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Research Article

Effect of *Gliricidia sepium* Leaf Meal on the Growth Performance of *Archachatina marginata*

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Abstract

Domestication of the giant African land snail, *Archachatina marginata,* requires diets of a good quality to balance the nutrient requirement. Therefore, this study examined the effect of leaves of forest tree, *Gliricidia sepium* as a diet (GSLM) on the growth, performance and proximate composition of meat of *A. marginata.* Ninety (90) giant African land snails, *Archachatina marginata,* were randomly allotted into five (5) experimental treatments. in a completely randomized design. The experimental diet consists of four dietary treatments of formulated feeds containing varying levels of GSLM with concentrate feed (layers mash). Treatment I was Concentrate only, and others were Concentrate with 25% GSLM inclusion, concentrate with 50% GSLM inclusion, Concentrate with 75% GSLM inclusion. were designated as Treatment II, Treatment III, Treatment IV and Treatment V respectively.

Results showed that the weight gain was negatively affected, it decreases across the treatment as the inclusion level of *Gliricidia sepium* Leave Meal (GSLM) increases. The crude protein, ash, fat and crude fibre were significantly affected ($p<0.05$) as for the proximate composition of the diets, with Treatment II having the highest in all the parameters. However, the proximate composition of the snail meats across all diets were not significantly ($p>0.05$) affected. From the result of this study which showed that snails did not performed well on diet of *Gliricidia sepium* as shown in response to their body weight and it could be concluded that *Gliricidia* leaves should not be incorporated in the diet of African giant land snail.

Introduction

According to Ekwu (2016) [1] snails have been noted to be the highest number of recorded extinction animals known in recent times; many more edible snail species are under threat of extinction. One of the endangering factors causing this is the societal behavior of the rural family dwellers which include gathering and hunting of snail from the wild to meet their economic needs. Typically, land snails live on or near the ground, feed on decaying plant matter, and lay their eggs in the soil [2]. They are most common in the tropical rain forest but occur also in cold regions, where they hibernate during an unfavourable condition (Friggens, 2003) [3]. The giant African land snails are common in West Africa. They are restricted to area from the Benin Republic, Nigeria, Ghana and Sierria leone in West Africa to Zaire in Central Africa [4] and they attain adult weight of 200 - 700g. Snail meat is a relished delicacy found in the diets of people living in the southern rainforest and the riparian northern guinea savannah zones of Nigeria [5]. Many factors are attributed to this including high species demands, and a significant consumption increase. The need to have snail meat coming from organized rearing system and breeding, in order to achieve a substantial and sustainable snail meat supply to the teeming population in Nigeria becomes necessary [6]. According to Agbogidi *et al.*, (2008) [7] the need for increase in animal protein consumption of the rural and urban Nigerian populace in the face of inflation has resulted in the increase in the consumption of snails as food and as a source of income to the peasant farmers and families in rural areas.

Snail meat commonly known as 'Congo meat' is one of the most popular delicacies in Nigeria and it forms a very important part of the diets of many households in rain forest belts [8]. The meat is high in protein (12-16%), and iron (45-50%), and low in fat (0.05-0.08%) and contains almost all the amino acids needed for human nutrition [9]. Many species of edible land snails are recognized in Nigeria, but the popular species of economic interest is the West African giant snail (*Archachatina marginata*) [10].

Naturally snails are left to wander about and search for food but this might cause their death when they encounter various insects and when they feed on poisonous leaves, so there is need to domesticate them and feed them. This enhances them to gain much weight; it also makes them available in much quantity in the market. So snail farming is the rearing of snails in captivity. The snails are confined in an enclosure and most of their requirements like feed and water are supplied on a regular basis. Snail rearing is necessary in order to save them from extinction, prevention of environmental degradation resulting to a balanced ecosystem. (Ubua *et al.*, 2012).

Gliricidia sepium has been described by Olatunji (2019) as a medium sized, thorn less, leguminous tree up to 10-12m high with its branching that is frequently from the base with basal diameter reaching up to 50-70cm. Its leaf proximate composition as analysed by Olatunji (2019) is 6.3% Protein, 0.7% fat, 2.8% ash, 2.5% crude fibre, 10.2% Carbohydrate and 77.5% moisture content, of which it has higher level of % ash compared to that of *Carica papaya* (2.6%), *M. alba* (2.4%), *Triplochyton scleroxylon* (2.2%) and *albizialebbeck* (2.6%). When fed to snail, it increases the shell length which could be as a result of higher mineral content residing in it. Ruminant animals have been found to be fed with *Gliricidia sepium* which is leguminous. Thus, the use of it as feed for snails arose because it will aid them to grow (Kehinde *et al.*, 2003). This study is to evaluate and compare the effect of *Gliricidia sepium* leaf meal on the growth performance of *A. marginata*. In achieving the general objective, the following specific objectives will be determining feed intake, feed conversion ratio and growth performance of the snails fed with diets containing varied levels of *Gliricidia sepium* leaf.

Materials and Methods

The experiment was conducted at the Wildlife Domestication Unit, Department of Fisheries and Wildlife and Ecotourism Management of the College of Agriculture, Osun State University, Osun State. And the snails were housed in plastic basket cages arranged within the concrete rectangular snail housing unit with dimension 9 m x 9 m x 3 m. The plastic baskets were arranged in a way that allows adequate ventilation. The roof of this unit was also covered with corrugated iron sheets.

Ninety (90) giant African land snails, *Archachatina marginata*, were randomly allotted into five (5) experimental treatments with three (3) replicates each in a completely randomized design. These are in fifteen (15) plastic baskets. Each of the treatment contains three (3) plastic baskets which house six snails each during the period of this research. The snails were supplied adequate water on daily bases. All the experimental units were subjected to the same environmental and hydrological conditions. Fresh mature *Gliricidia sepium* leaves were harvested from *Gliricidia sepium* trees around the study area. The leaves were thereafter dried at room temperature to constant moisture levels. The samples were then manually milled into powder and kept in air-tight covered bottles. This formed the *Gliricidia sepium* leave meal (GSLM) used for the study.

The experimental diet consists of four dietary treatments of formulated feeds containing varying levels of GSLM with concentrate feed (layers mash). Treatment I was Concentrate only, and others were Concentrate with 25% GSLM inclusion, concentrate with 50% GSLM inclusion, Concentrate with 75% GSLM inclusion and 100%. GSLM, these were designated as Treatment II, Treatment III, Treatment IV and Treatment V respectively. These diets were served at 08.00 am every day. Feed and water were supplied to the snails on daily bases without any restriction and the plastic baskets were cleaned each day throughout the experimental period. The feeding trial lasted for 42 days (6 weeks). Water was sprinkled on each of the experimental unit everyday between 07.00 and 09.00 with hand sprinkler to keep the humidity at optimum conducive level for the snails. All the snails will be fed between 07.00 and 09.00 every day. The supplied diet forms the only source of nutrient for the animals during the period of the experiment.

The amount of feed consumed by the snails during the experiment was determined by based on the consumption made by group of snails per replicate by subtracting the amount of feed left over from the feed offered. And the weight gained by snails were measured on a weekly basis using an electronic weighing balance and recorded in grams based on the group per replicate. The weight gains by snails were calculated by subtracting the final liveweight from the initial liveweight. Proximate compositions of experimental diet and snails were carried out to determine the crude protein, crude fiber, fat content, moisture content, and ash content (AOAC, 2005).

All data collected were subjected to analysis of variance using Systat (1995) analytical software packages and the significant means were separated using the least significant differential LSD of the same software.

Results

Growth Performance of African Giant Snail Fed Graded Levels of *Gliricidia Sepium*

Table 1 shows the growth parameters of *Archachatina marginata* fed varying levels of *Gliricidia sepium*. Highest final live weight (1050.00 ± 27.82 g) and highest feed intake (97.29 ± 10.42 g) were recorded in snails fed diet 1, while the lowest final live weight (943.00 ± 27.82) and the lowest mean feed intake (54.86 ± 10.42) were observed in snails fed diet 5. The weight gain was negatively affected as it decreases across the treatment and as the inclusion level of *Gliricidia sepium* increases.

Table 1: *Effect of graded levels of Gliricidia sepium on the growth and feed intake of Archachatina marginata (g)*

Parameters	Treatment					
	1	II	III	IV	V	SEM
Initial live weight (g)	1098.00	1085.00	1080.00	1099.00	1081.00	25.11
Final live weight (g)	1050.00^{a}	967.48^{ab}	967.86^{ab}	969.76^{ab}	943.00^{b}	27.82
Feed intake (g)	97.29^{a}	71.95^{b}	61.62^{bc}	63.20^{bc}	54.86^{c}	10.42
Average weight Gain	48.00	117.52	122.41	129.24	138.00	

^{abcd} Means with different superscript along the row are significantly different (P< 0.05)
KEY
Diet 1 - 100% Concentrate Feed
Diet II - 75% F & 25% GSLM
Diet III - 50% F & 50% GSLM
Diet IV - 25% F & 75% GSLM
Diet V - 100% GSLM

Proximate Composition of Experimental Diets

Table 2 showed the proximate composition of the experimental diets. The percentage crude protein was on the increase from 16.55% in diet 1(100% Concentrate feed) to 24.77% and 25.65% upon the addition of 25% GSLM in diet II and 50% GSLM respectively. However, as the level of GSLM inclusion increases to 75%, the crude protein reduces to 15.54% which is not significantly different from Diet 1. While the proximate composition of Diet 4 that is, 100% GSLM has 18.46% CP which is greater than diet 1(100% concentrate feed = 16.55% CP). Diet 1 contains the highest percentage of ash (17.05±0.30), Diet II contains the highest percentage of crude protein (24.77±0.65) and fat (15.62±0.52) and crude fibre (9.41±0.44). The ash content (minerals) in the diets differs significantly ($p<0.05$). Comparatively, diet 1 had the highest mineral content (17.05), however, not significantly different from that of diet II. It was observed that ash content decreases as the quantity of GSLM increases, with 100% GSLM having the lowest (10.90). The fat was not significantly different with respect to diet 1, III, IV, and V. However, the level of fat in diet II recorded highest. The same trends were followed in the levels of crude fibre in all the diets with highest in diet II. The dry matter contents were not significantly different ($p>0.05$) for all the diets.

Table 2: *Proximate composition of experimental diets*

Parameter	Diet				
	1	II	III	IV	V
Crude protein	16.55±0.30^d	24.77±0.65^a	25.65±0.10^a	15.54±0.67^d	18.46±0.67^c
Ash	17.05±0.30^a	15.62±0.52^a	14.45±0.10^b	13.84±0.70^b	10.90±0.41^c
Fat	5.20±0.33^b	5.66±0.39^a	5.55±0.10^b	5.24±0.10^b	5.50±0.23^b
Crude fibre	4.07±0.33^b	9.41±0.44^a	4.35±0.10^b	3.64±0.10^b	4.31±0.20^b
Dry matter	93.68±0.54	89.34±1.67	93.26±0.10	92.54±0.70	89.98±3.14

^{abcd} Means with different superscript along the row are significantly different ($P< 0.05$)

Proximate Composition of Experimental Snail

Table 3 represents the proximate composition of experimental snail. All the parameters considered for the proximate composition of the experimental snail were not significantly different ($p>0.05$). That is, the crude protein, ash, fat, crude fibre, dry matter and moisture content were not significantly different with respect to the diet given to the snails.

Table 3: *Proximate composition of experimental snail meat*

Parameter	Treatment				
	1	II	III	IV	V
Crude protein	16.83±0.80	15.20±1.40	15.82±2.54	15.95±2.24	16.50±1.13
Ash	0.79±0.15	0.84±0.20	1.07±0.20	1.05±0.16	0.90±0.11
Fat	1.63±0.03	1.42±0.06	1.57±0.18	1.43±0.10	1.41±0.10
Crude fibre	0.10±0.00	0.10±0.00	0.10±0.00	0.10±0.00	0.10±0.00
Dry matter	29.96±1.17	29.13±3.05	29.43±1.27	32.10±3.50	29.42±1.75
Moisture content	70.04±1.17	70.90±3.05	70.60±1.27	67.90±3.50	70.60±1.75

Discussion

The nutritional composition of every component of animal feeds perhaps forages are very essential which depends on the composition of the feed and the type of animal being fed [11]. From the results of this study, graded levels of *Grilicidia sepium* had a negative effect on the weight and by implication on the growth of African giant snail, *A. marginata*. Diet I being a formulated feed concentrate had the highest minerals composition and a better balance of nutrient gave the highest live weight, feed intake and average live weight gained. This could be as a result of crude protein that is well utilized by the experimental animals fed with it. This 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 (Ani *et al.*, 2013 and Atanasoff *et al.*, 2016) [12,13]. However, the effect of other diets (II, III, IV and V) caused a decrease in the weight of experimental animal. The subsequent high decrease in weight and feed intake among snails on the experimental diet could be attributed to the diminished growth performance of snails on these diets, because the diets with varying levels of *Gliricidia sepium* gave the lowest weight while the highest weight was observed in snails fed on Diet I. At 25% inclusion rate and beyond, there was significant reduction in growth performance which may be attributed to the highly increased fibre content. High dietary fiber is known to limit the availability of nutrients, especially energy and protein [14]. Depressed apparent nutrient digestibility and nutrient retention as a result of high dietary fiber content was reported in broilers [14], in pigs 15] and in rabbits [16]. And it has been attributed to high rate of passage of digester and excessive nutrient excretion in animals fed high fiber diets [17,18].

The increase in the body weight and the other parameters of the snail in diet I indicate that compounded diet have the potential of sustaining snail farming especially during the scarcity of snail's natural plant food [19].

There is varying opinion about the nutritive value of *Gliricidia sepium* (Gliricidia). It isgenerally agreed that it is high quality forage, but of low palatability when first introduced to animals and mostly being fed to ruminant [20]. Carew (1983) [21] found that *Gliricidia* in the diet of sheep and goats induced diarrhoea and depressed consumption of dried leaves during the first 3 weeks of feeding. Similar observations were made by Robertson (1988) where goats took 5 days to adapt to prescribed intakes of fresh and dried *Gliricidia* leaves. The odour of the leaves has been implicated in this initial reluctance of animals to eat *Gliricidia* (Brewbaker 1986). The tannin content of *Gliricidia* leaves does not appear to interfere with plant protein availability but may be one of the factors affecting palatability. From the result of the proximate composition of the diets of this study, it was seen that GSLM has the ability to increase the protein content of feed at 25% and 50% inclusion, and despite this effect, the growth and feed intake of the experimental animals kept reducing at an increasing rate. However, it is not possible to decide whether these effects were due to the anti-nutritional compounds present in *G. sepium* leaves such as tannin or some other factor removed or inactivated during drying. The factors affecting palatability of *Gliricidia* in ruminants are probably the same as those that depress digestibility and growth in rabbits and chickens given *Gliricidia* leaf meal diets [22]. Ahn (1990) [23] also found depressed intakes; weight loss and foetal deaths in rats offered a diet containing 20% dried *Gliricidia* leaf. Diet1 has the highest protein content which shows that the snails ate more of it and utilized the protein to nourish their body. This shows that snails with concentrate feed of layers mash recorded the highest weight gain while snails on Diet II recorded the least weight gain due the reduced feed intake. There was significant reduction on the growth performance of the snails which may be attributed to highly increased fiber content. High dietary fiber is known to limit the availability of nutrients especially energy and protein [14]. From the result of this study which showed that snails did not performed well on diet of *Gliricidia sepium* as shown in response to their body weight, it could be concluded that *Gliricidia* leaves should not be incorporated in the diet of African giant land snail. From the result of this study, it is therefore recommended that snail farmers should feed their snails with layers mash, which is commonly used in feeding other livestock [24-26].

Bibliography

1. Ekwu, S. (2016). Snail Farming. Risk Factors, Diseases and Conservation Practice in the Humid Tropics, Munich, GRIN Verlag. (pp. 1-9).

2. Omole, A. J., Osunkeye, O. J., Odejide, J. O., Sodamola, M. O. & Popoola, Y. A. (2011). The African giant land snails, Editors: Dr. F.T. Ajayi & A.O. Owosibo. Published by: Green choice agric. Publications, Ibadan, Nigeria. Back to Agriculture Series (10).

3. Osunkeye, O. J., Osinowo, O. A., Idowu, A. B. & Adenowo, J. T. (2006). Effects of temperature and moisture on the cumulative and weekly weight gain of giant African land snails (*Archachatina marginata* and *Achatina achatina*). *Asset Journal Series A., 6*(2), 37-44.

4. Ajayi, S. S. (1978). Observation of biological and nutritive value of the African giant snail (*Archachatina marginata*). *East African Wildlife Journal, 4,* 85-95.

5. Egonmwan, R. I. (2004). Maturation timing in the land sanils Archachatinamarginata ovum (Pfeifer) and *Limicolaria flammea* (Muller) (Pulmonata: Achatinidae). *Invertebrate Reproduction and Development, 46*(2-3), 159-171.

6. Elimsile, L. J. (1982). Snail and Snail farming. *World Animal Review, 4,* 20-26.

7. Agbogidi, O. M., Okonta, B. C. & Ezeani., E. L. (2008). Effects of two edible fruits on the growth performance of African giant land snail, (*Archachatina marginata*). *Journal of Agricultural and Biological Sciences, 3*(3), 26-29.

8. Hamzat, R. A., Omole, A. J., Babatunde, B. B., Adejomo, M. O. & Longe, O. G. (2007). Comparative value of kola testa, corn bran and rice bran with maize for mature African giant land snail (*A. marginata*). *Nigerian Journal of Animal Production, 34*(2), 265-276.

9. Abere, S. A. & Lameed, G. A. (2008). The medicinal utilization of snails in some states in Nigeria. An unpublished B.sc project submitted to the Department of Annual Production Technology, University of Usukka.

10. Hodasi, J. K. (1986). Some observation on the feeding behaviour and food preferences of the giant Africa Snail (*Archachatina marginata*). *Snail Farming Research, 1*(1), 54-67.

11. Malomo, G. A. & Ihegwuagu, N. E. (2017). Some aspect of animal feed sampling and analysis. In:Ideas and applications toward sample preparation for food and beverage analysis. Edited by Mark Stauffer. University of Pittsburgh at Greensburg, United States of America.

12. Ani, A. O., Ogbu, C. C., Elufidipe, Z. O. & Ugwuowo, L. C. (2013). Growth performance of african giant land snail (*Achatina achatina*) fed varying dietary protein and energy levels. *ARPN Journal of Agricultural and Biological Science, 8*(2), 184-190.

13. Atanasoff, A., Çağiltay, F. & Anton, R. (2016). The effect of two different protein levels in the diet on the growth performance of Turkish snail (Helix lucorum). *Biblid: 1821-4487., 20*(4), 170-172.

14. Maynard, L. A. & Loosli, J. K. (2000). Animal Nutrition, 11th edition. McGraw Hill Book Co. New York. (p. 542).

15. Ani, A. O. & Ikeh, E. I. (2011). Effect of graded levels of soybean hull on blood, carcass and organ characteristics of grower pigs. *Animal Production Research Advances, 7*(1), 58-64.

16. Jokthan, G. E., Alawa, J. P., Adeyinka, I. A. & Adamu A. M. (2006). The effect of fibre sources, on the performance of young rabbits. *Nig. J. Anim. Prod., 33*(2), 192-196.

17. Kung, P., Grueling, H. T., (2000). Enzyme supplementation of a poultry diet containing rye and wheat. *British Journal Nutr., 62*(1), 139-149.

18. MacDonald, P., Edwards, R. A., Greenhalgh, J. F. D. & Morgan, C. A. (2002). Animal Nutrition. (6th Ed.) Pearson Education (Singapore) Press Ltd New Delhi, India. (p. 693).

19. Ejidike, B. N. & 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, 2*(1).

20. Rusdy, M., Baba, S., Garantjang, S. & Syarif, I. (2019). Effects of supplementation with *Gliricidia sepium* leaves on performance of Bali cattle fed elephant grass. *Livestock Research for Rural Development, 31*(84).

21. Carew, B. A. R. (1983) *Gliricidia sepium* as a sole feed for small ruminants.

22. Onwudike, O. C. (1995). Use of the legumr tree crops *Gliricidia sepium* and *Leuceaena leucocephala* as green feeds for growing rabbits. *Animal Feed Science and Technology, 51*(1&2), 153-163.

23. Ahn, J. H. (1990). Quality assessment of tropical browse legumes: tannin content and nitrogen degradability. PhD thesis, The University of Queensland.

24. Carter, C. G., Houlihan, D. F. & Mcarthy, I. D. (1999). Feed utilization efficiencies. *Animal Review, 44,* 36-43.

25. Esak, K. O. & Takerhash, I. S. (1992). Snails as pest and food. *Malaysian Journal of Economic Agriculture*.

26. Omole, A. J. Oluokun, J. A. Oredein, A. O. Tiomiyu, A. K. Afolabi, A. O. Adetoro, F. O. & Adejuyibe, A. P. (1999). Snail production potential for increasing animal protein intake in West Africa. In: Proceedings of the 26th annual conference of the Nigeria Society of Animal Production held in Ilorin, Nigeria between 21st and 25th of March, 1999. (Pp. 393-401).