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PERFORMANCE OF GROWING SNAILS (*Archachatina Marginata)* FED MILK LEAF *(Euphorbia heterophylla)* SUPPLEMENTED WITH CALCIUM FROM THREE SOURCES (EGG SHELL, OYSTER SHELL AND BONE MEAL)

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ABSTRACT: *An experiment was conducted to study the performance of growing snails fed a basal diet of milk leaf (Euphorbia heterophylla) supplemented with calcium from three sources (egg shell, oyster shell and bone meal). A total of 120 growing snails with weight range of 100-110g were randomly allotted to four treatment groups (T_1, T_2, T_3 and T_4), replicated three times with 10 snails per replicate in a completely randomized design. The snails on T_1, T_2 and T_3 were fed with milk leaf supplemented with egg shell, oyster shell and bone meal as calcium sources respectively. T_4 consisted of snails fed with milk leaf alone. The feeding trial lasted 13 weeks. Calcium supplements analysed contained 73.6% calcium for eggshell, 59.4% calcium for oyster shell and 33.2% calcium for bone meal. The results showed that the total weight gain, shell length, shell width and shell thickness was highest with snails on egg shell (T_1). Snails on bonemeal as the calcium supplement (T_3) recorded the highest mortality of 40% and had the poorest performance which was similar to those of snails on control diet of milk leaf alone (T_4). Comparatively, the growth performance and feed per gain in the egg shell treatment group showed that egg shell is better than oyster shell and bone meal for use as calcium supplement in snail production.*

KEYWORDS: Archachatina marginata snails, Milk leaf, Egg shell, Oyster shell, Bone meal

ABBREVIATIONS: DM, dry matter

INTRODUCTION

African giant land snails (*Archachatina marginata)* are invertebrates that have a soft body and a covering of hard shell. They belong to the phylum mollusca. In nature they are found in damp places under leaves, trees, stumps and stones and are abundant during the raining season. Attempt was made recently at domesticating them to ensure all year round availability. This is the aftermath of an alarm raised by Food and Agricultural Organization (FAO) on deficiency of animal protein among Nigerians (Akinnusi, 2000). Snail meat popularly known as "Congo meat"is a delicacy and itis a very good source of animal protein. It is highly nutritious and contains 19.53g of protein/100g of fresh meat, has low fat content of 2.44% and rich in calcium (126.4mg/100g) and iron (2.29mg/100g) (Babalola and Akinsoyinu, 2009). The meat is low in cholesterol and is a source of vital minerals required for normal tissue development and maintenance. It also competes favourably with poultry egg and flesh in essential amino acid and digestible protein. (Funmilayo, 2008; Imevbore and Ademosun, 1988).

Snails are environmental friendly and can be reared at the backyard. This is due to the fact that they are noiseless, odourless and the droppings are firm and can be easily cleaned and disposed. Success in snail production involves among other things proper nutrition (Ajayi, 1971;

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Plummer, 1975; Ajayi*et al.*, 1978, Hodasi, 1989 and Akinnusi, 1998).Their conventional feed comprises fresh leaves/shoot (pawpaw, lettuce, cabbage, cassava, cocoyam, African spinach, waterleaf); ripe fresh fruits (pawpaw, banana, plantain, mango) and household/agricultural wastes (poultry litter, rice bran, palm kernel meal). (Ayodele and Asimalowo, 1999; Babalola and Akinsoyinu, 2010). In addition to these feeds, snails require calcium to build and repair their shell. Obviously, it is important that they get enough. Without enough calcium their shell become thin and rough instead of being thick, smooth and glossy. There is calcium in vegetables and fruits but this is not adequate for their need. There is therefore the need to supplement calcium in their diet.

Leaf, *Euphorbia heterophylla* has been utilized successfully as sole feed for growing *Archachatina marginata* snails with egg shell added to the soil for optimal performance (Babalola and Owolabi, 2014). There is the need to investigate other available calcium sources for use in snail production. This study was therefore conducted to evaluate the performance of snails fed milk leaf as basal diet supplemented with calcium from egg shell, oyster shell and bone meal.

MATERIALS AND METHODS

One hundred and twenty growing snails of weight range of 100-110g were randomly assigned to 4 dietary treatments as follows:

Treatment 1 (T_1) – Milk leaf + Egg shell

Treatment 2 (T_2) – Milk leaf + Oyster shell

Treatment 3 (T_3) – Milk leaf + Bone meal

Treatment 4 (T_4) – Milk leaf alone (control)

Each treatment had 30 snails with 3 replicates and 10 snails per replicate in a completely randomized design.The environmental temperature was between 25 and 30°C. The snails were reared in wooden cages of 0.5x0.5x0.5m^3 compartments.The cages were placed under a shade away from sunlight. The cages have four leg stand of 50cm each, dipped inside a container filled with water and used engine oil to prevent insect infestation. The base of the cage was made of strong wire mesh covered with perforated jute bag to allow free drainage of water when wetting. Loamy or humus soil was used to cover the bottom of the cage to a depth of about 15cm. The soil was sprinkled with water daily to keep the internal environment moist. The cover of the cage was covered with chicken wire mesh reinforced with mosquito net.Feeding was done once a day in the evenings because snails are nocturnal animals and feed mostly during the night. Freshly harvested milk leaf was supplied daily. Remnants of feed and excreta were removed daily before feeding. Feed and water were given *ad libitum*.The calcium supplements (egg shell, oyster shell and bone meal) were ground to a particle size of 1-2mm. They were fed to the snails alongside the basal diet and the refusals collected and weighed on daily basis. Calcium and water were supplied in separate bowls while milk leaf was supplied directly on the soil. Feed intake and weight gain were measured on a daily and weekly basis respectively. Shell length and width were measured with vernier caliper while micrometer screw gauge was used to measure the shell thickness. Other parameters determined were mortality and feed per gain. The feeding trial lasted 13 weeks. The calcium content of calcium

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supplements was analysed using titration method of McMurry and Fay, 2004. All data were subjected to analysis of variance while the treatment means were separated using Tukey multiple mean comparison test (SAS 2004).Cage was the experimental unit.

RESULTS

Calcium composition of calcium supplement

The calcium composition of calcium supplement on dry matter basis is as shown in Table 1.The amount of calcium in eggshell (73.6g/100g) was higher than that of the oystershell and bonemeal (59.4 and 33.2g/100g) respectively.

Table 1: Calcium composition of calcium supplements (DM)

CALCIUM SUPPLEMENT	CALCIUM COMPOSITION (g/100g)
Egg shell	73.6±0.67
Oyster shell	59.4±1.01
Bone meal	33.2±0.84

Mean of triplicate determinations ± std. deviation

Nutrient composition of milk leaf

The nutrient composition of milk leaf on dry matter basis is as shown in Table 2. It has crude protein of 33.7g/100g, ether extract of 1.0g/100g, ash of 11g/100g and Nitrogen Free Extract (NFE) of 45.3g/100g on dry matter basis.

Table 2: Nutrient composition of milk leaf (*Euphorbia heterophylla)*

NUTRIENT	COMPOSITION (g/100g DM)
Dry matter	27.1
Crude protein	33.7
Ether extract	1.0
Ash	11.0
Nitrogen free extract	45.3
Calcium	0.27

Feeding and growth performance

The result obtained for the performance characteristics of growing snails fed with milk leaf supplemented with different calcium sources is as shown in Table 3.There were significant differences ($P<0.05$) in the mean weekly dry matter milk leaf intake of the snails withthose on milk leaf alone recording the highest (36.85g) while snails on egg shell recorded the lowest

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(17.96g).There was an appreciable weight gain by the experimental snails. The highest weight gain was observed in snails on egg shell (76.56g), followed by those on oyster shell (67.17g) while those on milk leaf alone recorded the lowest(56.14g). The statistical analysis showed a significant difference ($P<0.05$) in the feed per gain. Snails on oyster shell recorded the highest value of 9.45 followed by snails on milk leaf alone (8.55) while those on egg shell had the lowest value of 5.56. The calcium sources had appreciable effect on the mean monthly shell length, width and thickness increment. Snails on egg shell had the highest increment while those on milk leaf alone had the lowest (Table 3). There were also significant differences ($P<0.05$) in the mean weekly calcium supplement intake among treatments. The values recorded were 25.39g, 14.75g and 11.14g for snails on oyster shell, egg shell and bone meal respectively.The highest mortality of 40% was recorded in snails on bone meal followed by snails on milk leaf alone (26.66%).No mortality was recorded in snails on egg shell and oyster shell.

Table 3: Performance characteristics of snails fed with milk leaf (*Euphorbia heterophylla)* supplemented with calcium from three sources

Parameters	Egg shell +milk leaf	Oyster shell +milk leaf	Bone meal +milk leaf	Milk leaf alone	SEM	P
Weekly dry matter milk leaf intake (g)	17.96^{d}	23.47^{c}	25.27^{b}	36.85^{a}	0.051	<0.0001
Initial weight (g)	106.57^{a}	102.90^{b}	101.66^{c}	100.63^{d}	0.042	<0.0001
Final weight (g)	183.13^{a}	170.07^{b}	159.05^{c}	156.77^{d}	0.029	<0.0001
Weekly weight gain (g)	5.89^{a}	5.17^{b}	4.41^{c}	4.31^{d}	0.017	<0.0001
Total weight gain (g)	76.56^{a}	67.17^{b}	57.39^{c}	56.14^{d}	0.047	<0.0001
Feed per gain	5.56^{c}	9.45^{a}	8.25^{b}	8.55^{b}	0.018	<0.0001
Mortality (%)	0.00	0.00	40.00^{a}	26.66^{b}	1.443	<0.0001
Monthly shell length increment (mm)	18.34^{a}	15.63^{b}	11.73^{c}	10.30^{d}	0.018	<0.0001
Monthly shell width increment (mm)	6.20^{a}	5.98^{b}	5.12^{c}	4.12^{d}	0.035	<0.0001
Monthly shell thickness increment (mm)	0.25^{a}	0.19^{b}	0.12^{c}	0.08^{c}	0.009	<0.0001
Weekly calcium supplement intake (g)	14.78^{b}	25.39^{a}	11.14^{c}	N/A	0.142	<0.0001

a, b, c, d: means along the same row with different superscripts are significantly different ($p<0.05$)

SEM: Standard Error of Means.
n = 3 per diet.

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DISCUSSION

The calcium supplements used to feedthe snails were observed to differ in composition. This definitely had effect on the growth pattern and shell development. These calcium supplements are required for growth and repair of damaged shell of the snails.The enhanced growth pattern, low feed per gain and highest shell length, width and thickness increment may be a reflection of the high calcium composition of egg shell compared to other calcium sources.It may also be that there is a better calcium retention when egg shell is fed alongside milk leaf.Oystershell was avidly consumed by the snails but this did not translate to commensurate weight and shell gain. There is the possibility that there may be interaction between the oyster shell and the milk leaf fed. Ireland (1991) also observed a reduction in the whole body weight of *Achatina fulica* at the highest dietary calcium concentration. This however is contrary to reports of Ebenso (2003) who fed *Archachatina marginata* hatchlings with fresh *Carica papaya* fruits and different calcium sources and Daouda (1993) who fed *Achatina achatina* with green forage and calcium supplements. They both concluded that snails fed oyster shell recorded the highest weight gain.The dressing percentage of *Archachatina marginata* snails ranges between 37-43% irrespective of the treatment (Oluokun *et al*., 2005; Okpeze et al., 2007; Babalola and Akinsoyinu, 2010 and Eze *et al*., 2010). The total weight gained by the snails is therefore of utmost importance as this will translate to commensurate edible portion growth.

Snails on bonemeal as the calcium supplement recorded the highest mortality of 40% and had the poorest performance. This put to question the use of bone meal as a calcium source in snail production. The bone meal may contain some contaminants which might have been introduced to it during its processing and this may not be favorable to the snails.

Snails on the basal diet without any calcium supplement also recorded a mortality of 26.66%. This is in partial agreement with Ireland (1991) who observed that mortality only occurred in snails on the low calcium diet. The non-inclusion of calcium supplement at all may be responsible for the mortality of snails fed milk leaf alone.

CONCLUSIONS

From the result of the present investigation, one can conclude that:

i. Eggshell is the best source of calcium for growing snails fed a basal diet of milk leaf.
ii. Based on the overall performance, in the absence of eggshell, oystershell can be utilized.
iii. The use of bonemeal is put to question as calcium source in snail production.
iv. Milk leaf should not be fed alone to snails without the inclusion of calcium supplement.

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