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Research Article
Effect of Feeding Graded Levels of Poultry Droppings as a Replacement for Palm Kernel Cake on the Growth Response of Young African Giant Land Snails (*Archachatina marginata*)

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Abstract

Background and Objectives: The study was designed to determine the effect of graded levels of poultry droppings as a replacement for palm kernel cake on growth response of young African giant land snails (*Archachatina marginata*). The study also sought to determine the increase in length and feed intake of snails as well as cost of raising snails using conventional feed ingredients and poultry droppings. **Materials and Methods:** A total of 300 young snails were obtained from Ugbogui Market in Benin City near Okada Town, while the sample of 90 snails was used for the study. Before the sample selection the snails were examined by experts as being healthy for the experiment. Three research questions and three null hypotheses guided the study. The increase in length and feed intake of the experimental snails were recorded. Data on length was collected weekly while data on feed intake was collected daily during the experiment. The length of the experimental snails was measured using measuring tape while the feed intake was measured using a weigh-back technique with the digital weighing balance. Data were analyzed using one-way Analysis of Variance (ANOVA). Mean and Standard deviation were used to answer the research questions. **Results:** The findings revealed that snails fed diets containing 50 and 75% of poultry droppings showed the highest increase in length and feed consumption rate respectively. **Conclusion:** Poultry droppings can be used as a partial substitute for palm kernel cake in the diet of snails up to 50 and 75% levels.

Key words: African giant land snails, poultry droppings, feed intake, palm kernel cake, snail farming

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Data Availability: All relevant data are within the paper and its supporting information files.

INTRODUCTION

The traditional practice of capturing snails from the wild is no longer trending. The loss of wild environment due to various human activities like bush burning, farming, building of roads etc., create a situation which has necessitated the snail farming. Cobbinah[1] described snails as invertebrates which belong to a phylum called mollusca with shell. *Archachatina marginata* is the African giant land snail belongs to a family called *Achatinidae* which originates from Western, Eastern and Southern Africa. Different species of snails are found in the forest of tropical countries while some are found in grassland.

The various species of snails that are found both in temperate regions and tropical Africa have been enumerated by Blair and Herron[2] as *Helix aspersa*, *Helix pomatia*, *Helix lucorum*, *Helix cibeta*, *Iberus alonensis*, *Otala-puntala*, *Achatina achatina*, *Achatina fulica*, *Archachatina marginata*, *Archachatina ventricosa*, *Archachatina degneri*, *Limicolaria* species amongst others. According to Blair and Herron[2] the African land giant snails are fleshy, highly prolific, with high adaptability and can survive easily. These unique characteristics of African giant land snail have led to its rearing in Nigeria and other parts of the world where it is found. Blair and Herron[2] also emphasized on snail farming because they are good source of proteins and have a lot of medicinal values. One of the importance of snail farming is that it helps to complement animal protein supply. Okereke-Ejiogu *et al.*[3] stated that snails farming should be well encouraged among the rural dwellers as they hardly can afford other sources of animal proteins which are more expensive while Ajayi in Okonta[4] reported that snail meat contains low saturated fat and lipid contents, which makes it good and fit for patients with hypertension and other people with health challenges who may not want to eat fatty foods. According to Ayodele and Ashimolowo in Okereke-Ejiogu *et al.*[3], snail mucus is used by nursing mothers to treat wounds in the umbilical cord among the Yoruba ethnic group in Western part of Nigeria. Akannusi in Cobbinah[1] reported that the mucus is used by the Igbos in Eastern part of Nigeria to treat heart attack, cardiac arrest, hypertension, stroke and high blood pressure. Its calcium contents also help to make healthy bones in human body. Atanasoff *et al.*,[5] also reported that snail meat is highly rich in lysine, leucine, isoleucine, phenylalanine, arginine, tryptophan, iron, calcium and phosphorus.

For farmers, in Nigeria snails are always available all year round, Blair and Herron[2], stated that it has become necessary to domesticate snails in very conducive and clean enclosure or pen while the farmers provide them with feeds that will enhance and promote their growth. Blair and Herron[2] also stated that the farmers who are interested in snails farming require adequate knowledge of its nutrition. Odo *et al.*[6], reported that the cost of livestock feed ingredients in Nigeria and other parts of the world have been on the increase and this has greatly hindered production of livestock. This situation has led the poultry nutritionists to search for alternative feed ingredients. Poultry waste is one of a potential alternative source of protein for poultry nutrition. Animal protein intake of Nigerians has been reported to be low which is a major cause of malnutrition amongst Nigerians. The low intake of protein is due to the fact that protein is being consumed by both humans and animals and this situation has increased the demand and cost of animal protein. In order to meet the high demand for animal protein, it became important for livestock farmers to domesticate animals whose feed can easily be formulated using some local and readily available ingredients, hence the rearing of snails.

Snail farming is a very cheap livestock production and simple to operate. Snails eat leaves, fruits, vegetables, tubers and household wastes. Snails also feed on conventional feedstuff which is purchased from the manufacturers and most ingredients used in formulating the feed such as maize, sorghum and soybeans are expensive and also used by humans. Plant materials used for snails feeding are seasonal and very expensive more especially during the dry season.

However, due to high cost of feed ingredients and unavailability of the plant materials during dry season, snail farmers could not get balanced diet for snails all year round. If this problem is not resolved, will hinder farmers from producing snails all year round and the few available snails will be so expensive. In order to solve this problem successfully, the researchers decided to try-out alternative feed ingredient that is locally and readily available. It was therefore necessary to study the effect of feeding poultry droppings on growth response of young snails as no investigation has been carried out on replacing palm kernel cake which is usually very scarce during dry season with poultry droppings.

The purpose of the study was to determine the effect of feeding graded levels of poultry droppings as a replacement for palm kernel cake on the growth response of young snails.

Research questions: The following research questions guided the study:

- How much did the increase in the length of African giant land snails fed graded levels of poultry droppings?
- How much did the feed intake of snails as measured by the amount of feed consumed daily?

- Which of the feed ingredients is cheaper to obtain in comparison to growth response of the snails.

Hypotheses: The following hypotheses were formulated and tested at 5% level of significance:

- There is no significant difference in the mean length of African giant land snails fed graded levels of poultry droppings and those fed palm kernel cake
- There is no significant difference in the mean feed intake of snails fed graded levels of poultry droppings and those fed palm kernel cake
- There is no significant difference in the mean cost of feed of snails fed graded levels of poultry droppings and those fed palm kernel cake.

MATERIALS AND METHODS

A true experimental research design was adopted for this study. Alens[7] described true experimental research design as a design which measures and identifies the effect of one variable on another. This design was considered most appropriate for this study because it measured and identified the effect of the independent variable (feed) on the dependent variables. It measured the impact of feed on the growth response of snails. Three research questions were answered and three hypotheses were tested at 5% level of significance. The study was carried out at Ugbowo, near University of Benin, Benin City, Edo State, Nigeria. Benin City is a humid tropical urban settlement which comprises of three Local Government Areas namely Egor, Ikpoba Okha and Oredo. It is the biggest City in Edo State with a population of 1,086,882. It is located within latitudes 6°20'N and 6°58'N and longitudes 5°35'E and 5°41'E[8]. The study was carried out in Edo State considering its appropriate weather condition for snails. A total of three hundred African giant land snails (*Archachatina marginata*) were used for this study which was purchased from snail dealers at Ugbogui Market near Okada Town in Ovia North East Local Government Area of Edo State and were certified by experts from the departments of Animal Science and Forestry/Wildlife, University of Benin, Benin City. The snails were allowed to acclimatize for two weeks during which they were fed vegetables, fruits and formulated feeds before the experiment commenced. The sample size for the study was ninety snails. Purposive and random sampling techniques were used to select the sample. A total of ninety healthy snails were selected from the population based on their suitability for the study. The 90 snails were distributed into 15 pens; each group has 3 pens as replicates. Six snails were distributed into each of the 15 pens.

The materials used to formulate the diets are: Maize (Carbohydrate feed ingredient), Soya bean meal, fish meal and poultry droppings (Protein feed ingredients), Bone meal (Mineral feed ingredient), Vitamin and Mineral Premixes (Additives), Fish meal (Fats and Oil feed ingredients), Poultry droppings (Fiber/protein feed ingredients) and Palm kernel cake. Other materials for the experiment included measuring tape, digital weighing balance, feeders and drinkers. The poultry dropping was collected from a poultry farm in Benin City between 7:00 pm to 9:00 am. The researcher visited the poultry house to request for the droppings. The collected poultry droppings was sun-dried on a clean plastic tray to a considerable moisture content. Foreign objects were removed from the poultry droppings to avoid contamination of the feed ingredient and reduction in crude protein. The sun-drying was carried out for one week after which the poultry droppings was milled, bagged and stored in a cool dry place before it was used to formulate feed at various percentages.

Other feed ingredients (maize, soya bean meal, fish meal, palm kernel cake and additives) were purchased from Uselu Market in Benin City and milled at a feed mill in the same market. The feed samples were taken to the laboratory for proximate analysis according to the method of Association of Official Analytical Chemists[9]. The experimental diets were formulated at 0, 25, 50, 75 and 100% replacement of palm kernel cake with poultry droppings respectively.

Fifteen pens were constructed and used for the experiment. After construction, the pens were washed thoroughly and disinfected a week prior to the assigning to the snails. The floor of the pens was covered with topsoil (loamy soil) to about 6cm high from the bottom. The soil was heated with fire to kill germs and ants before it was introduced into the pens. The feeders and drinkers (plastic containers) were also washed thoroughly. The snails were trial-fed for two weeks (14 days) prior to the commencement of the experiment for physiological adjustment. Before the commencement of the experiment, the snails were weighed using a sensitive digital weighing balance and subsequently on a weekly basis. The ninety snails were randomly assigned to five treatment groups with three replicates each in a completely randomized design. Water was provided *ad libitum* in the pen and each treatment group was fed with a particular diet daily for thirteen weeks (3 months). Feed intake and length of the snails were measured during the experiment. The length was determined using measuring tape on weekly basis while the feed intake was determined daily using weigh-back technique. It means that a known quantity of feed given to each experimental unit was weighed daily and recorded. The left-over feed in the feeders as well as wasted feed on the floor of the pen was collected, weighed

and recorded every morning before giving fresh feed to the snails. Quantity of feed consumed by the snails was determined thus: (Quantity Given-Quantity left over).

The feeders and drinkers were emptied and washed daily before using them to serve fresh feed and water. Their faeces were scooped from the floor of the pens to prevent microbial infestation. Water was also sprinkled on the floor of the snail pens daily to keep and maintain appropriate humidity and temperature needed for snail growth and optimal performance. The soil in the pens was changed monthly (after four weeks) to prevent pathogens of snail disease.

Statistical analysis: Data collected was subjected to One-Way Analysis of Variance (ANOVA) for testing of hypotheses at 5% level of significance using Statistical Package for Social Sciences (SPSS). The decision rule was: if 'P' is less than or equal to 0.05, it is significant, therefore the null hypothesis would be rejected but if 'P' is greater than or equal to 0.05, it is not significant and the null hypothesis would be accepted. The difference between the treatment means were tested using the Duncan's New Multiple Range Test. Tables and percentages were used to report data on the nutrient composition of the feed ingredients.

RESULTS

Research question 1: How much did the increase in the length of African giant land snails fed graded levels of poultry droppings?

Table 1 shows increase in the length of snail fed different dietary treatments. Snails fed diet 3 (50% poultry droppings) showed the highest mean length of 203.01 followed by diet 2 (25% poultry droppings) with mean length of 202.79. Snails fed with diet 4, 5 and 1 showed the mean length of 199.11, 187.69 and 186.56 respectively, indicating that 75, 100 and 0% levels of replacement did not show better growth performance.

Hypothesis 1: There is no significant difference in the mean length of African giant land snails fed graded levels of poultry droppings and those fed palm kernel cake.

Table 2 shows that there was a significant difference in the total increase in length of the snails fed graded levels of poultry droppings and those fed palm kernel cake. The null hypothesis was rejected as the p-value (0.041)<0.05.

Table 3 shows non-significant difference in the mean values of diets 1, 4 and 5; thus carrying the superscripts (a). Diets 2, 3 and 4 also showed non-significant difference in the mean values of increase in length. Meanwhile, diets 1, 2 and diet 3, 5 showed a significant difference as they carried different superscripts (a and b).

Research question 2: How much the feed intake of growing snails as measured by the amount of feed consumed daily?

Table 4 shows that the feed intake of growing snails fed with diet 4 (75% poultry droppings) was the highest with mean value of 171.72 followed by snails fed with diet 2 (25% poultry droppings) with mean value of 160.14. Snails fed with diet 5, 3 and 1 showed mean values of 154.98, 146.18 and 121.18 respectively.

Hypothesis 2: There is no significant difference in the mean feed intake of growing snails fed graded levels of poultry droppings and those fed palm kernel cake.

Table 5 shows that there was no significant difference in the mean value of feed intake of snails fed graded levels of poultry droppings and those fed palm kernel cake as the p-value (0.19)>0.05. Therefore, the null hypothesis was accepted.

Research Question 3: Which of the feed ingredients is cheaper to obtain in comparison to growth response of the snails?

Table 1: The increase in length of snails fed graded levels of poultry droppings

Treatments	Mean (g)	Standard deviation	Standard error mean	Degree of freedom	F-calculated	Significance
Diet 1 (0%)	186.56	14.45				
Diet 2 (25%)	202.79	25.53				
Diet 3 (50%)	203.01	23.77	2.32	89	2.62	0.04
Diet 4 (75%)	199.11	25.84				
Diet 5 (100%)	187.69	12.95				

Table 2: Analysis of Variance (ANOVA) of the mean of increase in length of snails fed graded levels of poultry droppings

	Sum of square	Degree of Freedom	Mean square	Frequency	Significance	Decision
Between groups	4733.103	4	1183.276			
Within groups	38438.614	85	452.219	2.617	0.041	Rejected
Total	43171.717	89				

Table 6 shows that the feed cost of diet 5 (100% poultry droppings) is the cheapest of all the feeds having the least mean value of 81.00. Diet 4 containing 75% poultry droppings showed a mean value of 83.17 while Diet 3 containing 50% poultry droppings showed a mean value of 85.33. Diet 2 containing 25% poultry droppings and diet 1 which is the control group with 0% poultry droppings showed mean values of 87.50 and 89.67 respectively.

Hypothesis 3: There is no significant difference in the mean cost of feed of growing snails fed graded levels of poultry droppings and those fed palm kernel cake.

Table 7 shows that there was a significant difference in the mean cost of feed of snails fed graded levels of poultry droppings and those fed palm kernel cake as the p-value (0.00)<0.05. Therefore, the null hypothesis was rejected.

Table 8 shows that there was not significant difference in the mean values of diets 1, 2 and 3, thus carrying the superscripts b. Also, diets 3, 4 and 5 showed no significant difference in the mean values of feed cost. There was no significant difference in the snails fed diets 1 and 2, as well as diets 4 and 5. Meanwhile, diets 1 and 2 and 4 and 5 showed a significant difference.

DISCUSSION

The result as shown in Table 1 revealed that the snails fed diet 3 containing 50% poultry droppings showed the highest increase in the mean length (203.01). The snails fed diet 3 showed the better growth performance than those fed diet 1, 2, 4 and 5. There was a significant difference in the mean length of snails fed graded levels of poultry droppings and those fed palm kernel cake. This is in agreement with the findings of Akankali and Nwafili[10] who reported that dried poultry manure can be used as substitute for fish meal to replace soyabean meal in the diets.

Table 2 shows that snails fed diet 4 containing 75% poultry droppings showed the highest mean feed intake (171.72). Table 2 also shows that snails in all the treated

Table 3: Duncan's Post Hoc test for increase in length of snails fed graded levels of poultry droppings

		Subset for alpha = 0.05	
Groups	N	1	2
Diet 1	18	186.56[a]	
Diet 2	18		202.79[b]
Diet 3	18		203.01[b]
Diet4	18	199.11[a]	199.11[b]
Diet 5	18	187.69[a]	

Table 4: The feed intake of snails fed graded levels of poultry droppings

Treatments	Mean (g)	Standard deviation	Standard error mean	Degree of freedom	F-calculated	Significance
Diet 1 (0%)	121.18	46.29				
Diet 2 (25%)	160.14	43.10				
Diet 3 (50%)	146.18	40.89	6.83	89	1.59	0.19
Diet 4 (75%)	171.72	77.34				
Diet 5 (100%)	154.98	93.79				

Table 5: Analysis of Variance (ANOVA) of the mean of feed intake of snails fed graded levels of poultry droppings

	Sum of square	Degree of freedom	Mean square	Frequency	Significance	Decision
Between groups	25932.832	4	6483.208			
Within groups	347667.615	85	4090.207	1.585	0.186	Accepted
Total	373600.447	89				

Table 6: The cost analysis of snails fed graded levels of poultry droppings

Treatments	Mean (g)	Standard deviation	Standard error mean	Degree of freedom	F-calculated	Significance
Diet 1 (0%)	89.67					
Diet 2 (25%)	87.50					
Diet 3 (50%)	85.33	61.66	27.58	4	0.00	0.00
Diet 4 (75%)	83.17					
Diet 5 (100%)	81.00					

Table 7: Analysis of Variance (ANOVA) of the mean of cost analysis of snails fed graded levels of poultry droppings

	Sum of square	Degree of freedom	Mean square	Frequency	Significance	Decision
Between groups	15210.000	4				
Within groups	0.000	0	3802.500	0.000	.000	Rejected
Total	15210.000	4				

Table 8: Duncan's post Hoc test for cost analysis of snails fed graded levels of poultry droppings

		Subset for alpha = 0.05	
Groups	N	1	2
Diet 1	18		89.67[b]
Diet 2	18		87.50[b]
Diet 3	18	85.33[a]	85.33[b]
Diet4	18	83.17[a]	
Diet 5	18	81.00[a]	

groups containing poultry droppings showed the higher mean values of feed intake than those fed the control diet (diet 1). This indicate that the diets 2, 3, 4 and 5 (containing poultry droppings) are more palatable. This agrees with the findings of Kanu in Blair and Herron[2] who stated that increased feed consumption rate of livestock has relationship with feed palatability. This is also in accordance with the results of Ghaly and MacDonald[11] who found out that poultry droppings contained sufficient digestible energy, crude fiber, protein, fat, cobalt and iodine. Table 4 also shows that there was no significant difference in the mean value of feed intake of snails fed graded levels of poultry droppings and those fed with palm kernel cake.

Table 3 indicates that diets 2, 3, 4 and 5 (which contained graded levels of poultry droppings) are cheaper to obtain when compared to the diet used for the control group. The results showed that the feed used for the control group (which has no poultry droppings) was more expensive than those of the feeds contained poultry droppings. It is clear from the present findings, the poultry droppings can be used to replace palm kernel cake in snail feeds in order to reduce the cost of feeds. Similar results were reported by Eze *et al.*[12] who found that snail diets containing poultry droppings was the cheapest and excellent for snail production. This study also showed clearly that there was a significant difference in the mean cost of feeds of snails fed graded levels of poultry droppings and those fed with palm kernel cake.

CONCLUSION

Poultry droppings could be included in the diet of snails up to 50 and 75% levels for better increment in length and feed intake. This helps to minimize production cost of snails. Generally, snails fed graded levels of poultry droppings performed better than those of the control group. From the experiment, it could be inferred that poultry droppings could be used to replace palm kernel cake in snail diets in order to ensure the availability of snail feeds throughout the year. The results also showed that poultry droppings have nutritive value which makes it useful as a feed ingredient for snails. The trial also proved that the replacement of palm kernel cake with poultry droppings in snail diet will not only increase productivity but also reduce overall cost.

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