Implication of Snails Haemolymph Fed with Formulated Diets Using Quail Droppings Meal as Sources of Protein on *Archachatina marginata* .

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Abstract

The challenge in snails rearing involved knowing how to formulate the feed that will meet the nutritional requirements of snails,most importantly in the dry season when almost all the vegetation are dried up. So, the aimed of the study is to formulate snail's feed using Quail Droppings Meal (QDM) and to ascertain how it can supplement the leaves which are commonly used in feeding snails. Four experimental feeds I -V with QDM of different ratios as source source of protein were formulated and chemical composition of the snails haemolymph were determined using standard procedures. Snails that were given feed V, consumed the highest amount of feed with high weight and width while the snails that were given feed I, has the highest Feed Conversion Ratio (FCR) and shell length. Snail haemolymph was analysed for its proximate which revealed that crude protein and ash contents value were low in snails treated with feed I and was highest in snails with feed V. Also, the mineral contents of snails hemolymph were analyzed for which recorded that snails treated with feed V had the highest value of phosphorus, calcium, iron, magnesium, potassium and sodium. The result of the study based on the result of analysis indicated that the formulated feeds with QDM were well-consumed by A. marginata which also increased their growth performance, more than the control feed which did not contain QDM.

Keywords: Formulated feed**,** growth performance, mineral contents, snail haemolymph.

Introduction

Snails are invertebrates ranging from the size of a palm nut or even less to an adult fist or a little larger. Snails belong to the phylum Mollusca, class *Gastropoda*, a soft bodied animal which characteristically move on their belly and are often enclosed in a spirally coiled shell. (Ademolu**,** Idowu, Mafiana, and Osinowo, 2004; Cobbinah, Vink, and Onwuka, 2008). They are found extensively in the Southern parts of Nigeria and the entire West African Coastal Area, Central and South Africa, where the weather is most favourable for their proliferation (Herbert and Kilburn, 2004). The calcareous shell of the snail when burnt, ground into powder, mixed with oil has been applied to boils by many indigenous Africans as a form of treatment.

The “blood” of the snail is technically called the “haemolymph.” It is a colourless to bluish fluid that carry nutrients to cells, performs therm o-regulation, ionic balance, general homeostasis and pH regulation. The haemolymph is made up of of water, organic compounds (hormones, carbohydrates, proteins (amino acids), and lipids) and inorganic salts (magnesium, calcium, sodium, potassium and chlorides). The haemolymph has a primary oxygen transporter molecule called haemocyanin. The haemolymph produced by the snails can also be used to cure hypertension, ulcer and asthma, kidney diseases, tuberculosis and anaemia (Odowu, *et al*., 2004). Due to the tremendous medical property of snail, there is a growing interest for snail, hence the growth in snail farming. The population of snails in the world is reduced by indiscriminate hunting and deforestation, which destroy the snail’s habitat. Rearing of land snails as a domestic animal would therefore help in some measures to satisfy the demand and survival of the species. However, one problem facing the rearing of snails is formulating an improved diet that will meet the nutrient requirement of snails at a cheaper cost, especially during the dry season when agricultural food of snails will not be available.

To achieve formulation of feed successfully, protein contents of the feed must be considered, since it plays an important role in animals’ well-being which includes growth, maintenance, hormonal and enzymatic activities. It has been shown that poultry litters can serve as potential source of protein because of its non-protein nitrogen (NPN) that can be easily converted to protein by animal and it is a cheaper source of protein when compared with commercial source of protein which are beyond small scale snail farmers (Ademolu, *et al;* 2004, Ilelaboye and Adegbola, 2018). When consider QDM as source of protein for formulation of animal feeds, there is no or little documentation concerning that. The purpose of this research was to evaluate the parameters contained in snails haemolymph of *A. marginata* treated with Quail droppings as protein source.

Materials and Method

Location and Source of Materials

The research was carried out in the Department of Science Laboratory Technology, Federal Polytechnic Ilaro, and Department of Science Laboratory Technology, Redeemer’s College of Technology and Management, Ogun state, Nigeria. The quail litter that was used in this research was gotten from a commercial farm in Ilaro and were droppings of caged layers. The quail droppings samples were sun-dried for seven days and were been turning at intervals to ensure the penetration of sun into the samples. When dried, the sorting was done to ensure that the stones and other foreign materials that might be in the litter was removed. Then, a hammer mill was used to ground the droppings into fine powder to produce quail dropping meal of 2 mm particle size.

Experimental Snails and Treatments

An average weight of 153.7g of fifty *(*50) species of edible *A. maginata* were bought from the local snail farm and was brought to the animal house for the experiment. Loamy soil was collected from the botanical garden and was packed in polyethylene nylon which was sterilized using autoclave at 121ºC for 15mins. This is done to kill any microorganisms in the loamy soil collected that might have a negative effect on the experimental snails. An artificial habitat of the snail was built for snail samples with cage which has an adequate perforations to enable easy-flow of air and proper drainage. The cage is made up of five segments, each segment has two rooms. The built cages were filled up to 6cm with treated loamy soil. Then, the dried leaves of *Terminalia catappa* were placed over the soil to serve as mulch for the soil. Ten (10) snails were introduced into each segment of the cage which serve as their habitat. The artificial habitat was ensured to sprinkled with water twice daily in order to maintain moist environment and to keep the snail alive and vibrant at all time.Then, 15g of formulated feeds (Weight I, W 1) were introduced to the experimental snails every evening at the hours of 4.00pm and 6.00pm for eighty-four days (12 weeks). The reason for feeding them at this stipulated time is that the snails are nocturnal animals and feed mostly at night (Ademolu, 2004). Every morning, the leftover feeds are recovered and re-weighed to ascertain the quantity consumed by the animals per day (Weight II, W II) and cage was cleared of snails' excreta to prevent the accumulation of pathogenic microorganisms and to ensure oxygen circulation. The amount of feeds consumed per day was determined by subtracting the weight of leftover feed (W II) from its previous weight before feeding the snails (W I). The determination feeds intake can be calculated as feeds conversion ratio (F.C.R.)

Experimental Feeds

Different ratios of quail droppings meal (QDM) at least 20% crude protein which served as protein sources on the formulated feeds (Feeds II-V) and Feed I which contained no quail droppings but other normal ingredients served as control were prepared.

Table 1. Feed Formulation and Composition of experimental Feeds

INGREDIENTS	FEED I	FEED II	FEED III	FEED IV	FEED 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
Lime stone	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

Data Collection

The following parameters were measured every seven days (every week) to determine its growth performance: Shell length and width using Vernier calipers, Body weight using a weighing balance (Camry electronic kitchen scale model EK 5350.O.1g) and feed conversion ratio using calculation method. After the measurements, three different snails from each treatment were selected and broken at the apex to collect the haemolymph. The Proximate analysis of the snail's haemolymph on different experimental feeds were carried out using standard AOAC methods (AOAC, 2006) while the Mineral analysis was using Atomic Absorption Spectroscopy (AAS). One-way Analysis of variance (ANOVA) was used to analyze the data collected and significant differences were separated by Duncan Multiple Range Test using the Statistical package for the social sciences for windows SPSS (2007).

Results and Discussion

Table 2: **Proximate composition (%DM) and Mineral composition (mg/100g) of the experimental feeds**

parameters	Feed I	Feed II	Feed III	Feed IV	Feed V
Proximate					
moisture	$10.80^{ab}\pm.28$	$10.70^{a}\pm.07$	$10.67^{a}\pm.16$	$10.89^{a}b\pm.09$	$11.17^{b}\pm.08$
protein	$26.42^{a}\pm1.17$	$29.22^{b}\pm08$	$31.44^{c}\pm.13$	$32.58^{c}\pm.06$	$34.49^{d}\pm.09$
fat	$4.02^{c}\pm.16$	$3.51^{c}\pm.08$	$3.37^{b}\pm.14$	$3.24^{b}\pm.06$	$2.82^{a}\pm.10$
fibre	$5.39^{a}\pm.38$	$6.37^{b}\pm.07$	$7.85^{c}\pm.14$	$8.85^{d}\pm.14$	$10.31^{e}\pm.11$
ash	$9.01^{a}\pm.74$	$10.52^{b}\pm.07$	$11.71^{c}\pm.15$	$13.43^{d}\pm.09$	$15.23^{e}\pm.01$
Carbohydrate	$44.37^{a}\pm.71$	$39.68^{b}\pm.04$	$34.96^{c}\pm.13$	$31.02^{d}\pm.15$	$25.99^{e}\pm.03$
Energy	$313.96^{c}\pm10.84$	$312.51^{c}\pm6.27$	$295.91^{b}\pm1.31$	$283.55^{b}\pm.87$	$267.28^{a}\pm.64$
Minerals					
Sodium	$484.58^{a}\pm.59$	$525.37^{b}\pm.87$	$584.22^{c}\pm.40$	$622.45^{d}\pm1.07$	$683.24^{e}\pm1.08$
Potassium	$831.69^{a}\pm.44$	$901.20^{b}\pm1.34$	$969.98^{c}\pm7.4$	$1041.85^{d}\pm.49$	$1105.85^{e}\pm1.20$
Calcium	$65.07^{a}\pm.66$	$69.58^{b}\pm.95$	$87.57^{c}\pm1.09$	$95.71^{d}\pm.27$	$108.51^{e}\pm.69$
Magnesium	6.15 ± 1.10	$6.32\pm.60$	$7.19\pm.38$	$7.57\pm.20$	$7.97\pm.91$
Iron	$84.60^{a}\pm.40$	$89.80^{b}\pm.46$	$97.36^{c}\pm.44$	$104.57^{d}\pm.71$	$112.09^{e}\pm.49$
Phosphorus	$21.43^{a}\pm.18$	$21.74^{a}\pm.44$	$26.10^{b}\pm.42$	$28.36^{c}\pm.20$	$29.58^{c}\pm.1.03$

(2021)

The snails were fed according to the formulation of the experimental feeds but the consumption of the feeds varied significantly ($p<0.05$). The feeding was done by dropping the feeding plates in their cages which around them to feed themselves. The record revealed that the amount of feed consumed by snails during the first four weeks was high but reduced from week five. The records supported, Ademolu, *et al*. (2004) findings which stated that snails have more preference for new food than a familiar food. The proximate composition of the experimental feeds. Diet V (100% quail dropping meal) recorded the highest percentage of fibre, ash concentration and crude protein with best performance and probably satisfying the growth requirement for snails as recorded in Table 2 above. This result agreed with Siyanbola, 2008, which stated that crude protein in the animal diets increases their growth performance. The result of the mineral analysis of the experimental feeds recorded all the parameters analyzed for has the significant difference (P<0.05) except magnesium where significant difference does not exist.(Table 2) This result indicated that there was an increase in the concentration of all the minerals from feed I to feed V.

3.1 Growth Performance of Snail

Table 3 Growth performance and nutritional absorbance of snail's Haemolymp fed experimental feeds.

Growth parameters	FEED I	FEED II	FEED III	FEED IV DIET IV	FEED V
Initial weight(g)	153.95±5.16	154.15±4.45	149.30±8.49	159.95±2.33	162.93±6.19
Final weight(g)	218.23±5.13	218.95±4.10	215.54±9.54	226.71±3.38	237.38±15.38
Weight gain(g)	64.28±.04	64.80±.35	66.24±1.05	66.76±1.05	75.45^{b}±9.19
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}±1.34	101.10^{a}±.42	103.25^{ab}±1.20	104.53^{b}±.32
Final length(cm)	147.66^{b}±1.15	144.45^{ab}±1.89	142.55^{a}±.60	145.58^{ab}±1.69	147.38^{b}±.45
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)	181.50^{a}±6.36	182.75^{a}±3.18	204.50^{b}±12.02	193.75^{ab}±1.77	245.50^{c}±.00
FCR	2.82^{a}±.00	2.82^{a}±.01	3.09^{b}±.00	2.90^{ab}±.01	3.25^{c}±.00

(2021)

As shown in Table 3, there was no clear trend in the amount of feeding by the snails as the degree of Q.D.M. inclusion increased. The snails fed Feed V had the highest feed consumption (245.50g), while Feed I and II had the lowest intake (181.50g and 182.75g, respectively). A substantial difference in the F.C.R. was revealed by statistical analysis, with snails on Feeds I and II having the lowest value (2.82). The F.C.R. value for Feed V was the highest (3.25). The experimental snails significantly increased in weight, however there was no discernible difference in the experimental snails' weight increase between Feeds I through IV;

nevertheless, the weight obtained by snails on Feeds V was significantly different and was the highest (75.45g). The findings support the hypothesis made by earlier researchers that increasing dietary protein and energy improves weight gain and feed efficiency (Onimisi and Omage 2004). Snails on Feed I had the maximum shell length gain, whereas snails on Feed III recorded the lowest shell length gain. The experimental snails' shell length gain varied greatly. The experimental snails grew a stunning amount of breadth. Feed V-fed snails gained the most width whereas Feed I-fed snails gained the least width. Due to the diet's high crude protein and mineral content, the observed maximum mean weight and shell width growth in snails fed with Feed V as shown in table 2. These agree with research by Adeyeye (2000), Ademolu (2004), Ilelaboye and Adegbola (2018), and Siyanbola (2008) showing that snails may use nutrients found in animal excrement to grow their bodies and shells. Comparatively, compounded diets have a great deal to offer in the year-round farming of snails without having to worry about a lack of food during the dry season as opposed to Ejidike and Afolayan, (2010).

3.2 Proximate and Mineral Composition of the Snail Haemolymph

Table 4: Proximate and Mineral Composition of the Snail Haemolymph.

parameters	Diet I	Diet II	Diet III	Diet IV	Diet V
Proximate					
Dry matters	4.81^{a}±.14	5.37^{b}±.08	6.06^{c}±.04	6.45^{d}±.14	7.17^{e}±.14
protein	37.26^{a}±.08	38.26^{b}±.07	39.31^{c}±.06	40.34^{d}±.35	41.35^{e}±.04
fat	14.41^{a}±.13	15.07^{b}±.08	15.65^{c}±.14	16.11^{d}±.04	16.81^{e}±.16
ash	1.16^{a}±.23	1.30^{a}±.03	1.49^{ab}±.00	1.78^{b}±.14	1.83^{b}±.11
Carbohydrate	42.36^{a}±.04	40.01^{b}±.04	37.50^{c}±.25	35.33^{d}±.04	32.85^{e}±.13
Energy	447.94±1.33	448.90±.88	448.06±.52	447.70±1.05	448.68±.17
Minerals					
Sodium	1.33±.30	1.55±.03	1.27±.78	2.04±.35	2.07±.64
Potassium	1.07^{b}±.37	$.70^{ab}$±.11	83^{ab}±.33	$.90^{b}$±.01	2.2^{b}±.05
Calcium	1.20±.15	.76±.35	1.73±.15	1.18±.33	1.50±.73
Magnesium	.53±.03	.43±.06	84±.30	.86±.58	1.03±.66
Iron	25.79^{a}±.66	27.93^{ab}±.43	28.55^{bc}±1.91	31.03^{cd}±.69	31.71^{d}±.66
Phosphorus	14.52^{a}±.37	14.56^{a}±72	15.27^{a}±.34	16.81^{b}±.37	17.45^{b}±.23

(2021)

By increasing the amount of Quail Droppings Meal (QDM) in the experimental feeds, it was found that the proximate composition of the snails' haemolymph increased significantly (p 0.05) and included dry matter (4.81% -7.17%), crude protein (37.26% -41.35%), fat (14.41% - 16.81%), and ash (1.16% -1.73%) (Table 4). Haemolymph's carbohydrate content decreased significantly (p 0.05) from 42.36% (diet I) to 32.85% (feed V). The energy values of the haemolymph of snails raised on the experimental feeds did not differ significantly (p 0.05). The present study's high haemolymph protein content is consistent with the USDA research from 2006 on the nutritional protein value of snail hemolymph which indicated that snails are rich in high-quality proteins (containing all essential amino acids). The results of the mineral profile of snails' haemolymph were displayed in Table 4. Iron (27.93-31.71 mg/100g), phosphorus (14.52-17.45 mg/100g), calcium (0.76-1.50 mg/100g), potassium (0.70-2.20 mg/100g), sodium (1.33-2.07 mg/100g), and magnesium (0.43-1.03 mg/100g) were the only minerals with significant (p0.05) differences in all treatment groups. The highest concentrations of sodium, potassium, calcium, and phosphorous were found in the haemolymph of experimental snails fed feed V, while the highest concentrations of magnesium and iron were found in the haemolymph of experimental snails fed feed I. Iron has the greatest concentration of all the minerals found in haemolymph after testing. The high consumption of snails' haemolymph by pregnant women may be caused by the high content of iron and the presence of other essential minerals including calcium, magnesium and zinc while snails on feed I recorded the highest concentration of magnesium and iron in haemolymph of the experimental snails. Of all the minerals tested for in haemolymph, iron recorded the highest concentration. High concentration of iron and the presence of other vital minerals like calcium, magnesium and zinc may be responsible for the high intake of snails' haemolymph by pregnant women according to Adeyeye, (1996). The inclusion of quail droppings in the formulation of A. marginata feed has a good impact on the snail's nutritional value.reported by Adeyeye, (1996). The use of quail dropping in the formulation of feed for *A. marginata* positively affect the nutritive value of the snail.

Conclusion

The findings of this investigation demonstrated that diet V had a favorable impact on the proximate and mineral content of the haemolymph. As a result, the inclusion of quail droppings in the formulation of the snail's food will increase its nutritional content. Since farmers will have access to these things for nearly nothing, farmers can afford them..

References

Ademolu, K.O., Idowu, A.B., Mafiana, C.F and Osinowo, O.A (2004). Performance Proximate and Mineral Analyses of African Giant Land Snail (*Archachatina marginata*) Fed Different Nitrogenous Sources; *Afr. J. of BPiotech.* 3(**8**): 412 - 417.

Ademolu, K.O. and Idowu, A.B. The Use of Poultry Dropping as Snail Feed. *Journal of Animal and Veterinary Advances*. 2005; 4(**6**):566-569

Adeyeye, E.I. (1996). Waste yield, Proximate and mineral Composition of three different types of land snail found in Nigeria. *International Journal of Food Science and Nutrition* 42(**2**): 111-116.

Akinnusi, O. (2002). Introduction to snail and snail farming. Triolas Exquisite Ventures. Abeokuta. 25pp

A. O.A.C., (2006). Official methods of Analysis of association of official analytical chemists, 18th Edition;

Cobbinah, J.R., Vink, A. and Onwuka B., (2008). Snail Farming: Production, Processing and Marketing, (Agromisia Foundation, Agrodok 47 and C.T.A., Wageningen.)

Emelue, G. and Dododawa, Z. (2017). Nutritional Composition of African Giant Land Snail (*Archachatina marginata*) Fed on Diet from Different Protein Sources. *Journal of Agriculture and Ecology Research International*, *13*(**1**), 1-7. https://doi.org/10.9734/JAERI/2017/33927

Ejidike, B. N. and Afolayan, T. A (2010). Effects of natural and compounded rations on the growth performance of African Giant Land Snail (*Archachatina marginata*). *Journal of Research in Forestry, Wildlife And Environment. Volume 2 No.1,*

Herbert, D.G and Kilburn, R.N (2004). Field guide to land to land snail and slugs of eastern South Africa:1-336. Pietermaritzburg, Natal Museum

Ilelaboye, N.O and Adegbola, O.O (2018). Growth Performance and Proximate Composition of *Archachatina marginata* Snail Fed with Formulated Diets Using Pawpaw (*Carcia papaya)* Leaf Meal and Poultry Droppings Meal as Protein Sources. *Journal of Agriculture and Ecology Research International*. 16(**1**): 1-10.

Odowu, O.F., Ogunleye, R.J., Tayo, G.N and Richard, B.A.O (2004). Medical values of snails. *Journal of Microbiology and Antimicrobial*. 3(**4**):13-22

Onimisi, P.A and Omage, J.J (2006). Evaluation of poultry litter as a feedstuff for growing rabbits. Livestock Research for Rural Development 18 (**11**)

Siyanbola, M. F. (2008). Preliminary investigation of the growth performance of Giant land snail (*Archachatina marginata*) fed with selected household wastes. *African Journal of Agricultural Research.* 3(**9**): 647-649.

SPSS Statistical Package for the Social Sciences for Windows, Version 17.0, Chicago, SPSS Inc.; 2007