$T_{ij} = \mu + t_i + e_{ij}$
Where:
T_{ij}= the effect of the j^{th} observation in the i^{th} treatment
μ_i = general mean of the population
t_i= the effect of the i^{th} treatment on the snails
e_{ij} = random error associated with the j^{th} observation in the i^{th} treatment

2.5 Proximate Analysis

The experiential diets and the carcass were analysed for their proximate components according to Association of official analytical chemists [4].

2.6 Data Analysis

The data collected were analyzed with descriptive statistics of frequency and percentage summarized in table and inferential statistics using analysis of variance (ANOVA). Means of variables that were significant were separated using Duncan's New Multiple Range Test.

3. RESULTS AND DISCUSSION

3.1 Proximate Composition

Table 1 below shows that proximate composition of the experimental diets. The results revealed a variation in the chemical composition of the experimental diets. The gross energy of the diet ranged from 1,649 to 2284 kcal/kg with the highest recorded in the bone meal diet, why the least was observed in the control diet. The % crude protein had comparable values for the formulated feed but differ significantly with the control feed (natural feed). The percentage crude fibre decrease with increase in protein, it ranged from 12.11% to 26.38% with the highest (26.38%) value recorded in the control meal while the least (12.11%) was observed in the feed formulated with the bone meal. The % fat increases with an increase in the crude protein content of the feed. The highest (19.84%) fat was observed in feed formulated with bone meal while the least (5.94%) was recorded in the control feed. The % ash content of the feed varies, with the feed formulated with limestone (32.49%), had the highest and the lowest (20.62%) was observed in the control feed. The Nitrogen free extract ranged from 28.25 to 42.14. The control diet recorded the highest (42.14) while the least (28.25 was observed in the feed formulated with limestone.

Table 1: Proximate Analysis of the Experimental Diets

Treatment	Gross Energy kcal/kg	%crude protein	%crude Fibre	% fat	% ASH	NFE
T_1(Limestone)	1840	19.43	17.32	6.21	32.49	28.25
T_2(Bone meal)	2284	19.49	12.11	9.84	26.84	31.72
T_3(Egg shell)	1764	19.20	19.74	7.46	21.56	36.73
T_4(Snail shell)	1993	19.58	11.92	7.77	23.73	37.27
T_5(Control)	1649	4.92	26.38	5.94	20.62	42.14

NFE-Nitrogen Free Extract

3.2 Weight Gain of The Snails

The results showed that there was no significant difference (P>0.05) in weight gain of the snails among the various sources of calcium in the feed. (Table 2), the mean weight gain of the snails, varied among the feed. The highest (12.50±3.15) mean weight gain was recorded in feed formulated with snail shell, while others are 12.41±3.21, 12.27±3.14, 12.23±2.87 and 8.06±2.51 for feed formulated with bone meal, agricultural limestone, egg shell and natural feed respectively (Table 2).

Table 2: Mean Weight Gain of the Snail (g)

Weeks	T_1(ALS)	T_2(BM)	T_3(ES)	T_4(SS)	T_5(Control)
1	8.0	8.3	8.7	8.5	4.5
2	8.7	8.9	8.7	9.0	5.0
3	9.2	9.4	9.1	9.6	5.3
4	10.0	9.8	9.6	9.9	5.9
5	10.1	10.3	10.2	10.3	6.2
6	10.4	10.3	10.8	10.9	6.6
7	10.6	10.9	10.8	11.0	7.2
8	11.2	11.4	11.1	11.3	7.2
9	11.9	11.8	11.7	11.8	8.5
10	12.6	12.5	12.5	12.7	8.8
11	13.0	13.3	12.9	13.2	9.1
12	13.8	13.5	13.6	13.9	9.4
13	14.5	14.9	14.3	14.7	9.9
14	16.6	16.8	15.9	16.3	10.3
15	17.2	17.6	17.3	17.8	11.6
16	18.5	18.9	18.6	19.1	13.4
Total	**196.3**	**198.6**	**195.8**	**200.0**	**128.9**
Mean	**12.27^a±3.14**	**12.41^a±3.21**	**12.23^a±2.87**	**12.50^a±3.15**	**8.06^a±2.57**
SEM 1.82					

Means with same letters are not significantly different (P>0.05)

3.3 Shell Length Increment of The Snails

As indicated in Table 3, there was no significant different (p>0.05) in shell length increment of the snails among the various sources of calcium under review, the feed formulated with snail shell had the highest (0.35±0.06) mean shell increment while the least (0.26±0.05) was recorded in the control.

Table 3: Mean shell length increment of the snails (cm)

Weeks	T_1(ALS)	T_2(B.M)	T_3(ES)	T_4(SS)	T_5(Control)
1	0.23	0.25	0.21	0.27	0.15
2	0.24	0.27	0.25	0.27	0.20
3	0.25	0.27	0.26	0.29	0.20
4	0.26	0.29	0.26	0.29	0.22
5	0.27	0.29	0.26	0.29	0.23
6	0.28	0.29	0.27	0.29	0.24
7	0.30	0.32	0.29	0.33	0.24
8	0.30	0.33	0.30	0.34	0.25
9	0.31	0.33	0.31	0.34	0.26
10	0.31	0.35	0.33	0.36	0.28
11	0.33	0.37	0.33	0.38	0.28
12	0.35	0.41	0.35	0.38	0.28
13	0.38	0.41	0.39	0.42	0.30
14	0.39	0.41	0.40	0.42	0.31
15	0.40	0.41	0.40	0.43	0.31
16	0.40	0.41	0.42	0.44	0.33
Total	**5.00**	**5.41**	**4.99**	**5.54**	**4.08**
Mean	**0.31^a±0.06**	**0.34^a±0.06**	**0.31^a±0.06**	**0.35^a±0.06**	**0.26^a±0.05**
SEM 0.02					

Means with same letters are not significantly different (P>0.05)

3.4 Shell Width Increment of Snails

The results showed that there was no significant difference (p>0.05) in mean shell width increment of the snails among the sources of calcium fed to the snail (Table 4) the mean shell width increment varied with the highest (0.163±0.03), recorded in the snails fed with feed formulated with snail shell while others are (0.161±0.02) 0.151±0.03, 0.0150±0.02 and 0.133±0.02 for feed formulated with bone meal, agricultural limestone, egg shell and control respectively.

Table 4: Mean shell width increment of the snail (cm)

Weeks	T_1(ALS)	T_2(B.M)	T_3(ES)	T_4(SS)	T_5(Control)
1	0.11	0.13	0.12	0.13	0.10
2	0.12	0.13	0.13	0.14	0.10
3	0.12	0.14	0.13	0.14	0.10
4	0.13	0.14	0.13	0.15	0.12
5	0.13	0.14	0.14	0.15	0.12
6	0.13	0.14	0.14	0.15	0.12
7	0.15	0.16	0.14	0.16	0.12
8	0.15	0.17	0.14	0.16	0.12
9	0.16	0.17	0.15	0.17	0.14
10	0.16	0.17	0.15	0.17	0.14
11	0.16	0.17	0.16	0.17	0.15
12	0.17	0.17	0.17	0.18	0.15
13	0.17	0.18	0.17	0.188	0.15
14	0.18	0.18	0.17	0.18	0.16
15	0.19	0.18	0.18	0.19	0.17
16	0.19	0.19	0.18	0.19	0.17
Total	**2.42**	**2.56**	**2.4**	**2.61**	**2.13**
Mean	**0.151^a±0.03**	**0.161^a±0.02**	**0.150^a±0.02**	**0.163±0.03**	**0.133^a±0.02**
SEM0.01					

Means with same letters are not significantly different (P>0.05)

3.5 Eggs of Snails Recorded

Table 5 shows the number of eggs recorded in each calcium sources. The highest number of eggs was found in snails fed with feed formulated with snail shell (8.0±1.00) while the least was recorded in agriculture limestone (3.3±1.97)

Table 5: Numbers of eggs recorded

Treatment	Number of eggs	Mean±S.D
T_1(ALS)	10	3.3±1.97
T_2(BM)	18	6.0±2.00
T_3(ES)	12	4.0±1.73
T_4(SS)	24	8.0±1.00
T5(Control)	14	4.7±1.53

The mortality rate of the snails was revealed in table 6. Snails fed with natural feed (control) have the highest (41.79), and then followed by snails fed with agriculture limestone. No mortality rate was recorded in the snail's shell.

Table 6: Mortality rate of the snails (%)

Treatment	Mortality	Mortality rate
T_1(ALS)	3	25.0%
T_2(BM)	2	16.7%
T_3(ES)	2	16.7%
T_4(SS)	-	0.00%
T5(Control)	5	41.7%

3.6 Feed Conversion Ratio (Fcr) And Feed Conversion Efficiency (Fce)

The results of the feed intake, feed conversion ratio (FCR) and feed conversion efficiency (FCE) are given in Table 7. The results revealed no significant difference (P>0.05) in feed intake and feed conversion ratios of the snails among the diets under review. The Table showed significant difference (P<0.05) in feed conversion efficiency of the snails in the diets under consideration.

Table 7: Feed intake, Feed conversion ratio (FCR) and Feed conversion efficiency (FCE) of the snails

Parameters	Agric limestone	Bone meal	Egg shell	Snail shell	Control	SEM
Feed intake	89^a±4.0	90^a±4.9	88.3^a±5.4	92.9^a±3.4	91.8^a±1.6	1.18
Feed conversion ratio	0.512^a±0.021	0.499^a±0.062	0.500^a±0.031	0.519^a±0.011	0.833^a±0.053	0.176
Feed conversion efficiency	2.028^a±0.34	2.095^a±0.22	2.093^a±0.16	2.005^a±0.21	1.318^b±0.42	0.11

Means with same letters along row are not significantly different (P>0.05)
Key:
FI –Feed intake
FCR-Feed conversion ratio
FCE-Feed conversion efficiency

3.7 Carcass Weight of N the Snails

Table 8 shows the edible tissue, shell and viscera weight of the snail. The results revealed significant differences (P<0.05) in edible tissue, shell and visceral weight of the snails fed with the experimental diet. Snails fed with feed formulated with snail shell dominated other feed in edible tissue and shell weight while snail fed with bone meal dominated other feed in the visceral weight of the snails.

Table 8: Mean Carcass weight of the snails

Parameters	Agric limestone	Bone meal	Egg shell	Snail shell	Control	SEM
Edible tissue weight	110.0c±0.25	111.4b±0.1	108.47d±0.67	112.57a±0.91	78.1e±0.2	±0.28
Shell weight	53.3e±0.54	55.53b±0.35	56.1b±0.2	58.5a±0.3	37.5d±0.46	±0.19
Visceral weight	30.53b±0.25	31.90a±0.2	28.67c±0.21	28.53c±0.15	21.37d±0.12	±0.11

Means with same letters along the row are not significantly different (P>0.05)

3.8 Proximate Carcass Composition of Snail

Table 9 shows the feed nutrient utilization indices. The results showed variation in the chemical composition of the snail tissue in the feed with the calcium sources. The moisture content of the snails in each treatment varied from 70.43 to 84.10% with the highest (84.90%) recorded in the snails fed with the control diet. The snails under bone meal diet had the highest % crude protein (7.94), % fat (7.12), while the lowest % crude protein (4.81) and % fat (3.62) were recorded in the snails under the control diets. The snails under the control diet had the highest (7.14) crude fibre while the lowest (4.85) was observed in the snail's carder bone meal diet.

Table 9: Proximate Carcass composition of A. marginata fed with different calcium sources

Treatment	Gross Energy kcal/kg	% crude protein	% crude fibre	% fat	% ASH	NFE
T_1(Agricultural Limestone)	72.10	6.84	4.16	5.49	11.34	72.17
T_2(Bone meal)	68.32	7.94	4.85	7.12	10.73	69.36
T_3(Egg shell)	76.29	5.13	5.11	4.87	7.62	77.27
T_4(Snail shell)	70.43	7.14	4.96	6.11	8.79	73.00
T_5(Control)	84.10	4.81	7.14	3.62	6.84	77.59

NFE - Nitrogen Free Extract

4. DISCUSSION

The findings revealed appreciable increment in live body weight, shell length and width of the snails. The growth performances of the snails fed with the formulated feed with calcium sources were better than the snails fed with natural feed. This revealed that calcium plays a significant role in growth performances of African giant land snails, (*Archachatina marginata*). The findings agree with the report made by Eruvbetine *et al.* (1996) that fast growth rate of snail feed with adequate quantity of calcium source promote shell growth and tissue development of snails [5]. However, the snails fed with feed formulated with snail shell performed better in weight gain, shell length and width increment (Tables 2, 3 and 4) compared to other sources of calcium considered for this study.

This result could be attributed to snail shell as source of calcium with high quality calcium. Ireland, noted that snails need a lot of high quality calcium intake for growth and shell formation [6]. Snails fed with a good source of calcium may attain proper development and growth under normal environment condition [2]. The quality of calcium source utilized by snails play an important role in egg production. The findings showed that more eggs were produced by snail shell (Table 5) than the snails fed with other diets under review. A researcher reported that snails deprived of calcium view under eypivie development have stunted growth with low eggs production and shell deformity [7].

It was observed from the findings that the mortality rate was highest (Table 6) in the snails fed with the natural feed (control), followed by those subjected to Agricultural limestone. No mortality was recorded in snails fed with snail shell. This could be attributed with the nature and quality of calcium sources consumed by the snails among other factors. The findings revealed that the lower the feed conversion ratio, the better the feed conversion efficiency. The lower feed conversion ratio recorded by the snails on the formulated feed over the snails on the control feed indicates that African giant land snail utilized the nutrients available in the formulated feed more efficiently. The snails in the formulated feed were efficient user of the feed. Though not significant (P>0.05), the feed formulated with the bone meal recorded the highest FCE (Table 7) as compared with other sources of calcium considered in this study. The results is in line with the report by some researcher state that snails fed with formulated diet of 20% crude protein are more efficient users of the diet over the snails fed with the natural feed [8]. The reason why snails on formulated feed perform better than the ones on natural feed might be due to the fact that available nutrients of the diets originate from different feedstuffs there by making them more balance. Observation from the findings showed that the feed formulated with the different calcium sources had appreciable effect on the edible tissue of the snails (Table 8) the snails fed with the feed formulated with snail shells had the highest edible weight as well as the shell weight compared with the snails raised under other calcium sources.

The nutrient utilization of the snails under the formulated feed was highly influenced by the dietary crude protein content of the diets. The nutrient composition (Table 9) is higher in the snails under the formulated feed, compared to the snails under natural feed. The variability that exist among the tissue composition of the snails under formulated feed might be due to the sources of calcium in the feed. The best was observed in the snail feed with the bone meal in terms of the % crude protein and % crude fat contents of the snails. The results is in agreement with Ejidike (2010) who reported that snail fed with formulated feed with high crude protein perform best in terms of edible tissue quality of the snails.

5. CONCLUSION

It could be generally concluded that the results from the study showed that the feed formulated with different calcium sources played a significant role in growth performance of African giant land snails (*Archachatina marginata*). The study revealed that fast growth rate and high increase in weight, shell length and shell diameter of *A. marginata* can be achieved by feed formulation with graded quality of snail shell (SS) Calcium sources.

This study further proved that snail shell meal in graded quantity added to supplement snail diet is palatable for snail consumption if properly prepared to attract snails. Normal amounts of snail shell added to snail diet improved the growth rate and tissue development of snail. This study shows that there is an indication that large scale commercial production of snails can be achieved when snails are placed on the consumption and utilization of snail shell diet as snails get to maturity fast due to fast growth rate.

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