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GROWTH PERFORMANCE, PROXIMATE COMPOSITION AND MINERAL CONTENT OF AFRICAN GIANT LAND SNAILS (ARCHACHATINA MARGINATA) FED FORMULATED DIET USING QUAIL DROPPINGS MEAL AS PROTEIN SOURCE

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Abstract

Snail meat is highly nutritious and compared favourably with conventional sources of protein such as beef and fish, also low in fat and serve as a good source of iron. This study was to investigate the growth performance, and chemical composition of Archachatina marginata (African Giant Land Snail) fed Quail droppings meal (Q.D.M.) substituted for soybean meal (S.B.M.) in snail feed. Fifty snails with the average weight 157.3g were subjected to 12week feed trials. Three experimental snail diets (Diet II-IV) were prepared using Q.D.M. in different ratios. Diet I is modified Cobbinah's snail feed and Diet V is 100% Q.D.M. The morphological characteristics of the snail and its flesh chemical composition were determined using standard methods. There was an appreciable increase in the weight gain, shell width gain and shell length gain across the treatment groups. The feed conversion ratio ranges from 2.74 to 3.75, with snails fed Diet I recording the highest feed conversion ratio. The meat of the snails fed on Diet V had the highest per cent protein, ash, and carbohydrate, while those fed Diet I had the highest fat and fibre content. The level of the minerals found in all the treatments is not toxic and are in a linear progression manner, with snails on diet V possessing the highest values in all the minerals analyzed (Na^+, K^+, Ca^+, Mg^+, Fe^+ and P), while snails on Diet I had the least amounts. The result of this study indicated that highest growth performance and feed utilization for A. marginata snail was favoured by Diet V. The substitution of S.B.M. with Q.D.M. in the experimental feed improve the nutritional quality of snails, hence reducing the cost of the compounded ration of snails.

Keywords: *Archachatina marginata, Feed Conversion Ratio, Minerals. Quail Droppings Meal, Soybean Meal.*

Growth Performance, Proximate Composition and Mineral Content of African Giant Land Snails (Archachatina marginata) fed Formulated Diet using Quail Droppings Meal as Protein Source

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Snail meat is highly nutritious and compared favourably with conventional sources of protein such as beef and fish, also low in fat and serve as a good source of iron. This study was to investigate the growth performance, and chemical composition of Archachatina marginata (African Giant Land Snail) fed Quail droppings meal (Q.D.M.) substituted for soybean meal (S.B.M.) in snail feed. Fifty snails with the average weight 157.3g were subjected to 12week feed trials. Three experimental snail diets (Diet II-IV) were prepared using Q.D.M. in different ratios. Diet I is modified Cobbinah's snail feed and Diet V is 100% Q.D.M. The morphological characteristics of the snail and its flesh chemical composition were determined using standard methods. There was an appreciable increase in the weight gain, shell width gain and shell length gain across the treatment groups. The feed conversion ratio ranges from 2.74 to 3.75, with snails fed Diet I recording the highest feed conversion ratio. The meat of the snails fed on Diet V had the highest per cent protein, ash, and carbohydrate, while those fed Diet I had the highest fat and fibre content. The level of the minerals found in all the treatments is not toxic and are in a linear progression manner, with snails on diet V possessing the highest values in all the minerals analyzed (Na^+, K^+, Ca^+, Mg^+, Fe^+ and P), while snails on Diet I had the least amounts. The result of this study indicated that highest growth performance and feed utilization for A. marginata snail was favoured by Diet V. The substitution of S.B.M. with Q.D.M. in the experimental feed improve the nutritional quality of snails, hence reducing the cost of the compounded ration of snails.

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INTRODUCTION

Snails are regarded as the largest groups of Mollusca constituting the largest animal group after arthropods (Emelue and Dododawa, 2017). Land snails are sources of protein apart from the conventional sources of protein which are mainly meat and fish. Snail meat is a nutritious food that is high in protein,

low in fat and a good source of iron (Orisawuyi, 1989). Imevbore and Ademosun (1988) reported that snail meat has a protein content of 88.37% which make them compete well with other conventional animal protein sources such as pork (82.42%) and beef (92.75%). Due to its nutritional benefits and healthy prospects, there is a rapid increase in the consumption of snail meat because people are avoiding red meat for perceived health reasons.

African Giant Land Snail (Archachatina marginata) is regarded as one of the highly consumed snail specie in Africa, especially Nigeria, due to its meaty flesh. As nutritious as snail meat is, human habitation, indiscriminate hunting and deforestation are drastically reducing and destroying snails' habitat. Rearing of this specie of snail (Archachatina marginata) and other meaty species will help conserve and ensure their survival. However, one routinely encountered problem in snail rearing is the selection of feed to keep this animal alive and meet their nutritional need. This problem may be solved by focusing attention towards protein as it plays a crucial role in animal well-being such as growth, maintenance, repair of tissues, proper metabolism and other enzymatic activities.

Therefore, this study aimed to examine the growth performance, proximate composition and mineral content of African Giant Land Snail fed with compounded feed using Quail droppings meal as the protein source in place of soybean meal and other protein sources in formulated snail feed.

MATERIALS AND METHODS

Location and Source of Materials

The research was done in the Department of Science Laboratory Technology, Federal Polytechnic Ilaro, Ogun State, Nigeria. Ilaro is a small city in Nigeria, situated at 6.89° North latitude, 3.02° East longitude and 68m elevation above the sea level. The daily temperature in Ilaro ranges between an average minimum of 23° C to a maximum of 34.2°C. The quail litter used for this work was the droppings of caged layers collected from a commercial farm in Ilaro. It was spread and sun-dried for one week while raking at intervals. Stones and other foreign materials were removed. After drying, the litter was milled into a fine powder using a hammer mill to produce quail dropping meal of 2 mm particle size.

Experimental Snails and Treatments

The snails used for the study are *A. maginata*. Fifty (50) pieces of snail (average weight of 153.7 g) were purchased from Boye's farm between November and December 2018 and transported to the animal house. A cage with perforations to enhance the easy flow of air and proper drainage was built for the snail samples which serve as habitat for the snail. Heat sterilized loamy soil was used to fill the 12 rooms which were divided into six segments in the cage up to about 6cm and dried almond fruit leaves was placed over the soil to serve as mulch for the snails. Each compartment contained five snails, and water was sprinkled on the snail twice a day to keep their environment moist. Since snails

are nocturnal animals and feed mostly at night Ademolu et al., (2004), they were provided with the experimental diets every evening between 4.00 and 6.00 pm for 12 weeks (84 days). The cage was cleared of leftover feed and excreta of the snails every day to prevent the buildup of pathogens.

Experimental Diets

The Q.D.M. was used in different ratios as a protein source to compound 4 experimental snail diets (Diets II - V) containing at least 20 % crude protein, the Diet I which is a modified feed formulation of Cobbinah et al., (2008) served as the control.

Table 1. Composition of experimental diets

INGREDIENTS	DIET I	DIET II	DIET III	DIET IV	DIET V
Maize	31.5	31.5	31.5	31.5	31.5
Protein source	64.8	47.8	30.55	13.3	
Bone meal	1.20	1.20	1.20	1.20	1.20
Limestone	2.25	2.25	2.25	2.25	2.25
Premix	0.25	0.25	0.25	0.25	0.25
Quail droppings		17	34.25	51.5	64.8
	100	100	100	100	100

Plastic feeding troughs were used to provide feeds and water to the snail, and 15g of wet snail feed was fed to the snails in each room per day between 4:00 and 6:00 pm for 12 weeks. Since snails are nocturnal and eat mostly at night they were fed with the Diet every evening The daily feed intake was determined by subtracting the weight of leftover feed from its previous value before feeding the snails.

Data collection

Data such as the snail weight and the length was taken twice in a week i. e Mondays and Thursdays while the cleaning of the snail house was done every day. Three snails each per replicate in treatment were marked for data collection. The growth performance of the snails was determined by measuring the following parameters every week. Bodyweight was taken using a weighing balance (Camry electronic kitchen scale model EK 5350. O.1g), shell length and shell width were measured with Vernier callipers, and feed conversion ratio was calculated.

Chemical Analysis

The thirty marked snails from each treatment were picked, sacrificed and processed into a powder and a portion used for proximate composition determination using standard A.O.A.C. methods (A.O.A.C.,

2006). The mineral analysis was carried out on the remaining portion using Atomic Absorption Spectroscopy (A.A.S.), after digestion using Hydrochloric acid and Nitric acid

Statistical Analysis

One-way analysis of variance (ANOVA) was used to analyze data collected in a Completely Randomized Design using the Statistical Package for Social Sciences, (S.P.S.S.) Version 17.0. Means of significant results were separated using Duncan Multiple Range Test at 5% probability level.

RESULTS AND DISCUSSION

Proximate Composition of the Experimental Diets

All the diets were well received and eaten by the snails, but the consumption of the diets by the snails varied significant ($p<0.05$). There was no definite pattern of feeding during the experimental period; the amount of feed consumed was high in the first four weeks of the experiment, followed by a decline in feed intake from week five. Hence confirms South (1992) and Ademolu et al. (2004) findings that snails have more preference for new food than a familiar food

As shown in Table 2, there was a significant difference ($P<0.05$) in the proximate composition of the experimental diets. Diet V (100% quail dropping meal) has the highest per cent crude protein, fibre and ash concentration and the snails fed with this Diet gave the best performance and probably satisfying the growth requirement for snails Siyanbola, 2008.

Table 2 Proximate composition of experimental diets %DM

Diet	moisture	ash	fat	fibre	protein	Carb	energy
[	10.80^{ab}±.28	9.01^{a}±.74	4.02^{c}±.16	5.39^{a}±.38	26.42^{a}±1.17	44.37^{a}±.71	313.96^{c}±10.84
II	10.70^{a}±.07	10.52^{b}±.07	3.51^{c} ±.08	6.37^{b}±.07	29.22^{b}±08	39.68^{b}±.04	312.51^{c}±6.27
III	10.67^{a}±.16	11.71^{c}±.15	3.37^{b}±.14	7.85^{c}±.14	31.44^{c}±.13	34.96^{c}±.13	295.91^{b}±1.31
IV	10.89^{a}b±.09	13.43^{d}±.09	3.24^{b} ±.06	8.85^{d}±.14	32.58^{c}±.06	31.02^{d}±.15	283.55^{b}±.87
V	11.17^{b}±.08	15.23^{e}±.01	2.82^{a}±.10	10.31^{e}±.11	34.49^{d}±.09	25.99^{e}±.03	267.28^{a}±.64

Different superscript on mean values in the same row indicate significant difference ($P < 0.05$).

Growth Performance of Snail

As depicted in Table 3, no definite pattern was observed in the level of feeding by the snails as the level of inclusion of Q.D.M. increases. Highest feed intake (245.50 g) was observed in snails fed Diet V, and the lowest feed intake of 181.50 g and 182.75 g were observed in those fed Diet I and II. The result of statistical analysis showed a significant difference in the F.C.R., with snails on Diet I having the highest (3.75) value followed by Diet II. Diet V had the lowest F.C.R. value (2.74) There was an appreciable weight gain by the experimental snails. Still, no significant difference between the experimental snails fed on Diet I- IV, however, weight gained by snail fed Diet V differed significantly and was the highest (75.45 g). The result is in agreement with the claim of other researchers that weight

gain and feed efficiency were improved with a higher amount of dietary protein and energy (Onimisi and Omage 2004). The shell length gain in the experimental snails varied significantly, snails on Diet I had the highest shell length gain while snails on Diet III recorded the least shell length gain. There was a remarkable width gained by the experimental snails. Snails fed on Diet V had the highest width gain while snails fed on Diet I had the lowest width gain. This result agreed with the findings of (Ademolu et al. (2004) that poultry droppings increased shell width and weight of snails. Quail dropping having higher nitrogen content which can be easily converted by animals to proteins will have an appreciable effect more significant than that of poultry droppings on the width gain, length and weight of snails. Comparatively, compounded diets have an excellent role to play in the farming of the snail all year round without facing scarcity of food during the dry period as against plant Ejidike and Afolayan (2010).

Table 3 Growth response and nutrient utilization of snail fed experimental diets

Growth parameters	DIET I	DIET II	DIET III	DIET IV	DIET V
Initial weight(g)	153.95±5.16	154.15±4.45	149.30±8.49	159.95±2.33	162.93±6.1
Final weight(g)	218.23±5.13	218.95±4.10	215.54±9.54	226.71±3.38	237.38±15.
Weight gain(g)	64.28±.04	64.80±.35	66.24±1.05	66.76±1.05	75.45^{b}±9.1
Initial width(cm)	50.80±.00	51.45±1.41	51.90±2.26	52.48±.25	54.00±2.83
Final width(cm)	68.58±.00	69.46±1.91	70.07±3.05	70.84±.33	72.90±3.82
Width gain(cm)	17.78±.00	18.01±.49	18.17±.79	18.37±.09	18.90±.99
Initial length(cm)	104.73^{b}±.81	102.45^{ab}±1.3	101.10^{a}±.42	103.25^{ab}±1.20	104.53^{b}±.3
Final length(cm)	147.66^{b}±1.1	144.45^{ab}±1.8	142.55^{a}±.60	145.58^{ab}±1.69	147.38^{b}±.4
Length gain(cm)	42.94^{b}±.33	42.00^{ab}±.55	41.45^{a}±.17	42.33^{ab}±.49	42.86^{b}±.13
Feed intake(g)	181.50a±6.3	182.75a±3.1	204.50b±12.0	193.75^{ab}±1.77	245.50c±.0
FCR	3.75^{a}±.00	3.16^{b}±.01	2.92^{bc}±.00	2.82^{c}±.01	$2.74.^{c}$±.00

Different superscript on mean values in the same row indicate significant difference ($P < 0.05$).

Proximate Composition of the Snail Flesh

Proximate analysis of the snail flesh as presented in Table 4, revealed that the protein contents of the snail reared with Diet I and Diet II are statistically the same, and the crude protein content of snails fed Diet III to V were significantly different ($p<0.05$). 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. The observation is also in line with the findings of Adeyemo and Borire (2000) that reported significant differences in the body weight gain of snails fed with different levels of yam peel. The result of the morphological properties and proximate analysis of the flesh of snails fed on the above Diet comprising of varying ratio of quail droppings, confirmed the work of other researchers such as Ademolu et al. (2004), Ilelaboye and Adegbola (2018) that snails have the ability to convert nitrogen

content in animal waste into bodyweight. This could probably explain the high daily weight gain, and total weight gain of the snail fed with Diet V. Therefore, the use of quail droppings in the formulation of feed for A. marginata will positively affect the performance and the nutritional value of the snail.

Table 4 Proximate Composition, the flesh of *A. marginata*, fed Quail Droppings Meal Supplemented diets

Diets	Moisture	Protein	Fat	Ash	Fibre	Carb	Energy
I	69.46^{d}±.06	22.28^{a}±.07	2.81^{c}±08	2.83±.14	1.30^{c}±.07	1.32^{a}±.11	119.88^{a}±1.06
II	69.34^{d}±.02	22.43^{a}±.16	2.68^{c}±04	2.92±.11	1.33^{c} ±.13	1.30^{a} .07	119.02^{a} ±05
III	68.20^{ab}±.11	22.80^{ab}±.08	2.56^{c} ±.13	3.10±.12	1.16^{bc}±.08	1.90^{b}±.08	124.49^{b}±1.87
IV	68.07^{a}±.07	22.85^{ab}±.49	2.08^{b}±.06	3.08±.07	1.07^{b}±.08	2.36^{c}±.07	119.52^{a}±2.27
V	68.27^{b}±.03	23.38^{b}±.04	1.62^{a}±.04	3.18±.18	$.82^{a}$±.04	2.74^{d}±.16	119.06^{a}±.83

Different superscript on mean values in the same row indicate significant difference ($P < 0.05$).

Mineral content

All the minerals observed in the flesh of African Giant Land Snails presented in table 5 showed significant difference ($P<0.05$) across the treatment groups. Minerals analysis of the snail showed the presence of Sodium (Na), Potassium (K), Calcium (Ca), Magnesium (Mg), Iron (Fe) and Phosphorus (P). All these minerals are essential for the average growth and proper metabolism and utilization of other nutrients in the human body but at a minimal level. The effect of the diets on mineral concentration in the flesh followed a definite increasing pattern. As the level of inclusion of Q.D.M. increases, mineral concentration also increases. Diet V was recorded to have the highest amount of all the minerals while snails fed Diet I with no inclusion of Q.D.M. recorded the lowest concentration of minerals. The high concentration of minerals in the experimental diets could be attributed to the presence of Uric acid in Quail droppings. Like poultry droppings, wil linhibit the microbial synthesis of essential vitamins and minerals of the host (Ebously and Vander Poel, 1994). The consumption of snails fed with Diet V could increase the level of Sodium (Na), Potassium (K), Calcium (Ca), Magnesium (Mg), Iron (Fe) and Phosphorus (P) in the body and contribute to normal blood clotting, calcification of bones and teeth, the formation of the bone structure of the body and iron absorption in the blood which prevent anaemia (Fagbuaro et al., 2016)

Table 5: Mineral composition of the flesh of snails, A. marginata fed Quail Droppings Meal Supplemented diets

Minerals	**Diet I**	**Diet II**	**Diet III**	**Diet IV**	**Diet V**
Sodium (Na)	33.23^{a}±.69	35.82^{b}±.71	37.41^{ab}±.73	39.56^{c}±1.06	41.89^{d}±1.07
Potassium (K)	115.34^{a}±1.41	121.90^{b}±1.41	131.12^{c}±1.41	136.79^{d}±.74	142.03^{e}±1.2

Calcium (Ca)	106.31^{a}±.01	111.25^{b}±.73	121.68^{c}±.75	126.26^{d}±1.27	137.08^{e}±.72
Magnesium (Mg)	17.71^{a}±1.43	21.87^{b}±1.42	20.88^{bc}±.92	23.37^{bc}±.69	24.01^{c}±.47
Iron (Fe)	2.35^{a}±.01	2.70^{ab}±.01	3.25^{bc}±.04	3.63^{c}±.03	4.70^{d}±.69
Phosphorus (P)	4.70^{d}±.69	18.96^{a}±1.43	20.16^{ab}±.72	21.37^{bc}±.64	22.49^{c}±.59

Different superscript on mean values in the same row indicate significant difference ($P < 0.05$).

CONCLUSION

Quail Droppings Mean (Q.D.M.)as clearly stated in the results of this present study has no detrimental effects on the nutritional quality of snail meat. Its use as a replacement for other expensive protein sources such as Soybean meal, Groundnut cake, cottonseed cake etc. should be encouraged in formulating diets for snails. The highest inclusion level used in this study helps raised the nutrient contents of the snail meat above the control group. Its cheap, simple to process and useful protein features make it a good source of protein in snail feed.

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