

## Effect of different sources of calcium supplementation on growth performance of African Giant Land Snail (*Archachatina marginata*)

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### ABSTRACT

The effect of different sources of calcium supplementation on growth performance of African giant land snail (*Archachatina marginata*) was investigated for a period of 12 weeks. The study was conducted in 5 wooden boxes that measured 45cm x 45cm x 45 cm. Each wooden box contained 8 African giant land snail, and each snail was a replicate. The experimental diets used were: Diet 1: concentrate + oyster shell, Diet 2: concentrate + bone meal, Diet 3: concentrate + egg shell, Diet 4: concentrate + snail shell and Diet 5: concentrate (control). Data collected were: weekly weight gain, weekly shell length gain, weekly shell width gain, feed conversion ratio, daily feed intake and mortality ratio. It was observed that the snails that were fed on Diet 3 gained the highest weight (83.48g), highest shell length increment (8.58cm) and highest shell width increment (0.72cm) while snails that were fed on Diet 5 gained no weight, but weight loss (-6.70g), lowest shell length increment (0.32cm) and lowest shell width increment (0.08cm) as a result of calcium deficiency. Snails that were fed on Diet 5 recorded the highest feed conversion ratio (9.9%), the lowest feed intake value (308g) and lowest mortality rate (37.5%) which was the least values. The findings revealed that calcium plays a particularly vital role in snail diet. Therefore, it is necessary that calcium is included in the diet of African giant land snail.

**Keywords:** Calcium source, African giant land snail, growth performance, experimental diet, deficiency, supplements.

### INTRODUCTION

African giant land snail belongs to the phylum "mollusca", class "gastropoda" and genus "archachatina". It is the second largest in the animal kingdom (Gascogne, 1994 and Me Donald, 1995). Generally, snails are naturally herbivores. However, they could also utilize artificial diets (Amao *et al.*, 2003). They feed on diverse food ranging from fruits, vegetables,

concentrates, tubers, *etc.* According to Isah and Peter (2012), snails are noiseless, easy to handle and can be reared in many places.

Snails mainly prefer herbs and succulent fruits (Imevbore and Ademosun, 1998; Cobbina, 1993), but they also need calcium for their daily survival. Olomu (1995) reported that calcium plays vital roles in muscle contraction, hormone

secretion, cell division and regulate the acid-base status of blood. It is also beneficial for shell and egg formation. Calcium deficiency in most livestock result in reduced growth rate, failed appetite, decalcification of skeleton, improper bone and shell formation (Olomu, 1995). Snail thrives better on calcium from the soil than other sources (Okpeku and Omueti, 2003). But meeting the supply of calcium becomes more and more difficult in large scale intensive snailery especially in the savanna area where the loamy soil has a low level of calcium. This has necessitated the need to seek for alternative sources of calcium.

Although snails utilize varieties of vegetables while in the wild (Phillips, 1992), large scale production of snails has been limited by the availability of adequate fresh natural feeding materials, especially in savanna area. In order to achieve success in snail domestication appropriate feeding materials other than fresh natural herbage must be made available.

Therefore, there is a need to feed snails on concentrate with different sources of calcium supplement to increase their growth performances. This study was therefore, conducted to investigate the growth performance of African giant land snail fed on different calcium source supplements.

#### **MATERIALS AND METHOD**

The experiment was carried out in the mini-zoo of Federal College of Wildlife Management, New Bussa located in the savanna zone of Nigeria. It is a semi natural reserve between Kainji Dam and New Bussa Township, about 2 km along Awuru Road. It lies between latitudes  $7^{\circ}30'$  and  $10^{\circ}00'N$  and longitude  $4^{\circ}30'$  and  $40^{\circ}33'E$  (Adewetan *et al.*, 1984).

The average monthly maximum temperature is  $30^{\circ}C$ , the highest value being  $41^{\circ}C$  with a mean annual relative humidity of 60% and the mean annual rainfall of 104.45mm. The first rain occurs normally in March. The peak of the rainy season is in the months of July and August before gradually declining in September (Osakwe and Onyeanusi, 1984).

#### **Experimental design**

A wooden box housing system was used for rearing the snail. Five (5) wooden boxes each with dimension of 45m x 45m x 45m were constructed. The wooden boxes were filled with loamy soil rich in organic matters to a depth of 5cm. Also the stands of the wooden boxes were placed in large tin containers in which engine oil was poured to prevent insects from entering the boxes. The house was shaded by *Azadirachta indica*. Water was sprinkled daily to keep the environment moist at all times.

Forty grower snail stocks were purchased locally at Oje market, Ibadan, Oyo State. Care was taken not to select snails with injured and perforated shell. All snails were fed with pawpaw leaves, devoid of calcium for 3 weeks to allow them use up their stored calcium and to manifest symptoms of calcium deficiency.

#### **Experimental diets**

Diet1: Concentrate + oyster shell

Diet2: Concentrate + bone meal

Diet3: Concentrate + egg shell

Diet4: Concentrate + snail shell

Diet 5: Concentrate without calcium source (control)

Table 1 indicates the percentage composition of experimental diets used for this study.

**Table 1. Percentage composition of experimental diets**

Ingredients %	Diet 1	Diet 2	Diet 3	Diet 4	Diet 5
Maize bran	35	35	35	35	40
Palm kernel cake	14	14	14	14	14
Groundnut cake	14	14	14	14	14
Lysine	0.25	0.25	0.25	0.25	0.25
Vitamin premix	0.25	0.25	0.25	0.25	0.25
Rice bran	11	11	11	11	11
Soya bean	5	5	5	5	5
Wheat bran	15	15	15	15	15
Methionine	0.5	0.5	0.5	0.5	0.5
Oyster shell	5	-	-	-	-
Bone meal	-	5	-	-	-
Egg shell	-	-	5	-	-
Snail shell	-	-	-	5	-
<i>Calculated analysis</i>	100	100	100	100	100

#### Data collection and Analysis

A total of forty grower snails were randomly selected and allotted to 5 experimental diets. Each experimental diet had 8 replicates. The experimental grower snails of different average weight were fed once daily between 7:00am and 8:00am at the rate of 3% of their body weight per day as recommended by Amusan *et al.*, (1998). The experimental diets were crushed into powder before feeding them to the snails. The snails were sampled weekly for growth increase, and the feed ration was adjusted based on the weight obtained from the sampling exercise. The experiment lasted for 12 weeks. Parameters measured were weekly shell length increment, weekly shell width increment, weekly feed intake, weekly weight gain and feed efficiency.

Data collected were subjected to analysis of variance (ANOVA) test (Steel and Torrie, 1980). Duncan's Multiple Range Test at 0.05 level of probability was used to determine which of the experimental diet means differ significantly from the other.

#### RESULT

The snails that were fed on Diet 1 to Diet 4 progressively increased in weight over the weeks (Table 2). However, the rate of growth in snails that were fed on Diet 5 was negative, indicating loss of weight. The snails that were fed on Diet 3 recorded the highest weight gain (83.48g) while the snails that were fed on Diet 5 recorded a loss of weight.

The highest average shell length gain was recorded in Diet 3 while the lowest average shell length gain was recorded in Diet 5 (Table 3). Also, the snails that were fed on Diet 3 recorded the highest average shell width gain while the snails that were fed on Diet 5 recorded the lowest average shell width gain. However, it was observed that the snails that were fed on Diet 5 recorded the highest feed conversion ratio (9.90) while the snails that were fed on Diet 4 recorded the lowest feed conversion ratio (4.63).

The snails that were fed on Diet 1 recorded the highest feed intake (1090g), while the snails that were fed on Diet 5 recorded the lowest feed intake (308g). The highest mortality was recorded in snails that were fed on Diet 5 which was 37.5%

as a result of deficiency of calcium in the diet. During the course of this study, the snails that were fed on diets 1, 3, 4, laid and hatched after 27days. It was also

observed that there was a significant difference ( $p < 0.05$ ) in the overall performances of snails that were fed on the experimental diets.

**Table 2. Growth performance of snail fed on the experimental diets**

Parameter (g)	Diet 1	Diet 2	Diet 3	Diet 4	Diet 5
Initial mean weight	137.50 <sup>c</sup>	112.50 <sup>b</sup>	125.00 <sup>c</sup>	162.50 <sup>a</sup>	125.00 <sup>b</sup>
Final mean weight	197.92 <sup>c</sup>	156.99 <sup>b</sup>	208.48 <sup>c</sup>	225.00 <sup>a</sup>	118.30 <sup>b</sup>
Weight gain	60.42 <sup>c</sup>	44.49 <sup>b</sup>	83.48 <sup>c</sup>	62.50 <sup>a</sup>	-6.70 <sup>b</sup>
% weight gain	43.94 <sup>c</sup>	39.54 <sup>b</sup>	66.80 <sup>c</sup>	38.46 <sup>a</sup>	-5.36 <sup>b</sup>

<sup>a,b,c</sup> Mean values in the same row with different superscripts differ significantly ( $p < 0.05$ )

**Table 3. Overall performance characteristics of snails fed on the experimental diets**

Parameter	Diet 1	Diet 2	Diet 3	Diet 4	Diet 5
Av initial body weight (g)	137.50 <sup>b</sup>	112.50 <sup>b</sup>	125.00 <sup>a</sup>	162.50 <sup>b</sup>	125.00 <sup>b</sup>
Av final body weight (g)	197.92 <sup>b</sup>	156.99 <sup>b</sup>	208.48 <sup>a</sup>	225.00 <sup>b</sup>	118.30 <sup>b</sup>
Av daily weight gain (g)	0.72 <sup>b</sup>	0.53 <sup>b</sup>	0.99 <sup>a</sup>	0.74 <sup>b</sup>	0.08 <sup>b</sup>
Av. Body weight gain(g)	60.42 <sup>b</sup>	44.49 <sup>b</sup>	83.48 <sup>a</sup>	62.50 <sup>b</sup>	-6.70 <sup>b</sup>
Av. Initial shell length (cm)	9.66 <sup>c</sup>	9.40 <sup>b</sup>	9.67 <sup>a</sup>	9.75 <sup>c</sup>	8.95 <sup>b</sup>
Av final shell length (cm)	10.28 <sup>c</sup>	10.01 <sup>b</sup>	10.5 <sup>a</sup>	10.37 <sup>c</sup>	9.27 <sup>b</sup>
Av Shell length gain (cm)	0.62 <sup>c</sup>	0.61 <sup>b</sup>	0.83 <sup>a</sup>	0.62 <sup>c</sup>	0.32 <sup>b</sup>
% Shell length gain (cm)	6.42 <sup>c</sup>	6.49 <sup>b</sup>	8.58 <sup>a</sup>	6.36 <sup>c</sup>	3.58 <sup>b</sup>
Av. Initial shellwidth (cm)	5.26 <sup>b</sup>	5.46 <sup>b</sup>	5.85 <sup>c</sup>	5.91 <sup>a</sup>	5.55 <sup>b</sup>
Av. Final shellwidth (cm)	6.06 <sup>b</sup>	6.13 <sup>b</sup>	6.57 <sup>c</sup>	6.70 <sup>a</sup>	5.63 <sup>b</sup>
Av. Shell width gain (cm)	0.8 <sup>b</sup>	0.67 <sup>b</sup>	0.72 <sup>c</sup>	0.80 <sup>a</sup>	0.08 <sup>b</sup>
% Shell width gain (cm)	15.20 <sup>b</sup>	12.27 <sup>b</sup>	12.37 <sup>c</sup>	13.56 <sup>a</sup>	1.44 <sup>b</sup>
Feed conversion ratio	5.30	6.70 <sup>b</sup>	5.50	4.63	9.90
Feed intake (g)	1090	690	1070	1070	308
Mortality %	-	12.5	12.5	-	3.75
Egg production	many	Few	Many	Many	-

<sup>a,b,c</sup> Mean values in the same row with different superscripts differ significantly ( $p < 0.05$ ).

## DISCUSSION

The result of weight gain of snails fed with Diets supplemented with calcium (Table 2) shows that calcium is very essential for growth of snails. This is in agreement with the findings of Okpeku and Omueti (2003) that snails need calcium in their supplementary diet for maximum growth performance when raised in captivity. The snails fed with egg shell diet (Diet 3) showed highest weight gain and shell

length. This can be attributed to the fact that egg shell calcium presents healthy balanced calcium due to trace amount of other materials contained in it. Wilder (2011) is of the view that egg shell calcium is probably the best natural source of calcium and it is easier for the body to digest and absorb. The chicken egg shell is 95-97% calcium carbonate crystal, which is stabilized by a protein matrix (Arias and Fernandez, 2001). Without the protein, the

crystal structure will be too brittle to keep its form and the organic matrix is thought to have a role in deposition of calcium during the mineralization process (Burley and Vadehra, 1989). In the study conducted by Ebenso (2003) Oyster shell recorded the highest body weight in the snail.

The percent shell width gain of the snails fed with egg shell and bone meal were 12.27% and 12.37% respectively. This similarity in weight gain can be attributed to the fact that the composition of an egg shell is very similar to that of the bone as well as teeth (Wilder, 2011). One whole medium sized egg shell makes about one tea spoon of egg powder which yields about 750-800mgs of elemental calcium plus other micro elements i.e. magnesium, boron, copper etc. Also, mortality of 12.5% were recorded in both snails fed with egg shell diet and those fed with bone meal diet respectively while a lower mortality of 3.75% was observed in snails fed on the control diet. This is contrary to the report of Ireland (1991) that mortality occurred on only snail fed on varied levels of calcium. However, the studies of Ebenso (2003) who fed snails with the same supplements in diet recorded no mortality.

Results obtained in this study is also partly in line with the report of Daouda (1993) who studied *Achatina achatina* fed with powdered oyster shell and libitum separately from green forage. The difference between the findings of this work and that of Daoula (1993) could be attributed to the variation of 5% and 20% level of oyster supplement respectively used. Snails fed with oyster shell diet had the highest % shell width gain (15.20%). This shows that oyster can be used as a good source of calcium. This is also in line with Badmus *et al* (2011) who revealed that snail fed with diet containing oyster shell as the source of calcium performed better than that fed bone meal,

egg shell and lime stone in terms of shell width gain.

Diet 1 was most preferred among others by the snails (Table 3). This reflected on the level of consumption of the oyster shell supplemented feed by the snail.

## CONCLUSION

The finding from this study revealed that calcium is extremely crucial in snail diet. Calcium is therefore, recommended for healthy growth of African giant land snail. Of all the sources of calcium tested, egg shell proves to be the best and is therefore recommended for growth of snails in captivity. However, other sources of calcium also had a positive influence on the growth performance of African giant land. In the absence of egg shell, oysters can serve as a alternative source of calcium in snail feed. This study further revealed that deficiency of calcium in snail diet could result in the death of snail, shell faded colour, perforated shell and reduction in weight.

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