology

Research Design

The sampling method adopted was simple random sampling technique from where 100 snails of each colour type (black and white) were collected from different locations in Calabar. A random sample of 15 snails was selected from each colour type used for the study.

Collection and Preparation of Samples

A total of 200 snails (*A. marginata* saturalis comprising of 100 black skinned and 100 white skinned colour types where collected) from each colour type, 15 snails were

randomly selected and prepared for analysis. The snails collected were prepared by removing the flesh from the shell with limpet rod and washed with ethanol to remove the slime content. It was cut into pieces and oven-dried at 70^{o}c to a constant weight. The dried samples were stored in the refrigerator at a temperature of 16^{o}c until needed for proximate and mineral analysis.

Determination of Proximate Composition

The recommended methods of the Association of Official Analytical Chemists (15) were used to determine the crude protein, crude fat, ash, and moisture content of the dried snail. Total carbohydrate content was determined by difference. The Kjeldahl method (% N x 6.25) was used to determine the crude protein content of 15g samples of dried milled snails. The crude fat content of the snail samples was determined using the soxhlet extraction apparatus to thoroughly extract crude fat from 15g of milled snail sample using petroleum either (boiling point 40 – 60^{o}c), in the soxhlet method of fat determination. The weight of fat extracted divided by the weight of sample multiplied by 100% gave the percent crude fat content. Ash was determined by incinerating 15g of the milled snail sample at 150^{o}c in an oven. The weights before and after ashing were used to calculate the percent ash content. The moisture content was determined by oven drying 2.0g of milled snail sample at 105^{o}c to a constant weight oven (Gallenkamp, England). The difference in weight before and after drying was used to calculate the percentage moisture content (see Table 1).

Total carbohydrate was obtained by subtracting the per cent amounts of crude protein, crude fat, moisture, and ash from 100%. The energy value of the snail sample

was obtained by multiplying the percent composition of protein, fat, and carbohydrate by their corresponding estimated by the difference between sum of the values of the previous nutritional components which is the accepted overall value of nutritional component (Uboh *et al*, 2010). Crude fibre was determined by hydrolysis with 0.128m of H_2SO_H and 0.22ml of KOH.

Determination of the Mineral Contents

The mineral composition of the edible portion of the flesh were analyzed from solution obtained by first dry-ashing the fleshy samples at 550_oc and dissolving the ash in standard flasks with distilled, de-ionized water containing a few drops of concentrated hydrochloric acid. Phosphorus was determined colorimetrically from the prepared sample using spectronic – 20 (Gallenkamp, UK) as described by Pearson (1976) with $KH_2\ PO_4$ as a standard. Sodium and potassium were analysed by means of flame photometer using Nacl and KCL to prepare the standards calcium, magnesium, iron and zinc were analysed by means of atomic absorption spectrophotometry (models Spa, Pye unican, UK).

Determination of Palatability Content Between the Black and White Snails of *Archachatina Marginata saturalis.*

Ten snails of *Archachatina marginata* saturalis were randomly collected from each colour type for the determination of palatability test. The snails were cooked using water and a pinch of salt was added. Eight (8) respondents were randomly picked for the palatability test from the lecturers and students of the Faculty of Agriculture, Forestry and Wildlife Resources Management, and they were to score for Juiciness, flavour,

chewability, colour, tenderness and aroma, using a likert scale method to determine the acceptability between the black and white snail colour types, ranging from 1-4 i.e. 4 (Best) 3 (Very Good) 2 (G00d) and 1 (Fair). After which the total score was added up and divided by the number of respondents (8) to get the mean score, and it was ranked accordingly. The minimum of the score was set as 2.5 whereby any value that fall outside the minimum is not considered as an influence choice (see Tables 3 and 4).

Data analysis

T-test was used to compare the proximate and mineral composition of the two colour types. Using Genstat version 8.1 (2005) and the difference among them separated using LSD at 5% level of significance. Palatability test data was analysed using the likert scale ranging from 1-4 with the 2.5 being the minimum level of acceptance.

Results and discussion

Results

Proximate composition of black and white snails of *Archachatina marginata* saturalis

The result of the experiment showed that there was a significant ($P < 0.05$ t-test) defference in the nutrient composition of the *Archachatina marginata* saturalis. (Table 1). No significance ($P>0.05$ t-test) was however observed in the crude fibre and ether extract in the two species. Significantly, more ash (4.83± 0.17) and carbohydrate (39.73±0.23) was observed in the white snail than in the black snail, but the black snails had significantly ($P < 0.05$ t-test) more crude protein (64.44 ± 0.13) ether extract (3.93 ± 0.67) and moisture (79.13 ± 0.67).

Table 1: Proximate composition of Black and White snails (*Archachatina marginata* saturalis)

Proximate composition (%)	***A. Marginata* saturalis (Black)**	***A. Marginata* saturalis (White)**
Ash	3.93 ± 0.12	4.83 ± 0.29 **
CHO	27.69 ± 0.01	39.73 ± 0.40**
Crude fibre	0.00 ± 0.01	0.00 ± 0.00NS
Crude protein	64.44 ± 0.23	52.27 ± 0.40**
Ether Extract	3.93 ± 0.12	3.17 ± 0.29NS
Moisture	79.13 ± 0.12	77.93 ± 0.06**

Note: Mean values with different superscript are significantly different ($P < 0.05$ t-test)

Mineral Composition of the Snails

Result of the mineral composition of the two species of land snails showed significant difference ($P < 0.05$ t-test) in ± the parameters measured. Significantly ($P<0.05$ t-test) more calcium (Ca^{++}), Iron (Fe^{++}) and magnesium (Mg^{++}) ions were recorded from *A. marginata* saturalis (black) while for *A. marginata* saturalis (white) significantly ($P <0.05$ t-test) more potassium (K^{+}) and sodium (Na^{+}) ions were recorded. No significant ($P>0.05$) difference was recorded for the phosphorus (P^{+}) composition between the two species.

Table 2: Mineral composition of the snails

Mineral (mg/100g	***A. Marginata* saturalis (Black)**	***A. Marginata* saturalis (White)**
Ca^{++}	8640.17 ± 0.29	4800.33 ± 0.58*
Fe^{++}	69.95 ± 0.05	46.43 ± 0.01*
K^{+}	4073.97 ± 0.06	4163.98 ± 0.03*
Mg^{++}	1728.02 ± 0.12	1000.00 ± 0.000*
Na^{+}	138.07 ± 0.12	139.00 ± 0.01*
P^{++}	374.98 ± 0.23	375.09 ± 0.03^{NS}

Note: Mean values with different superscript are significantly different ($P < 0.05$ t-test)

Palatability Test of Black and White Snails (*Archachatina marginata* saturalis)

The result of the palatability test showed that white respondent attest to the same aroma and flavor of both the black and white snail species, they however ranked the black snail species higher based on chewability than the white species (Table 3 and 4) equal on tenderness, but ranked the white species colour prominence over the black. Thus based on the parameters measures, the respondents, prefer the black snail species over the white snail species (Table 3 and 4).

Table 3: Palatability test result on *Archachatina marginata* saturalis (Black and White)

Black				**White**		
Variables	**TS**	**MS**	**Rank**	**TS**	**MS**	**Rank**
Juiciness	22	2.8	3rd	22	2.8	3rd
Flavor	23	2.9	2nd	23	2.9	2nd
Chewability	23	2.9	2nd	17	2.2	5th
Colour	20	2.5	4th	21	2.7	3rd
Tenderness	20	2.5	4th	20	2.5	4th
Aroma	24	3	1st	24	3	1st

Note: TS= Total score, MS= Mean score.

Discussion

The amount of protein recorded in the species especially the black snails of *A. marginata,* saturalis which was high with low ash content and zero fibre suggests that the content is comparable to donkey meat (Ademolu *et al,* 2003). It was however lower than the 82.38±1.83 obtained by Ebenso (2003) on the white snails. Snail meat has been reported to be a high quality food that is rich in protein, low fat and a source of vital minerals that is required for tissue development and maintenance (Orisawuyi, 1989; Ademoh *et al*., 2004, faybuaro *et al*., 2006, fummilayo, 2008).

The high amount of moisture content, crude protein, carbohydrates, Ca^{++}, Fe^{++}, K^{+}, Mg^{++} recorded in this work suggest that the two species can be effectively used as supplements in livestock feed (Uboh *et al*., 2010). The two species showed significantly high protein contents confirming the reports by Ebenso (2003) Ademolu *et al.*, (2004) and Fagbuaro *et al*., (2006).

The snails also showed high mineral content in the two colour types, the black being significantly higher in Ca^{++}, Fe^{++}, Mg^{++} than the white). This high mineral contents support the report of Fagbuaro *et al*., (2006) that the four species of GALS are rich in mineral contents of Zinc, Iron, Magnesium, Calcium, Phosphorus, Potassium and Sodium. The significantly ($P < 0.05$ t-test) high calcium content observed in the black and white snails of *A. marginata* saturalis suggest that the species can play an important role in blood clothing and bone development in humans (Uboh *et al*., 2010), Skeleton and teeth development (Pearson 1976).

However, the respondents agreed that aroma was the best parameter for the two snail species, while the white snail was rated higher than the black snail in terms of colour and therefore organoleptic quality. The black snail was rated higher in chewability than the white snail. Indeed, the consumption of any of the two species of giant land snails (GALS) is highly recommended for both young and old, since they constitute an alternative source of essential nutritional element at a lower cost.

The similar palatability of the two colour types in this study suggests that the choice of the colour types for food has no bearing on the nutrient content, but rather on cultural discrimination in the consumption of the two types. Ebenso (2003) also blamed the rejection of the white snails of A. marginata on cultural reasons rather than its nutrient

content. According to Okon and Ibom (2012), the white skinned ecotypes are edible and have the same nutritional attributes as other snails but are discriminated against because of taboos and superstitious beliefs. They further stated that in Nigeria, some people believe that the white skinned snails are used witch doctors for witchcraft while others associate them with certain gods or deities.

A reconnaissance survey of the bushes around the study area indicated that the population of the white snails was much higher than that of the black snails. This could be due to the fact that the white snails are not collected for food by the inhabitants of this area which could make them to become a pest of some food crops like cocoyam, banana and plantain while the black snails are being reduced and threatened with extinction. This observation is line with the findings of Okon and Ibom (2012) who stated that the white skinned ecotypes are rarely found in forests, rather they are found mainly in bushes around cities and villages. The utilization of the white snails for food and livestock feed could cut cost of the feed and prevent them from becoming a nuisance.

Conclusion and Recommendations

Conclusion

The results of this study showed that there is significant ($P < 0.05$ t-test) difference in the nutrients and mineral composition between the *Archachatina marginata* saturalis (Black and White,) snails. While there was no significant difference in the two colour types ($P < 0.05$ t-test) in palatability,.

Recommendations

It was recommended that snail meat of *Archachatina marginata* Saturalis (Black and White) should be used for food since they are rich in protein, low in lipid content and rich in minerals. The shell is also a good source of calcium and should be used in livestock rations. This species should be consumed to combat asthma, and ulcer. It could also be used to prepare concoction for a pregnant woman to hasten the expulsion of the foetus and placenta during child birth. Eating of the black and white snails could reduce the incidence of hypertension and heart diseases which are prevalent nowadays.

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