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Effects of the Inclusion of Chicken Egg Shells in the Meals of Captive Archachatina marginata (Giant West African Snail) on the Growth and Fecundity of the Species

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Abstract
Eighteen giant West African land snails *(Archachatina marginata*) were collected and identified. The snails were put in a single cage and allowed to acclimatize. The snails were then randomly selected and put in two cages, each containing 9 snails. The experimental samples and control were both fed with the same food. To the experimental samples however, egg shell was added to test for its effect on growth and fecundity of snails. Measurements of weight, shell length and shell width were taken for a period of seven weeks. These readings were subjected to One-way Analysis of Variance (One-way ANOVA). The difference in shell length gained was not statistically significant ($P>0.05$) between the control and the experimental samples. Shell width gain however, was significantly different ($P<0.05$) between the control and the experimental samples. Snail weight gain was similar to that of shell length and the difference in shell length gained by the control and experimental samples was not statistically significant ($P>0.05$). Snails in the experimental group laid five clutches of eggs with a total of 27eggs, 3 eggs hatched. However, those in the control did not lay any eggs. The result obtained from the experimental group shows that the chicken egg shells had positive influence on the fecundity of the snails. This result has implication for snail farmers and for snails as intermediate hosts where they can have access to chicken egg shells in their environment.
Keywords: *Archachatina marginata*, Fecundity, Egg shell, Inclusion, Congo meat

INTRODUCTION

Animal protein has continued to diminish from year to year in the diet of Nigerians. This can be attributed in part to the economic down-turn and the poverty of Nigerians. This has become almost impossible for the common man to buy products of conventional sources of animal protein. Okon et.al(2011), posited that to close the gap in protein intake deficit, there is need for non-conventional meat sources.

Snail meat is socially well accepted in many parts of Nigeria. Popularly known as “Congo meat” in Nigeria, it is also consumed in many parts of the world (Oguniyi, 2009). Nutritionally, snail meat is high in protein (12-16%) and iron(45-60mg/kg), low in fats(0.05-0.08%), contains all the amino acids needed by man, being also rich in vitamins(Amusan and Omidiji,1998). In the work of Imevbore and Ademosun(1988) on the nutritive value of the snail meat(protein content=88.37%) compared favourably with the conventional animal protein sources whose protein value ranged from 82.42%(pork) to 92.75%(beef). Musa et.al(2011) have reported that some communities in Nigeria use the snails’ haemo-lymph in the traditional management of hypertension.

Ordinarily in Nigeria, snails are collected from the wild. However, this has dwindled in recent times due to the impact of such human activities like; deforestation, pesticide use, slash and burnt agriculture (Raut and Barker, 2002). Rearing of the giant land snail as a domestic animal will therefore, restore the economic base of the rural women, hence become a tool for poverty alleviation amongst them(Moyin-Jesu and Kemi, 2008). This will also serve as a measure to satisfy alternative source of demand for meat and ensure the survival of the species(Ademolu;et.al,2004). This same source reported that there is renewed interest in snail farming because of its inherent importance to food security and sustainable livelihood in rural households. However, the inherent problem is the issue of formulating improved diet that will meet the nutrient requirement of the snails.

Justification

Calcium is a very important constituent of snails. Its demand is very high and cannot be met by the normal diet; which includes leaves and fruits of some plants (pawpaw, cassava, banana, water melon and cucumber). Though snails can obtain calcium from the soil, it will depreciate with time particularly breeding where the snails may have limited access to soil or space. There is thus the need for a potent calcium supplement that is readily available at the lowest possible cost.

MATERIALS AND METHODS

Location of Study

The study was carried out in the garden of the Department of Biological Sciences, Ahmadu Bello University Zaria; Kaduna State. Zaria is located on Latitude 11^0 4’ 54.858”North and Longitude 7^0 42’57.3654”East at an altitude

of about 600m a.s.l.

Snail cages with a length of 0.6m and height of 0.3m and width of 0.45m were constructed. The top and sides of the cages were covered with chicken nets, while the under part was left open to have access to soil moisture and nutrients.

The cages were kept in a secure house made of chicken nets to protect snails from large predators. 18 snails were collected from the Botanical garden of the Department of Biological Sciences of ABU Zaria. The snails were marked and kept in a single cage and allowed to acclimatize. The snails were then randomly picked and placed in two different cages of 9 snails each. The cages were labelled, 'A' and 'B'.

Snails were fed with vegetable leaves of cabbage, carrot, lettuce and spinach. They were also fed with fruits of water melon, pineapple peels, banana peels and cucumber. Snails showed preference for water melon and cucumber; so emphasis was placed on these two food items(plates 2 and 3).

Experimental Procedures

The snails in cage 'A'(Experimental samples) were fed with egg shells to supplement their calcium intake; while those in cage 'B' were only placed on the normal diet. Measurements were taken of the snails weight using an Electric weighing balance and the shell length and width were measured with a Veneer calliper. The readings were taken weekly for 7 weeks.

Data Analysis

Data collected was subjected to One-Way Analysis of Variance(One-way ANOVA)

RESULTS

The snails in both the treatment and control were active during the experimental period. No snail mortality was recorded during the 7 weeks of the experiment.

Table.1. Analysis of Variance for Change In Shell Length.

Source of Variation	SS	Df	MS	F	P-value	F-Crit
Between groups	0.176022	1	0.176022	4.309136	0.054388	4.493998
Within groups	0.653578	16	0.040849			
Total	**0.8296**	**17**				

Effect of chicken egg shell on snail shell length is shown in table.1. From table1;F(1,16)=4.3091, with a P-value of 0.05438. Since the P-value is greater than P-alpha at 0.05, the result is not statistically significant (P>0.05), thereby confirming the null hypothesis which states that, 'chicken egg shell does not have any effect on the growth of snails'.

Table.2. Analysis Of Variance for The Total Change In Shell Width.

Source of Variation	SS	Df	MS	F	P-value	F-Crit
Between groups	0.073472	1	0.073472	8.877328	0.00885	4.493998
Within groups	0.132422	16	0.008276			
Total	**0.205894**	**17**				

Table.2 shows F(1,16)=8.8773 with a P-value of 0.00885. Since the P-value is less than P-alpha at 0.05, the result is statistically significant(P<0.05); hence the 'null hypothesis' which states that, ' chicken egg shell as a source of calcium does not have any effect on the growth of snails' is rejected.

Table.3.Analysis Of Variance For The Change In Snail Weight.

Source of Variation	SS	Df	MS	F	P-value	F-Crit
Between groups	157.8272	1	157.8272	2.144813	0.162424	4.493998
Within groups	1177.369	16	73.58556			
Total	**1335.196**	**17**				

In table.3, F (1, 16) = 2.1448 with a P-value of 0.1624. Since the P-value is greater than P-alpha at 0.05, the result is not statistically significant (P>0.05), hence the 'null hypothesis' which states that, 'chicken egg shell as a source of calcium does not have any effect on the growth of snails is accepted.

Table.4. Summary of The Response Of Snails To Chicken Egg Shell Intake.

Parameter	Control samples	Experimental samples
Mean initial shell length (cm)	9.4433	9.9578
Mean final shell length (cm)	10.0311	11.4633
Mean shell length gain (cm)	0.3911	0.5889
Mean initial shell width (cm)	5.5177	5.5056
Mean final shell width (cm)	5.3978	5.9500
Mean shell width gain (cm)	0.2067	0.3344
Mean initial shell weight (g)	99.5778	130.6333
Mean final shell weight (g)	136.4222	165.5889
Mean shell weight gain (g)	29.0667	34.9889

Cm=centimetre g=gram

Table.4 shows the growth response of the snails to egg shell intake based on the following indices; shell length, shell width and shell weight gain. As shown by the figures of the growth indices, there is higher growth in the experimental group than the control group.

Table. 5. Eggs and Hatclings Produced By The Experimental Samples.

Clutch	No. of Eggs	No. Of Hatchlings
A	8	0
B	6	2
C	4	0
D	5	0
E	4	1
Total	27	3

During the 7-week period of the experiment, snails in the control group laid no eggs. The snails in the experimental group however, laid 6 clutches of eggs(plates 4,5,6,7,8).Table.5 shows that all the clutches laid eggs, but only clutches B and E had few hatchlings.

DISCUSSION

The Means of Initial Shell Length showed no significant difference ($P>0.05$) between the control and the experimental samples. No significant difference ($P>0.05$) was also observed in the final shell length. The shell length gained between the control and the experimental group also showed no significant difference ($P>0.05$). The above observations indicate that the change in shell length between the experimental and the control samples were similar.

The Means of the Initial Shell Width test at P-alpha of 0.05 showed no significant difference with a P-value of 0.1015, which is greater than P-alpha. The final shell width means of the experimental and control samples were however, significantly different ($P<0.05$) with a P-value of 0.0257. The mean change in shell width was also significantly different ($P<0.05$) with a P-value of 0.0089. This means that egg shell intake influence the increase in shell width of the experimental group with a mean total change in shell width of 0.3344. The mean change in shell width for the control group was 0.2067. These observations under growth in shell width are in consonance with the work of Thompson and Cheney (2004) who worked on rising of snails.

The mean initial snail weight, showed no significant difference ($P>0.05$).This same trend was observed for the final snail weight and total change in snail weight. The experimental group had a mean shell weight gain of 34.9889 which was higher than that of the control group(29.0667). This result is in agreement with that reported by Hodasi(1995) in a similar investigation he carried out. Like the observations made by Ebenso(2003), the difference between the weights gained by control and the experimental groups were not statistically significant($P>0.05$). Ireland(1991), studying *Achatina fulica,* observed a reduction in the whole body weight at the highest dietary calcium intake in which the excess calcium passed into the snail meat. Ebenso(2003) argued that loss of calcium into the tissue could result in weight increases when the whole snail is weighed. That is to say that calcium metabolism in the body is in dynamic action as the element is broken down for tissue metabolism with losses through faeces, thus explaining the weight loss.

Since the control group could not lay eggs, it could be inferred that calcium intake was the factor that influenced egg-laying in the experimental samples.

In conclusion, the study was designed to test the potential of using chicken egg shell to supplement for calcium, particularly in captive breeding situations. The effect on egg-laying indicates these egg shells can influence reproduction in *Archachatina marginata;* thus it is recommended for inclusion in snail diet in captive breeding or snail farming. The effect on growth however, was not significantly different from that of the control.

This could be as a result of calcium sufficiency in the soil. The snails from the control group may have persistently, derived their shell growth, making it possible for them to gain such great shell length and width.

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APPENDIX

APPENDIX 1: PLATES SHOWING SNAILS

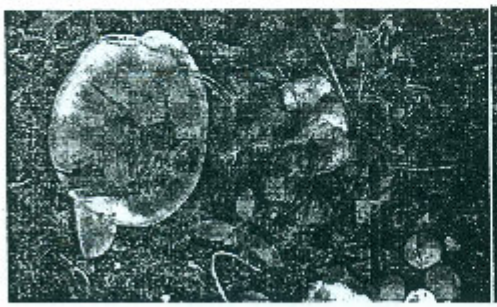

Plate 1: Snails in cage with Water Melon and egg shell

Plate 2; Two Snails Feeding On Water Melon

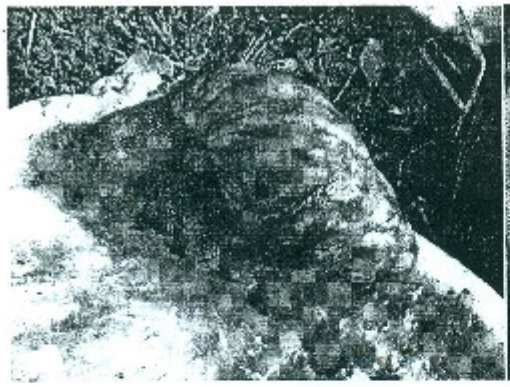

Plate 3; Snail Feeding On Water Melon

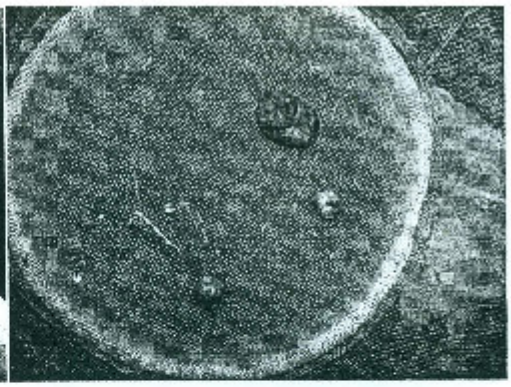

Plate 4; Snailets on Mosquito Nets

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