Original Research Article

NUTRITIONAL COMPOSITION OF AFRICAN GIANT LAND SNAIL (*Archachatina marginata*) FED ON DIET FROM DIFFERENT PROTEIN SOURCES

ABSTRACT

The study of nutritional composition of African giant land snail (*Archachatina marginata*) fed on diet from different protein sources: soya bean meal, fish meal and blood meal with Pawpaw leaves and pumpkin leaves serving as the controls was carried out in the Wildlife domestication unit of the Department of Forestry and Wildlife, University of Benin, Benin City. One hundred and twenty (120) snails of average weight of between 110 and 120g were used. Eight (8) treatments (T1-T8) were established and the snails were separated in groups of fifteen (15) snails per treatment. Each group was randomly fed one of the eight diets. There were three (3) replicates per treatment with five (5) snails per replicate in a completely randomized experimental design. Twenty four (24) plastic baskets measuring 20cm deep, 37.5cm long and 23.8cm wide were used to house the snails with each plastic basket containing five (5) snails. At the termination of the 12 weeks experiment, proximate analysis, mineral composition and heavy metal composition of the snail flesh were carried out. The results revealed that the crude protein content of the different treatments were significantly different ($p<0.05$). Results showed that Crude protein value was highest in treatment 7 (87.5%) and lowest in treatment 1 (61.25%) and treatment 5 (63.00%). The snails fed with protein sources also have higher crude protein than those fed with only leaves. The results of the mineral profile showed that the Calcium, Magnesium and Phosphorus of the different treatment were significantly different ($p<0.05$). Treatment 2 recorded the highest value (mg/kg) in Calcium (59.00) and Magnesium (71.00) while Treatment 7 had the least value in Calcium (13.0) and Treatment 1 and Treatment 8 had the least values in Magnesium (25.0).

The result of the heavy metals showed that the Copper, Zinc and Lead of the different treatment were significantly different.

It can be concluded that Snail meat has high crude protein and minerals like Calcium, Magnesium and Phosphorus. Feeding snails with protein sources increases the amount of crude protein and minerals required by the body.

Key words: *Archachatina marginata*, protein sources, nutritional composition, proximate analysis, crude-protein,

INTRODUCTION

Snails are the largest group of molluscs constituting the largest animal group next to arthropods. The giant land snails are non-conventional protein sources whose meat is a highly relished delicacy (also known as *'Congo meat'*) and constitutes an important source of animal protein in many coastal communities of Nigeria and other parts of Africa (Omole *et al.,* 2007). Snail meat is regarded as a form of bush meat or game meat to be eaten occasionally instead of being a nutritious meat to be relished on a daily basis just like the meat of other conventional livestock (Malik & Dikko, 2009). Some ethnic groups even have superstitious beliefs that discourage the eating of snail meat or the eating of certain species of snails to the detriment of others. Uboh *et al* (2010) has observed that while *Archachatina marginata* is generally accepted for consumption, there is a strong cultural discrimination in the consumption of *Achatina achatina* by some tribes in Southern Nigeria. Studies by Omole *et al*., (2000) have shown that different breeds of snails can be found in Nigeria and they are characterized by high efficiency of nutrient transformation into quality protein. Omole (1997) stated that the African giant snail (*Archachatina marginata*) is the most common edible land snail found and reared in Nigeria.

Most of the conventional animal protein sources such as beef, goat, pork and poultry products have become too expensive for the average citizen. These major sources are decreasing at an alarming rate due to persistent drought, disease, high cost of feed and primitive husbandry techniques (Siyanbola, 2008). In order to provide a cheaper source of protein for human consumption, there is need for an intensive system of rearing alternative sources of animal protein, in the form of game meat and snail meat. It has been observed that collection of such sources from the wild cannot meet man's demand for protein (Ejidike, 2007).

Snails are important sources of animal protein and contain almost all the essential amino acids required by man (Ejidike, 2002). Meat of snail is palatable, nutritious and rich in essential amino acids such as lysine, leucine, isoleucine and phenylalanine as well as high iron contents (Imevbore, 1990; Stievenart, 1996**;** Ebenebe**,** 2000). Snail meat popularly known as 'Congo meat' has been described as a high quality food that is reach in protein, iron, contain high levels of magnesium, phosphorus and potassium but low levels of sodium, fat and cholesterol (Ajayi *et al*, 1978; Adeyeye, 1996 and Akintomide, 2004). The low contents of fat and cholesterol make snail meat a good antidote for vascular diseases such as heart attack, cardiac arrest, hypertension and stroke (Akinnusi, 2002). The availability of giant land snails in the world is decreasing gradually through indiscriminate hunting and deforestation which destroys the snail's natural habitat (Ademolu *et al*., 2004). It has been observed that snails collected from the wild cannot meet man's demand as a source of protein (Siyanbola 2008), hence there is need to rear them on a household and on a commercial basis. Ejidike (2004) has shown that feeding plays a vital role in the survival, growth and reproduction of most cultivated animals and have shown that snails' feed conversion rates are quite high compared to some other micro-livestock. Hence, this study investigated the flesh quality of the African giant land snail (*Archachatina marginata*) fed on fish meal, soya bean

meal and blood meal with pawpaw leaves (*Carica papaya*) and Ugwu leaves (*Telfaira spp.*) as basal diets and also serving as control.

MATERIALS AND METHODS

Location and period of study

The experiment was carried out in the Wildlife domestication unit of the Department of Forestry and Wildlife, University of Benin, Benin City. The Ugbowo main campus of the University of Benin, Benin City, Nigeria, has a total land area of 1,748 hectares. The Latitude and Longitude of University of Benin is 6^{o} 20' 1.32"N and 5^{o} 36' 0.53"E. The altitude is 74.5m above sea level.

The climate in the University of Benin is that of the rainforest zone of southwest Nigeria. Where it is situated in continually moist or has no prolonged draught (Nwoboshi, 1982). Rainfall is usually high, about 2000mm annually and in some places exceeding 8000mm.

The northern part of the campus is drained by Ikpoba River. The area is characteristically of high temperature from 27^{0}C to 32^{0}C with an average temperature of 27^{0}C. It has a relative humidity ranging from 75% (12 noon) and 95% (6.00am). The study was carried out for a period of 12 weeks.

Experimental Design and Treatment

Eight (8) different treatments were used. The experimental designs in relation to food items that were used are as follows.

Treatment 1 fed with pawpaw leaves (*Carica papaya*)

Treatment 2 fed with pawpaw leaves and blood meal

Treatment 3 fed with pawpaw leaves and fish meal

Treatment 4 fed with pawpaw leaves and soya bean meal

Treatment 5 fed with pumpkin leaves (*Telfaira spp.*)

Treatment 6 fed with pumpkin leaves and fish meal

Treatment 7 fed with pumpkin leaves and soya bean meal

Treatment 8 fed with pumpkin leaves and blood meal

Pawpaw leaves and pumpkin leaves served as the controls.

Methodology

One hundred and twenty (120) snails were bought in Uwa market, Benin City, Edo state. They were of average weight of 110 - 120g. They were separated in groups of fifteen (15) snails per treatment. Each group was randomly fed one of the eight diet. There were three (3) replicates per treatment with five (5) snails per replicate in a completely randomized experimental design. Twenty four (24) plastic baskets measuring 20cm deep, 37.5cm long and 23.8cm wide were used to house the snails with each plastic basket containing five (5) snails. The baskets were half-filled with loamy soil. Water and feed were supplied ad libitum every evening from 5pm. This will ensure that their food is always fresh at the time of feeding as snails are described as nocturnal animals. The snails were weighed once in two weeks (Lameed, 2006) with an electronic weighing balance throughout the experiment which lasted for 12 weeks.

At termination after the 12 weeks experiment, nine snails from each treatment, that is, three snails from each replicate were harvested, sacrificed, and properly cleaned prior to their preparation for proximate analysis.

116 **Statistical Analysis**

117 All analysis were performed in triplicates and the results were expressed as mean. Data for all
118 determinations were subjected to one way Analysis of Variance (ANOVA) using the
119 Complete Randomized Design (CRD) model. Where the means were significant, they were
120 separated using the Duncan's Multiple Range Test (at 5% probability level) using the Genstat
121 computer software (16^{th} edition).

122 **RESULT AND DISCUSSIONS**

123 Table 1, 2 and 3 below showed the proximate composition, mineral analysis and heavy
124 metals of the feed items used respectively. The protein sources (soya bean meal, fish meal
125 and blood meal) have the highest crude protein: 36.75%, 63.00% and 33.25%, respectively,
126 while the fresh leaves (pawpaw leaves and pumpkin leaves) had the least crude protein:
127 14.00% and 15.75% respectively (Table 1).

128 **Table 1: Proximate Composition of the Feed items used**

Nutrient	Fresh pawpaw leaves	Fresh pumpkin leaves	Soya bean meal	Fish meal	Blood meal
% Moisture	42.50	45.00	15.00	15.00	42.50
% Ash	5.90	0.15	4.80	7.00	2.70
% Fat	2.25	3.10	4.10	14.75	0.45
%Crude protein	14.00	15.75	36.75	63.00	33.25
N.F.E	32.80	35.00	34.35	0.25	21.10
Gross energy	245.85	265.38	411.54	501.49	553.71

(Kcal/g)					
% Crude fibre	2.55	1.00	5.00	---	---

Source: Laboratory Analysis, 2014

Table 2: Mineral Composition of the Feed items used (mg/kg)

	Fresh pawpaw leaves	Fresh pumpkin leaves	Soya bean meal	Fish meal	Blood meal
Calcium	34.00	36.00	33.00	70.00	65.00
Magnesium	53.00	26.00	27.00	105.00	105.00
Phosphorus	888.00	768.00	1264.00	1480.00	231.00

Source: Laboratory Analysis, 2014

Table 3: Heavy Metal Composition of the Feed items used (mg/kg)

	Fresh pawpaw leaves	Fresh pumpkin leaves	Soya bean meal	Fish meal	Blood meal
Copper	23.90	14.50	19.60	16.00	18.00
Zinc	54.00	36.90	64.90	129.10	12.40
Lead	15.10	---	---	13.40	4.50

Source: Laboratory Analysis, 2014

DISCUSSION

Proximate Analysis

Proximate analysis of the snail flesh revealed that the crude protein content of the different treatments were significantly different from one another ($p<0.05$). The values ranged from 87.5% for Treatment 7 to 61.25% for Treatment 1 (Table 4). The ash content were significantly different from one another with Treatment 4 having the highest value of 7.2% and Treatment 8 with the lowest value of 0.6%. There was also a significant difference in the fat content with treatment 6 having the highest value of 3.7% and treatment 5 with the least value of 2.7%. The moisture content and gross energy were not significantly different from one another ($p<0.05$).

The snails fed with protein sources (T2, T3, T4, T6, T7 and T8) were more nutritious than those fed with pumpkin and pawpaw leaves (T1 and T5) because they contain higher crude protein and gross energy. The snails fed with protein sources also have higher total weight gain than those fed with only leaves. This observation is similar to the work of Awa (1992) that diets with high crude protein and crude fat contents increase total body weight gained by animals. This is also in line with the findings of Adeyemo and Borire (2000) that reported significant differences in the body weight gain of snails fed different levels of yam peel. At the onset of the study (the first four weeks), the treatments with protein sources had lower responses in growth performance. After this period the snails became adapted to the protein sources. This is in agreement with the findings of (Cobbinah, 1993) that snails will accept many types of food over period of time while in captivity.

Table 4: Mean Values of the Proximate Analysis of the Snail Flesh

NUTRIENT	T1	T2	T3	T4	T5	T6	T7	T8
% Moisture	37.1[a]	38.5[a]	38[a]	35.2[a]	35.5[a]	37[a]	38.01[a]	40.21[a]
% Ash	5.5[e]	6.9[f]	5.3[be]	7.2[f]	3.9[b]	4.4[bcd]	3.9[bc]	0.6[a]
% Fat	3.25[ab]	3.35[b]	3.55[b]	3.3[ab]	2.7[a]	3.7[b]	3.25[ab]	3.2[ab]
% Crude protein	61.25[a]	84[g]	84[g]	78.75[e]	63[b]	77[d]	87.5[f]	68.25[c]
N.F.E	30.0[f]	5.75[a]	7.15[b]	10.75[c]	30.4[f]	14.9[d]	5.35[a]	27.95[e]
Gross Energy (Kcal/g)	482.18[a]	515.33[a]	522.87[a]	504.97[a]	488.37[a]	555.79[a]	542.02[a]	513.28[a]

Means in the same row with the same or similar letters are not significantly different from each other ($p<0.05$)

T1 = Treatment 1 fed with pawpaw leaves (*Carica papaya*)

T2 = Treatment 2 fed with pawpaw leaves and blood meal

T3 = Treatment 3 fed with pawpaw leaves and fish meal

T4 = Treatment 4 fed with pawpaw leaves and soya bean meal

T5 = Treatment 5 fed with pumpkin leaves (*Telfaira spp.*)

T6 = Treatment 6 fed with pumpkin leaves and fish meal

T7 = Treatment 7 fed with pumpkin leaves and soya bean meal

T8 = Treatment 8 fed with pumpkin leaves and blood meal

N.F.E = Nitrogen Free Extract

Mineral Composition

The result of the mineral profile (Table 5) showed that the Calcium, Magnesium and Phosphorus of the different treatment were significantly different from one another ($p<0.05$). Treatment 2 recorded the highest value (mg/kg) in Calcium (59.00) and Magnesium (71.00) while Treatment 7 had the least value in Calcium (13.0) and Treatment 1 and Treatment 8 had the least values in Magnesium (25.0). The values of the Phosphorus ranged from 1424.00 for Treatment 6 to 1096.00 for Treatment 2.

The snails fed with pawpaw leaves and blood meal (Treatment 2) recorded the highest value in Calcium and Magnesium. The consumption of snails fed with this diet could increase Calcium levels in the body and contribute to normal blood clotting (Fagbuaro *et al.* 2006). The snails fed with pumpkin leaves and fish meal (Treatment 6) recorded the highest value in Phosphorus. This could be as a result of the high value of Phosphorus in the fish meal (Table 5). The consumption of snails fed with pumpkin leaves and fish meal could increase Phosphorus levels in the body. Phosphorus helps the kidney gets rid of waste and can reduce muscle pain after strenuous exercise.

Table 5: Mean Values of the Mineral Composition of the Snail Flesh (mg/kg)

	T1	T2	T3	T4	T5	T6	T7	T8
Calcium	55.0^{d}	59.0^{d}	35.0^{c}	35.0^{c}	25.0^{b}	35.0^{c}	13.0^{a}	31.0^{c}
Magnesium	25.0^{c}	71.0^{b}	40.0^{a}	58.0^{d}	55.0^{d}	60.0^{d}	26.0^{c}	25.0^{c}
Phosphorus	1120^{ab}	1096^{a}	1312^{fg}	1264^{ef}	1152^{abc}	1424^{g}	1248^{cd}	1280^{ef}

Source: Laboratory Analysis, 2014

Means in the same row with the same or similar letters are not significantly different from each other ($p<0.05$)

Heavy Metals Composition

The result of the heavy metals (Table 6) showed that the Copper, Zinc and Lead of the different treatment were significantly different from one another ($p<0.05$). Treatment 3 recorded the highest value (mg/kg) in Copper (24.00) and Zinc (116.00) while Treatment 8 had the least values of 12.50 and 32.20 respectively. The values of the Lead ranged from 10.60 for Treatment 6 to 4.50 for Treatment 4. There was no detection of Lead in Treatment 7.

Table 6 shows the heavy metal composition of the snails. The amount of copper of the snails in all the treatments were found to be high as the general guideline is 8-15mg of zinc for every 1mg of copper (Sheldon, 2013). The snails from Treatment 1 to treatment 8 were found to contain high level of zinc. The effects of lead normally accumulate over time through a series of low level doses. Treatment 7 was found not to contain any amount of lead because the diet used (pumpkin leaves and soya bean meal) was lead free.

Table 6: Mean Values of the Heavy Metals Composition of the Snail Flesh (mg/kg)

	T1	T2	T3	T4	T5	T6	T7	T8
Copper	20.4^{bc}	22.4^{c}	24.0^{c}	16.8^{b}	20.8^{bc}	20.5^{bc}	19.6^{bc}	12.5^{a}
Zinc	68.6^{e}	71.5^{e}	116.0^{d}	89.4^{f}	79.5^{b}	87.7^{f}	99.5^{c}	32.2^{a}
Lead	6.5^{b}	9.7^{c}	6.2^{b}	4.5^{b}	9.0^{bc}	10.6^{c}	0.00^{a}	8.7^{bc}

Source: Laboratory Analysis, 2014

Means in the same row with the same or similar letters are not significantly different from each other ($p<0.05$)

CONCLUSION

Snail meat is rich in minerals like Calcium, Magnesium and Phosphorus. The consumption of snails could increase calcium, Magnesium and Phosphorus levels in the body and contribute to normal blood clotting, helps the kidney gets rid of waste and can reduce muscle pain after strenuous exercise. Adults, children and pregnant women are advised to always consume snail meat because of the minerals it contains. The snail meat fed with pumpkin leaves and soya bean meal were lead free as the diets do not contain lead.

Apart from the good performances of snails when fed with protein diets, it was considered to be easily accessible at all feed mills and available all the year round. Other advantage is that it can be stored for a longer period of time when compared with direct agricultural feed such as pumpkin and pawpaw leaves. The protein diet is also seen as been economically viable for intensive and large-scale snail farmers because it acts as growth booster.

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