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NUTRITIONAL COMPOSITION OF AFRICAN GIANT LAND SNAILS (*ARCHACHATINA MARGINATA*) FED RUMEN CONTENT INCLUSION

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Target Audience: Snail farmers; Animal Breeders; Snail vendors; Researchers

Abstract

The nutritional quality of snail meat depends on the quality of feed they eat which then determines the preference and palatability by man. There are information on the relationship between the nutritional composition of snail feeds and palatability of their edible flesh to man. The research was conducted at Teaching and Research farm of Department of Agricultural Technology, Federal Polytechnic, Ado-Ekiti, Ekiti State, Nigeria to evaluate the effect of rumen content inclusion on nutritional composition of meat obtained from snails fed diets with different levels of the test ingredient. Sixteen (16) mature giant African land snails with initial weight range of 220-250g and four dietary groups consisting of four diets were used in this study. Snails were randomly assigned to the four diets with four snails per replicate at 0%, 5%, 10% and 15% replacement levels. Results of proximate analysis revealed that snail meat was high in protein (26.12%); moisture content (66.27%); Ash (3.18%) and low in fat (0.91%) and carbohydrates (2.63%) at 15% rumen content inclusion. The values of calcium (189.01ppm) and lron (1.67ppm) were the most abundant of all the minerals screened. Significantly (P<0.05) higher mean values of calcium and phosphorus were obtained from meat of snails fed rumen content inclusion. Phytate and tannin were statistically (P<0.05) higher in the meat of snails fed 15% rumen content inclusion but their levels were not toxic. It was evident from this study that the presence of rumen content inclusion up to 15% in the four dietary groups did not reduce the nutritive value of snail meat and was also safe for human consumption and may be used to treat nutritional deficiencies and manage diseases such as high blood pressure, diabetes mellitus and stroke.

Keywords: *Archachatina marginata*, diets, nutritional composition, rumen content, snails

Introduction

Heliciculture, which is generally known as snail farming, is the process of raising land snails mainly for man use, either to use their flesh as edible food, or to obtain snail slime for use in cosmetics, or snail eggs for human consumption (Omole, 2007). The giant African snail naturally can be seen throughout the coastal area and West Africa, ranging from Cameroon, to Democratic Republic of the Congo and can be found in the Caribbean, in Martinique (United States Department of Agriculture, 2007). The West African land snails (*Achatina marginata*) are found mostly in the Southern parts of Nigeria, especially the Western part of the country, where the weather is most favourable for their proliferation.

The West Africa giant land snail (*Archachatina marginata*) are large terrestrial snails that can reach up to 20cm (8 inches) in length and 10cm (4 inches) in maximum diameter. Their brownish shell with darker brown with vertical stripes covers at least half of the snail length (Ohlweiler *et al*., 2010). They can easily attached to any means of transport in their developmental stage and are able to go into a state of aestivation in cooler conditions and so is easily transportable over many distances. Once they escaped, they can manage to establish themselves and reproduce excessively in tropical and some temperate locations.

Archachatina marginata can live up to 10years; they attain sexual maturity at 9-10 months under laboratory conditions. Clutch size varies; it may lay as large as 40 eggs. The eggs are yellowish in colour and sometimes have dark blotches. The eggs can have an incubation period of approximately 40 days.

Specifically, this species do not cause any appreciable damage to native crops and are actually considered as means of asset among many native peoples who include it in their diet. In many parts of West Africa, it is accepted as the second best snail to eat after *Achatina achatina.* They have been shown to stow away on banana shipments (Petsnails, 2018).

Snail Farming is very useful in many areas; the flesh is rich in protein, iron and calcium; the slime is used by cosmetic and pharmaceutical companies in drug production why the shell is used for making ornaments and jewelleries. In Nigeria, it was observed that animal protein intake was generally low, leading to acute Malnutrition amongst the poor and illiterate. Presently, the conventional sources of animal protein source for the people are cattle goat, sheep, pig, and poultry and fish etc. However, there are other sources which are yet to be recognised but have great potentials for nutritional development such snail farming in Nigeria (Fatai, 2018).

In some part of Africa, these snails also play a major role in native medicine in the preparation of remedies against, whooping cough, asthma, hypertension, diabetes, etc. some belief that the glandular substances from edible snails causes agglutination of certain bacteria (Offiong *et al*., 2013). Snail have also been recommended for the treatment of anaemia, asthma, high blood pressure, and other related ailments due to their relatively low cholesterol levels as reported by (Kalio and Etela, 2011).

Snails are huge part of the diet in many parts of Africa, although they are not always affordable and available all year round. Their high protein, low fat and cholesterol content make them a nutritional favourite (John-Paul, 2013). Snail farming is a very lucrative and easy business. The demand for snail all around the world is growing exponentially. It is therefore a product of international value, it is not capital intensive and also not time consuming, and it can also be done alongside other businesses.

The continuous increase in demand for animal protein supplies and scarcity of locally produced protein supplement in animal diets has been subjects of great concern to Nigerians. The major sources of meat protein for the Nigerians come mainly from livestock in the form of poultry, beef, mutton and pork. These major sources are being decreased by persistent drought, high feed cost, ancient animal husbandry techniques, diseases, and low productivity of local animal breeds (Fagbuaro *et al*., 2016).

Over the years, snail farming has been targeted towards alternative feed resources that could maintain and improve the nutritive value of individual animal and sustain the livestock industry in Nigeria. Hence, this study was therefore conducted to determine the nutritional composition of snail fed rumen content inclusion.

MATERIALS AND METHODS

The study was carried out at the teaching and research farm of Department of Agricultural Technology, Federal Polytechnic, Ado-Ekiti, Ekiti State, Nigeria. The state is located in south western part of the country, Ekiti State covers a land area of 6,353km square (2453sqm) with a population estimated in 2005 to be 2,737,186. It enjoys tropical climate with two distinct seasons, these are rainy season (April to October) and dry season (November to March).

The city of Ado-Ekiti has a temperature ranges between 21 degrees Celsius to 28 degrees Celsius with high humidity, the South we sternly wind and the North east trade which blows in the raining season and dry (harmarttan) season respectively, the tropical forest exists in the south of Ekiti State while savannah occupies the northern peripheries.

Sixteen (16) healthy-looking growing *Archachatina marginata* initial average weight of (220±0.02g) were allocated to 4 treatment groups and divided into four (4) replicates of four snails each in a completely randomized design (CRD). The snails T_1 were fed with (0%); T2 (5%); T3 (10%) and T4 (15%) rumen content inclusion respectively. At termination after the 8 weeks feeding trial, 2 snails from each of the 4 replicates per treatment were harvested, sacrificed, eviscerated and properly cleaned in the Animal Science Laboratory prior to their preparation for analysis.

The edible part (foot) were separated from the offal and dried in a laboratory oven at a temperature of 60℃ for 24 hours (Eneji *et al.*,2008).The dried sample were milled to powder in a kitchen electric blender and preserved in air tight plastic container. The stored sample were analysed to determine their proximate composition, mineral as well as anti-nutritional factor contents. Each dried sample of snails was replicated in different processing times. All data generated were statistically analysed using Genstat (2011) statistical package for analysis of variance (ANOVA). Means were separated using Least Significant Difference (LSD) module at 5% level of probability.

RESULTS AND DISCUSSION

Gross composition of snail meat fed rumen content inclusion diets at different level of replacement was shown in table 1.The snail feeds composed of different levels of mixture of ingredients like wheat offal, maize, groundnut cake, soybean meal, bone meal vitamins etc. with rumen content inclusion.

Table 1 Gross composition of Rumen content inclusion Snail diets

Ingredients	Levels of replacement T1 0%	T2 5%	T3 10%	T4 15%
Maize	56.00	54.00	52.00	50.00
Wheat offal	33.85	35.00	36.60	38.40
Groundnut cake	4.40	4.00	3.80	3.20
Soybean	2.00	1.80	1.60	1.60
Fishmeal	0.40	0.40	0.40	0.40
Palm kernel cake	2.80	2.80	2.60	2.40
Bone meal	0.35	0.35	0.35	0.35
Methionine	0.05	0.05	0.05	0.05
Limestone	0.05	0.50	0.50	0.50
Lysine	0.05	0.05	0.05	0.05
Vitamin premix	0.05	0.05	0.05	0.05
Rumen content	0	1.00	2.00	3.00
Total	**100**	**100**	**100**	**100**

Table 2 showed the proximate composition of snail meat fed rumen content inclusion at different levels of replacement. The results of the analysis as indicated in table 2 showed that there was no significant difference (P>0.05) among the dietary groups. The moisture content was low in snail fed with rumen content inclusion (65.03%-69.74%) compared to 78.64 – 80.78% reported by 79.20g-100g-1 (Eruvbetine, 2012) but higher than 6.58 ± 0.23% reported by Engmann *et al*. (2013).

From the findings of this study, the crude protein was significantly higher in 15% rumen content inclusion (26.12%) which was higher than crude protein (12.01±8.60%) reported by Engmann *et al*. (2013). This showed that feed type did not alter crude protein content of the snail meat. The high crude protein content recorded in this study is in agreement with the reports of Okon and Ibom (2012) that snail meat has high quality protein content. This finding can also be attributed to the fact that snail meat is basically made up of muscles and also the fact that proteins are indispensable constituents of every living cell.

Proteins are mainly worn out tissues repair and may account for it being used by traditional people to enhance the healing of amputated limbs. Being a good source of animal protein, snails can be used in a powdered form to prepare nutritious food for babies who are being weaned from breast milk, particularly in forested areas to prevent protein energy malnutrition among children under five years.

The results of analysed crude fat showed that dietary groups and levels of replacement did not affect the fat content of snail meat statistically ($p>0.05$).The fat level of 15% rumen content inclusion (0.91%) was lower compared favourably with the range values of 3.98±0.11% and 4.50 – 4.91% reported by Engmann *et al*. (2013) and Soniran *et al*. (2013) respectively. The low fat content across the dietary groups showed that inclusion of rumen content in snail diets did not increase the inherent fat content of snail meat.

Carbohydrate content of snails fed with rumen content inclusion of the four treatments, did not differ statistically ($P>0.05$) at all levels of replacement among the treatments. This result revealed carbohydrate (2.62-2.83%) which disagreed with the range values of 6.57 – 15.50% reported by Eneji *et al*. (2008), also lower than the values of 3.26±0.13% carbohydrate reported by Engmann *et al*. (2013).

Snail meat could be said to be a poor source of carbohydrate. The result of proximate/chemical analysis showed that crude fibre content of snail fed 5% rumen content inclusion (12.01%) was statistically ($P<0.05$) the highest. The levels of crude fibre at 0% rumen content inclusion (8.60%) obtained in this study were slightly lower than the range values of 10.75 – 11.82% reported by Soniran *et al*. (2013). Ash content of snail meat was not significantly different ($P>0.05$) at all the levels of inclusion of rumen content. The result showed that inclusion of 15% rumen content (3.18%) was in agreement with 3.22% ash content reported by Engmann *et al*. (2013). This implies that snail meat is a good source of mineral.

Table 2: Proximate Analysis of Meat of Snail Fed Different Experimental Diets

	Control	**Level of**	**replacement**		
	T1 0%	**T2 5%**	**T3 10%**	**T4 15%**	**SEM**
Moisture(%)	69.74[a]	67.87[b]	65.03[d]	66.27[c]	0.64
Protein (%)	21.10[d]	24.17[c]	25.07[b]	26.12[a]	0.64
Fat (%)	1.96[b]	1.27[c]	2.40[a]	0.91[d]	0.64
Ash (%)	6.19[a]	5.17[c]	5.81[b]	3.18[d]	0.64
Fibre (%)	8.60[d]	12.01[a]	11.97[b]	11.17[c]	0.64
CHO (%)	2.83[a]	2.62[c]	2.68[b]	2.63[c]	0.64

SEM-Standard Error of Mean

The mineral composition of snail meat fed rumen content inclusion was shown in Table 3. It was revealed that snails fed (15%) rumen content inclusion had the highest significant ($P<0.05$) mean value of calcium. The mean values of calcium (189.01ppm) recorded in this study were lower than 585.50±5.6 mg 100 g-1 recorded by Engmann *et al*. (2013). The presence of calcium at high levels in snail meat in this study is important because calcium is known to assist in teeth and skeletal development in animals. It plays a role in regulating the acid-alkaline balance in the body.

Phosphorus values were significantly ($P<0.05$) the highest in snail fed with (0%) rumen content inclusion. The values of phosphorus (65.78ppm) obtained in this study were lower than the values of 272mg 100 g-1 reported by Eruvbetine, (2012) for snail meat. The difference could be due to feed type and soil type used in the study.

Magnesium content did not differ statistically ($p>0.05$) among treatment. The values of magnesium content ranges from 31.05-38.14ppm recorded in this study were lower than 48.34 mg reported by Kalio and Etela (2011).

Potassium content revealed in all the dietary groups ranges from 51.00- 62.74ppm were higher than 3.8 mg 100 bg-1 reported by Eruvbetine (2012), but lower than the range of 162.13 – 179.99 mg 100 g-1 reported by Ubua (2011). Potassium in the body fight against muscular weakness which is associated with malaria and some diseases also slow down sclerosis of vascular system. It also fights against bacteria and purify the digestive system (Ayoola and Adeyeye, 2010).

Treatment and levels of inclusion of rumen content inclusion did not significantly ($P>0.05$) affect the zinc content of snail meat. The mean values of zinc (1.03 -1.13ppm) is in agreement with Eruvbetine (2012) who reported 1.00mg 100g-1 but lower than 39.0±1.40 mg 100 g-1 reported by Engmann *et al*. (2013). The low zinc content observed in this study implies that meat of snail fed different level of rumen content is not toxic to health.

Results of iron content (1.12-1.67ppm) showed no significant (P>0.05) difference, indicating that treatments and levels of replacement did not adversely affect the meat quality but it was lower than 9.8±0.3mg $100g^{-1}$reported by Engmann *et al*. (2013). The presence of iron in snail meat at high concentration could be attributed to its abundance in soil sample and feed consumed by snails under captivity.

Table 3: Mineral Composition (ppm) of Snail Meat Fed different Experimental Diets

	Control	Level of	replacement		
	T1	T2	T3	T4	
	0%	5%	10%	15%	SEM
Zinc	1.13[a]	1.12[b]	1.03[c]	1.12[b]	4.02
Calcium	61.07[b]	137.08[d]	158.04[c]	189.01[a]	4.02
Magnesium	38.14[a]	31.05[d]	36.17[b]	35.12[c]	4.02
Phosphorus	65.78[a]	57.17[b]	53.10[d]	55.00[c]	4.02
Potassium	62.74[a]	57.00[b]	51.00[c]	51.32[c]	4.02
Iron	1.21[c]	1.12[d]	1.31[b]	1.67[a]	4.02

SEM-Standard Error of Mean

Table 4 showed the anti-nutritional factors in the meat of snail fed different experimental diets. Phytate was found to be the most abundant of the anti-nutritional factors screened (Table 4). The highest significant (P<0.05) concentration of phytate was found in meat of snail fed with 15% rumen content (1.34%). It has been shown that Phytate has a strong affinity for calcium, copper, zinc, magnesium and iron making these minerals unavailable for absorption in the intestine (Ekhol *et al*., 2013). The fact that the chemical analysis on the mineral elements at 15% rumen content gave results that were comparable to the control diet (0%) is a proof that phytate content of snail meat was not fatal.

The general result on oxalate showed that the highest significant ($P<0.05$) quantity of oxalate was found in meat of snails fed with 10% rumen content (0.002%). Consumption of large doses of oxalate leads to corrosive gastro enteritis which may result in renal damage and low plasma. The phytochemical investigation revealed in this study was in agreement with Bwai (2015) who reported the presence of tannins, steroids, saponins, phenols, alkaloids, cardenolides, terpenoids, carbohydrates, cardiac glycosides, resins and balsams. Alkaloids contributed to a plant species fitness of survival.

They often have pharmacological effects and were used as medication and recreational drug. Phenolic compounds are reported to exert a wide spectrum of biological effects such as- antioxidant and free radical scavenging activity and antimicrobial activity (Volluri, 2011). Similarly, tannins are well known for their antioxidant and antimicrobial properties as well as skin regeneration, anti-inflammatory and diuretic properties. Flavonoids are widely recognized for exerting antioxidant, antimicrobial, anti-carcinogenic and antitumor properties (llondu, 2013).

CONCLUSION

In conclusion, up to 15% rumen content can be included in the diet of growing snails without adverse effect on nutrient (especially protein, calcium and iron) content. The levels of anti-nutritional factors present in meat samples were not toxic to snails and hence humans.

Besides application of heat on the meat during processing (by boiling) could further reduce or eliminate the anti-nutritional factors present.

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