

Carcass characteristics, proximate composition and mineral analysis of African giant snail (*Archachantina marginata*)

SOLA-SUNDAY, Fagbuaro*†

Department of Animal Production and Health Sciences, Faculty of Agricultural Sciences, Ekiti state University, Ado-Ekiti, Nigeria.

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Abstract

The experiment was carried out at the Snailry unit of the Department of Forestry and Wild life, Faculty of Agricultural Sciences, Ekiti State University, Ado Ekiti using African Giant Land Snails (*Archachantina marginata*) procured from farmers in a settlement close to Ado Ekiti and reared in improvised plastic baskets between 1st of August and 30th of November 2012. At the end of the rearing period, the snails were killed and the internal mass separated from the shell. The separated feet were randomly divided into two groups tagged Treatments 1 and 2. Treatment 1 was deslimed with lime while Treatment 2 was deslimed with alum. The mean live weight, foot weight, viscera weight and shell weight of the experimental animals were determined and their respective percentages calculated. The sensory evaluation study, proximate and mineral analyses were also carried out. All the data obtained were subjected to statistical analyses using the cross sectional design of the two-sample t-Test for independent samples with equal and unequal variances. The results of the study showed that the percentage constituents of the body parts that made up a matured snail include: Foot (40.15 – 41.18 %), viscera mass (15.98 – 16.12 %), shell (16.97 – 17.17 %) and the balance of 25.53 - 26.89 % was water. The result of the sensory evaluation study revealed no significant ($p>0.05$) differences between the two treatments but treatment 1 was the more preferred combining all the sensory profiling parameters investigated. The proximate analysis of the snail meat showed that the values of protein, ash, moisture and crude fat were similar ($p>0.05$) in the two treatments. The content of carbohydrate was significantly ($p<0.05$) higher in Treatment 2 but crude fibre was however not detected in both treatments. The results of the mineral profile of the two treatments showed consistent significant ($p<0.05$) differences in all the macrominerals and in the micro mineral components, they were all similar ($p>0.05$). In conclusion, *Achachantina marginata* meat is rich in nutrients and the edible flesh (meat) of snails deslimed with lime was preferred to the alum deslimed meat.

Snailery, African Giant Land Snail, deslimed, carcass study, sensory evaluation study, proximate analysis, mineral analysis

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* Correspondence to Author (email: dipofajemilehin@yahoo.com)

† Researcher contributing first author.

Introduction

The growing burden of death resulting from chronic disease in the world today is attracting global interest. Red meat (beef, mutton, chevon, pork) have being associated with this unhealthy image due to the relative proportion of saturated fatty acids present in them which do not favour their consumptions. However diets low in saturated fatty acid had been reported to have major impacts in combating this high toll of death and disease (FAO/WHO, 2003). Consequently, exploiting the potentials of non-conventional animal protein sources referred to as 'Mini – livestock' that are environmentally friendly like land snails becomes imperative.

The chief source of snail meat to consumers in Nigeria is those collected from the wild and brought for sale in markets. The most worrisome challenge to continuous availability of the meat in Nigeria markets is the decline in production from this source as a result of man's impact on their natural habitat in areas of deforestation, use of chemicals, slash and bush burning and possibly collection of snails before maturity. It is therefore a well thought and mindful efforts made by man to rear snails domestically so that the availability and conservation of the animal species can be guaranteed.

Consequent upon this, a re-orientation from old system of snail hunting to a new branch of animal agriculture called heliculture has evolved. Heliculture is the system of rearing snails domestically and it is becoming more popular each passing day. For a venture in animal agriculture to be successful, productivity in terms of quality and quantity should not be compromised. However, this cannot come about without re-allocation of resources from other biological functions. Such reallocations can interrupt biological balances and disrupt nutritive value of the animal species.

In appreciation of this, various researchers have investigated the nutritive values (Imevbore and Ademosun, 1988; Ademolu et al, 2004; Fagbuaro et al. 2006 and Babalola and Akinsoyinu, 2009) and carcass characteristics (Omole, 2010 and Ojebiyi et al., 2011) of this animal species. However there were no consistencies in their findings. Therefore, this work is carried out to validate or/and invalidate these findings.

Materials and methods

Experimental site and Housing

The experiment was carried out at the Snailry unit of the Department of Forestry and Wild life, Faculty of Agricultural Sciences, Ekiti State University, Ado Ekiti. The experiment lasted between 1st of August and 30th of November 2012. The snails were reared under shade in improvised plastic baskets suspended 30 cm off the ground with planks. The legs of the planks were placed in large plastic bowls containing water with engine oil. The floors of the baskets were covered with sacks after which loamy soil rich in organic matter was poured to a depth of 14 cm. The sides of the baskets were covered with wire mesh and mosquito nets and the top covered with rough aluminum sheets. This exercise was carried out to protect the snails from invasion by soldier ants, insects and predators like reptiles, birds and rodents.

Experimental animal

The African Giant Snails (*Archachatina marginata*) used for this study were procured from farmers in a settlement close to Ado Ekiti called Aba Egbira and reared in improvised plastic baskets described above.

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Feeding and watering

The snails were fed with pawpaw leaf once daily throughout the duration of the experiment. The leftover feeds were removed before given a fresh one. Adequate amount of water was given by wetting them regularly during the rearing period.

Processing

The steps involved in processing the meat included deshelling to expose the entire snail meat; desliming and cleaning the meat.

Deshelling

Two methods could be used to deshell snails - either by hot water soak which lubricates the interior of the shells and enables snails to easily slip out or to crack the shell, using a mallet or a stone. The first method softens the meat but keeps the shells intact, and available for future decoration uses. In this study the snails were killed by striking iron rod on the shell carefully at the apex of the shell. The internal mass made up of the foot and the visceral mass was then separated from the shell. The viscera mass lies above the foot of the snail. It is a light grey sac full of fluid and snail guts. The mass was separated by gripping the sac, where it connects to the foot and pulling it. The sac/guts were discarded. The foot was then slit open along a natural line using a small sharp knife. The separated feet were randomly divided into two groups tagged Treatments 1 and 2. Treatment 1 was to be deslimed with lime while the other Treatment was to be deslimed with alum.

Desliming and cleaning snails

The snails were deslimed by using lime for Treatment 1 and alum for Treatment 2.

Though, lime is acidic while alum, as used in preparing snails is hydrated potassium aluminum sulphate (potassium alum) – a solid, crystalline chemical, both of them possess astringent qualities and the ability to cut through grease and slime. This was done by massaging either the alum or the lime to every inch of the snail, especially the ‘hinges’, on the outside of the snail which acts as a pool, trapping slime. On completion of desliming, the snails were rinsed off with clean cold water and checked for residual slime.

Carcass Analysis

The mean live weight, foot weight, viscera weight and shell weight of the experimental animals were determined and their respective percentages calculated as follows

Weight of parameter \times 100

Live weight of the snail

Sensory evaluation study

Eight taste panelists, with age ranging between 23 and 25 years, were selected to participate in the sensory evaluation study. They were humbly instructed by the authors to avoid eating, drinking or smoking at least thirty minutes before each test; to avoid conversations during the exercise and to rinse their mouths with water after each text. Score sheets were given to the taste panelists for grading. Thereafter, the snail meat was steamed without spices for 10 minutes for each of the treatments. After preparation, the two treatments were replicated eight times and served in a saucer at a time and presented to each of the eight trained taste panelists using cafeteria method. Two points was awarded for the better parameter and a least score of 1 point to the other parameter for each parameter investigated in each of the treatments.

Proximate analysis

A fraction of the deslimed foot obtained from both treatments were dried in an oven at 60°C to constant weight and then analyzed for its proximate and mineral contents. Crude protein, ether extract, and ash contents of the flesh were determined by the methods of the Association of Official Analytical Chemists (AOAC, 2005). Value for the carbohydrate was obtained by subtracting the sum of the values of moisture, crude protein, ether extract and ash from 100 %.

Mineral analysis

From the ash obtained in the proximate analysis, mineral contents were determined. Phosphorus was determined with vanadomolybdate and the concentration assessed with a UV spectrophotometer at a wavelength of 470 nm. Calcium was determined by flame photometry. Other minerals were determined by means of Atomic Absorption Spectrophotometry (AAS) at a wavelength of 324.7 nm for copper, 285.2 nm for magnesium, 248.3 nm for iron, 283.3 nm for lead and 198.5 nm for mercury.

Statistical analysis

All the Data obtained were subjected to statistical analyses using the cross sectional design of the two-sample t-Test for independent samples with equal and unequal variances (Rosner, 2000) while using PC-SAS T-test Programme (PROGT-Test) computer package to carry out the analyses. Equality of variances was verified using the F-test and significant level determined by two-sample t-Test as described by Snedecor and Cochran (1973).

Results and Discussion

Carcass analysis and sensory evaluation

Table 1 showed the results of the carcass analysis. In all the parameters investigated, the processing methods did not show significant differences ($p > 0.05$). The percentage constituents of the body parts that made up a matured snail were: Foot (40.15 – 41.18 %), viscera mass (15.98 – 16.12 %), shell (16.97 – 17.17 %) and the balance of 25.53 - 26.89 % was water. This result is in agreement with the report of Omole, (2010) and Ojebiyi et al. (2011).

Parameters	Treatment 1	Treatment 2
Mean live weight (g)	324.13±3.28	323.92±34.87
Foot weight (g)	133.48±3.64	130.05±2.10
Foot percentage	41.18±1.02	40.15±0.93
Viscera weight	52.25±0.84	51.76±0.87
Viscera percentage	16.12±0.73	15.98±0.61
Shell weight	55.65±1.62	54.98±1.35
Shell weight percentage	17.17±1.12	16.97±0.98

Table 1 Carcass analysis of matured snails processed differently

T1 = Snail deslimed with lime

T2 = snail deslimed with alum

Table 2 showed the result of the sensory evaluation study. Sensory evaluation of snail meat was carried out to find out the impact of the methods of desliming snails on their sensory qualities and how the qualities may influence the palatability and preference for snail meat by consumers.

The results revealed no significant differences between the two treatments but treatment 1 was the more preferred combining all the sensory profiling parameters investigated. Sensory qualities are very beneficial to owners of restaurants who trade in snail meat to guarantee patronage by customers.

Parameters	Treatment 1	Treatment 2
Tastiness	1.4	1.5
Toughness	1.4	1.4
Tenderness	1.3	1.3
Flavor	1.5	1.3
Mean	1.40	1.38
Preference ranking	1 st	2 nd

Palatability score: 1 was awarded for good and 2 for better

Table 2 Sensory profiling of differently deslimed snail meat based on tastiness, toughness, tenderness and flavour

T1: Snails deslimed by using lime

T1: Snails deslimed by using alum

Table 3 showed the proximate compositions of the snail meat. The values of protein, ash and crude fat were similar ($p>0.05$) in the two treatments. Also, the moisture contents in the two treatments were similar ($p>0.05$) though treatment one was superior by 1.48 %. The values of moisture contents recorded in the two treatments under this study were higher than the value of 73.67 % recorded for the same species of snail by Ademolu et al (2004) and 66.60 % reported for Whelk, Buccinidae, (Exler, 1987). However, the values were lower than the value of 81.22 % reported for Cod, *Gadus morhua* (Exler, 1987) but close to the value of 76.56 % reported by Fagbuaro et al., (2006) for *Archachantina marginata* (ovum) pfeiffer.

The crude protein contents of the two treatments were similar ($p>0.05$). The values were found to be inferior to the values obtained for conventional livestock (FAO, 2001); the value of 17 -18 % obtained by Awesu, 1980; Odukoya, 1998 and Omole, 2003; the value of 20.50 % obtained by Fagbuaro et al. (2006) and the values of 17.81 % and 23.84 % reported respectively for Cod and Whelk (Exler, (1987). However, it is fairly close to crude protein value of 16.9 % obtained for mutton (FAO, 1969).

The fat contents of 4.27 and 4.10 % obtained for the two treatments in this study were higher than the value of 2.44% obtained for AM by Ademolu et al (2004); 1.36% obtained by Awesu (1980); 1.3-1.5% by Asibey and Eyeson (1975); 0.005-0.8% by Cobbinah (1993) and 0.82-0.95% by Hamzat (2004). However the fat content obtained in this study was low when compared with 9.6, 21.4 and 23.0% found in egg, mutton and duck products respectively (FAO, 1969). The low fat content makes snail meat a good antidote for the hypertensive patient and those that have fat related diseases i.e. arteriosclerosis (Bright, 1999).

Nutrient composition	T ₁	T ₂
% Moisture content	79.11	77.62
% Ash	1.36	1.37
% Fat	4.27	4.10
% Crude protein	14.48	14.75
% Crude fibre	ND	ND
% Carbohydrate	0.78	2.16

ab means with no superscripts are statistically similar ($p>0.05$)

Table 3 Proximate composition of matured African Giant land snail (*Archachantina marginata*)

T1: Snails deslimed by using lime

T1: Snails deslimed by using alum

The ash contents of the two treatments were similar ($p>0.05$) while the content of carbohydrate was significantly ($p<0.05$) higher in Treatment 2. Crude fibre was however not detected in both treatments.

The results of the mineral profile of the two treatments were shown in Table 4. Treatment 2 showed consistent significant ($p<0.05$) differences in all the macrominerals and in the micro mineral components, they were all similar ($p>0.05$). The result showed that *Achachantina marginata* in Treatment 1 recorded higher value (mg/100 g) in calcium (205.08), sodium (193.09), phosphorus (221.67), magnesium (47.80) and potassium (69.16) while Treatment 2 had the least values of 190.82, 182.56, 214.32, 38.14 and 49.32 respectively.. There was no detection of lead and mercury in any of the samples.

Snail meat is rich in calcium. A value of 205.08 mg/ 100 g obtained in this study is an indicator to this. This value is comparable with the value obtained by Adeyeye (1996) but higher than the value obtained by Ademolu et al., (2004). A comparison with other animal products like beef, liver, eggs, and milk whose calcium content in mg / 100g are 7, 6, 54 and 120 respectively further corroborate the richness of *Achachantina marginata* in calcium. 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 breed of snail investigated suggests that consumption of snail can increase the calcium content in the body and contribute tremendously to the blood clotting process.

Snail meat like calcium is rich in phosphorus as obtained in this study. A range of 214.32 – 221.67 mg/ 100 g obtained in this study is an attestation to this.

This range of value is sufficiently lower than the values reported by Ademolu et al., (2004), the values of 156 and 95 mg/100g obtained for beef and milk respectively; comparable with 218 mg/100g in milk and lower than 313 mg/100g obtained for liver (Fox and Cameron, 1980). Snails are therefore a good source of phosphorus. Phosphorous like calcium is also involved in calcification of bones and teeth. It plays a vital part in the oxidation of nutrients in the form of phosphate groups in ATP (Fox and Cameron, 1980).

Magnesium like calcium and phosphorus is also involved in the formation of the bone structure of the body. The values too like potassium were comparatively low in the two treatments assessed.

The iron content in (mg /100 g) of 4.98 - 5.02 obtained in this study were high compared with a range of 2.7-3.05 reported by Imevbore and Ademosun (1988), the value of 2.29 mg/100 g reported by Ademolu et al., (2004) and corresponding values of 6, 11.4, 2.9, 1.9, 2.1, 0.1, 2.0 and 1.08 mg/100g in conventional animal products like kidney, liver, sardines, beef, eggs, milk, mutton and duck respectively (Fox and Cameron, 1980). Iron facilitates the oxidation of carbohydrates, proteins and fats. Half of the iron in meat is present as heme in hemoglobin. The iron in meat does not only enhance the absorption of iron from other sources such as cereal but increases considerably the level of iron absorption in the blood and prevent anemia which is so widespread in the developing countries such as Nigeria (Bender, 1992). Iron is one of the mineral elements which may be lacking in an average diet and so there is need to be conscious of taking diets rich in iron most especially the vulnerable group of people that is women who are in child-bearing age, pregnant and nursing women.

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The Cu content of 0.61-0.70 mg/100 g of meat obtained in this study was low compared with the value of 1.03 mg/100 g reported by Ademolu et al., (2004). Fox and Cameron, (1980) recommended a daily intake of 1-3 mg per day. Consequently, consumption of 100 g of snail per day is able to supply between 61 and 70 % of the daily need for copper. Copper is an essential trace element that forms part of several enzyme systems including cytochrome oxidase and tyrosinase. Copper is associated with iron and catalyses oxidation-reduction mechanisms concerned with tissue respiration. Tyrosinase is concerned with the oxidation of tyrosine (Fox and Cameron, 1980).

Minerals	T ₁	T ₂
Sodium	182.56 ^b	193.09 ^a
Magnesium	38.14 ^b	47.80 ^a
Potassium	49.32 ^b	69.16 ^a
Calcium	190.82 ^b	205.08 ^a
Phosphorus	214.32 ^b	221.67 ^a
Manganese	0.52	0.52
Iron	5.02	4.98
Copper	0.61	0.70
Zinc	1.88	2.11
Lead	ND	ND

ab means with different superscripts are significantly different (P<0.05)

Table 4 Mineral contents (mg/100 g) in the edible flesh of the African giant land snail (*Archachantina marginata*)

T1: Snails deslimed by using lime

T2: Snails deslimed by using alum

Conclusion

Succinctly, this study revealed that *Achachantina marginata* meat is rich in nutrients compared to the more conventional animal protein sources such as beef, chicken, chevon, mutton and pork.

The edible flesh (meat) of snails deslimed with lime was preferred to the alum deslimed meat. Snail consumption is therefore recommended for both old and young as this will combine effectively with other food components in providing the required essential element to the body.

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