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EFFECT OF DIFFERENT SOURCES OF DIETARY CALCIUM ON THE CARCASS AND SENSORY QUALITIES OF GIANT AFRICAN LAND SNAILS (*Archachatina marginata*).

Badmos[1], A. A., Sola-Ojo[1], F. E., Oke[1], S. A., Amusa[2], T. O., Amali[3], H. E., and Lawal[4], A. O.

ABSTRACT

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A study was conducted to investigate the efficiency of different sources of calcium in the diet of growing giant African land snails (Archachatina marginata). A total of 48 snails, averagely aged 3 months were randomly allocated to four (4) treatments and each treatment was replicated three times with four snails per replicate in a completely randomized design, for a 12 week period. Diets were formulated to contain 6% calcium of various sources: bone meal (BM) as Treatment1 (T1), oyster shell (OS) as T2, limestone (L) as T3, and egg shell (ES) as T4. The results showed that L retained calcium most (p>0.05), OS diets supported highest edible carcass values, but sensory values and dressing percentage of the meat were not significantly affected (p>0.05). It was concluded that all the calcium sources used for experimental diets (oyster shell, bone meal, lime stone and egg shell) could be used successfully for snail production.

INTRODUCTION

The rapid growth of human population has not only led to higher demand for animal protein, but has called for increased efficiency in feedstuff utilization by livestock. Osho *et al.* (2007) emphasized the need for improved feeding management as essential to overcome inadequate protein supply in Nigeria. There is presently great demand in Nigerian for highly nutritive, medicinally complementary, efficient by-product utilizers like snail (Hamzat et *al.*, 2002). Onoja (2005) stated that snail meat tastes good and is of high nutritive value. The relatively small capital required to set up the business, as well as the low fat and cholesterol content has made snail farming highly promising (Olufokumbi *et al.,* 1989). Oyenike (2008) reported that snail meat serves as special delicacies at homes and restaurants. According to a survey carried out by Omole (2003), giant African land snails, *Archachatina marginata* are the most common edible land snails found and reared in south-western Nigeria. The snail meat has a high protein content of 88.37%, a value which compares favourably with conventional animal protein sources (Imevbore and Ademosun, 1998). Agbogidi *et al.* (2008) also reported that snails are high in protein, iron and low in fat. Adeyeye (1996) noted that snails contain almost all the amino acids required by man.

The shell of snails is composed of calcium carbonate, thus mineral supplementation (calcium) in the diet of snail is an important component of snail farming systems (Thompson and Cheney, 1996; Akinnusi, 2002). Amusan and Omidiji (1988) observed that low calcium intake leads to slow growth of snails. There are several sources of calcium for snails, yet most of the research efforts aimed at cost-effective sources have always focused on the use of egg shell.

Ebenso (2003) fed calcium supplements to snails at hatching in the Niger Delta region, and reported that 20 % dietary calcium supplementation is optimal for calcium depleted soils of that area. Kalio *et al.* (2010) also in that region compared the efficiency of periwinkle shell, egg shell, and oyster shell as calcium supplements and concluded that dietary supplements, particularly oyster shell will improve intake of pawpaw leaf basal diets. Oluokun *et al.* (2005) in the South West Nigeria evaluated the effect of four, six, and eight percent levels of calcium supplementation in snail feed, and reported that shell growth was significantly greatest for the eight percent fed snails, but dressing percent was not significantly different between the six and eight percent diets.

This study was conducted to evaluate the effect of the different sources of calcium (oyster shell, bone meal, limestone and egg shell) in the diet of giant African land snail on the carcass, calcium retention and acceptability of the meat.

MATERIALS AND METHODS

Experimental site

The experiment was carried out at the snailery unit of the Department of Animal Production, University of Ilorin, Nigeria.

Experimental diets

Four diets were formulated to contain four sources of calcium including bone meal (T_1), oyster shell (T_2), limestone (T_3) and eggshell (T_4). All the calcium sources were included at 6%. The diet was formulated to contain 22% crude protein and energy level of 2300 kcal per kg ME.

Experimental design

The snails were randomly distributed to four treatments in a Completely Randomized Design (CRD), The treatments were replicated thrice with four snails per replicate

Management of experimental snails

The snails were reared in bucket type plastic cages, placed on Sandy loamy soil which was loosened and raised up to depth of 5cm, under the shade. The snail mash was served in open plastic containers. Feed and water were supplied *ad libitum* throughout the period of the experiment and feed intake measurements taken daily.

Data collection

Feed intake was measured daily by supplying the feed to the snails in the evenings, and removing the leftover in the subsequent evening, washing the earthenware feeder, and supplying the new feed. The difference in the weight of the supplied feed and the leftover in the subsequent day represent the feed intake. The weight of the shell, viscera and the foot (edible portion) were recorded.

Proximate analysis and calcium retention

Feed and feacal samples belonging to each treatment group were analyzed for proximate composition according to the method of A.O.A.C (1990). This included the crude protein, crude fiber, ash, dry matter, ether extracts and nitrogen free extract. Calcium content of the feed and feaces was also determined. The retention study lasted for ten days. Snail excreta were collected daily from each replicate as described above. Samples of feed and feaces were dried daily to constant weight in the hot air oven. The dry matter content of feed and excreta samples were determined by initially weighing 5 g sample and drying it for 16 hours at 104 °C, and determining the moisture loss. The samples were then a shed in a muffle furnace for 4 hours at 600 °C. The ash was extracted in *aqua regia* (Nitric Acid and 82% Hydrochloric Acid). The concentration of calcium was measured by atomic absorption spectrometer. The procedure was in line with that of Oluokun *et al.* (2005). The nutrient in faeces of snails was subtracted from the nutrient intake to obtain the nutrient retention. Similarly the calcium retention was the difference of intake and faecal calcium.

Measurements

The body weight gain and calcium retention were assessed. The snails were killed at the end of the experiment, the shell being broken with a small hammer, similar to the work of Oluokun *et al.* (2005).

Sensory evaluation

A panel of forty (40) trained students of the Faculty of Agriculture, University of Ilorin was used for the sensory evaluation (colour, flavor, taste, texture and general acceptability), with the 5 point hedonic scale (Lammond, 1977; Potter and Hotchkiss, 2007).The snails were fried (with vegetable oil) and distributed for sensory evaluation.

Statistical analysis

All data were subjected to Analysis of Variance (ANOVA) and significant means were separated by Duncan Multiple Range Test (DMRT) according to Steel and Torrie (1980).

Table 1: Gross composition/formulation of the experimental diets

Ingredients (%)	T_1 (BM)	T_2 (OS)	T_3(L)	T_4(ES)
Maize	10	15	16	15
GNC	26	26	25	24
SBM`	7.5	6	6	7
Fish/meal	3	3	3	3
Corn bran	22	23	21	21
PKC	10	10.5	12.5	13
Bone Meal	21	-	-	-
Oyster Shell	-	16	-	-
Limestone	-	-	16	-
Egg Shell	-	-	-	16.5
Vitamin premix	0.5	0.5	0.5	0.5
Calculated analysis				
Protein (%)	22.28	22.26	22.06	22.05
Ca (%)	6.01	6.08	6.07	6.19
Total (%)	100	100	100	100

Note: BM = Bone Meal, OS = Oyster Shell, L = Limestone, ES = Egg Shell

Table 2: Proximate composition of the experimental diets

Parameter (%)	T_1 (BM)	T_2 (OS)	T_3(L)	T_4(ES)
Dry Matter	93.50	94.31	93.50	93.33
Crude Protein	22.09	22.31	22.31	21.88
Ash	23.20	22.04	22.46	20.54
Ether Extract	1.86	1.95	1.84	1.76
Crude Fiber	13.74	14.33	13.52	13.80
Nitrogen free Extract	32.61	33.68	33.37	35.35
Calcium	6.02	6.05	6.10	6.15

RESULTS AND DISCUSSION

The carcass analysis show that the foot and offal's weights were affected by the dietary treatments as shown in Table 3, with T2 (oyster shell) having highest weight gain, shell weight and highest percentage of edible portion while T4 (egg shell) had the lowest values. The report of Daouda (1993) and Ebenso (2003) that highest weight gain of snails was supported by oyster shell inclusion in diets corroborates the findings of this work. The higher retention of calcium and nutrients as shown in Table 5 appears responsible for the growth of shell and foot of snail. The digestibility of T2 appears higher than other diets, putting less pressure on the intestinal tissues, and requiring less growth of the visceral tissues, and is shown by T4 having the lowest visceral weight. Ebenso (2003) observed that calcium metabolism in the body is in dynamic action as the element is broken down for tissue metabolism with losses through faeces which is expected to result in weight loss. The rate of calcium breakdown appear to be lower in oyster shell (OS), relative to other calcium sources, which might be the reason for OS supporting greater weight gain. A similar trend was observed for the shell. The dressing percent, which is the ratio of the foot (edible portion) to the live weight was not significantly different ($p>0.05$) across all the treatments. The dressing percentage reported in this trial was higher than what was reported by Hamzat *et al.*, (2007) and this could be due to the fact that the snails in this study were fed on single sources of calcium e.g. oyster shell only, and not the combination of oyster shell and bone meal.

The results of sensory evaluation by the panelists shows that there were no significant differences in the mean taste, colour, texture and general acceptability of the meat of the snails fed different sources of calcium as observed in Table 4. Thus any of the above calcium sources available in an area can be used in snail diet formulation. Kalio *et al.* (2010) recommended oyster shell for use in snail diets, corroborating the result of this study. Table 5 shows that there were no significant differences in the calcium retention ($p>0.05$) with different sources of calcium. This is at variance with the work of Oluokun *et al.* (2005) apparently due to the different levels of calcium (4, 6, and 8 %) used in that study.

Table 3: Effects of dietary calcium source on snails carcass traits

Parameters	T_1 (BM)	T_2 (OS)	T_3(L)	T_4(ES)	S.E.M
Live weight (g)	75.13^a	77.43^a	72.98^b	70.73^b	2.23
Foot (g)	34.80^b	37.83^a	33.10^b	32.20^b	1.14
Shell(g)	25.47^b	28.37^a	23.87^b	20.13^b	1.05
Visceral (g)	15.18^b	12.70^c	13.56^c	17.47^a	0.63
Dressing %	46.32	48.86	45.35	45.53	1.39 (NS)

Abc: Means with different superscripts along the same row are significantly different ($p<0.05$).
Note: BM = Bone Meal, OS = Oyster Shell, L = Limestone, ES = Egg Shell
NS= Not Significant

Table 4: Sensory evaluation of meat of snails fed different sources of calcium

Parameters	T_1	T_1	T_3	T_4	S.E.M.
Colour	5.01	5.02	5.06	5.00	0.14 (NS)
Taste	4.99	5.00	5.00	4.87	0.14 (NS)
Flavour	4.50	5.00	4.68	4.81	0.15 (NS)
Texture	4.50	4.98	5.03	5.04	0.15 (NS)
Acceptability	5.03	5.02	4.93	5.11	0.15 (NS)

NS= Not Significant

CONCLUSION AND RECOMMENDATION

The results of this study showed that there was no significant difference in the dressing percent, sensory qualities, or calcium retention in all the treatments. Thus all the calcium sources used for experimental diet (oyster shell, bone meal, lime stone and egg shell) could be used successfully for snail production without adverse effect.

Table 5: Effect of dietary calcium source in snails feed on calcium retention

Parameters (mean / day)	T_1	T_2	T_3	T_4	S.E.M.
Dry matter retained (%)	78.54^a	71.00^a	72.50^b	76.54^b	0.16
Calcium retained (%)	68.27	71.07	69.18	70.24	0.55(NS)

Abc: Means with different superscripts along the same row are significantly different ($p<0.05$).
NS= Not Significant

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