

Tolerance of African giant land snails (*Archachatina marginata*) to varying levels of table Salt

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Abstract

An experiment was conducted to determine the growth response of African giant land snail *Archachatina marginata* fed diets containing different levels of sodium chloride. One hundred and twenty snails were subjected to four dietary treatments of T1, T2, T3 and T4 with 0%, 0.25%, 0.5% and 0.75% sodium chloride respectively. The treatments were replicated thrice with 10 snails per replicate. The measured parameters included weight gain, feed intake, shell length, shell circumference and shell thickness. Feed cost, cost of feed per kg weight gain and feed conversion ratio were also calculated. Results showed that there were significant differences ($p < 0.05$) in average daily weight gain, average daily feed intake, feed conversion ratio, feed cost and shell thickness but there were no significant differences ($p > 0.05$) in cost of feed per kg weight gain, shell length and shell circumference in the snails fed the treatment diets. Treatment 2 had the highest average daily weight gain (0.07 ± 0.01), average daily feed intake (0.91 ± 0.08) and feed cost (7.19 ± 0.64) but the lowest feed conversion ratio (13.15 ± 61.76) while treatment 1 had the lowest average daily weight gain (0.04 ± 0.01), average daily feed intake (0.70 ± 0.20) and feed cost (5.54 ± 0.18) but the highest feed conversion ratio (15.86 ± 0.5). This shows that inclusion of sodium chloride above 0.25% in the diet of *Archachatina marginata* affects both the feed intake and weight gain of the snails.

Keywords: Salt, Tolerance, Diet, Snail, *Archachatina marginata*

Introduction

African giant snails serve an increasing important role in the tropics by virtue of their survival under captive rearing, ability to accept and convert plant parts and artificial diet to flesh as well as being of high consumer's preference. In West Africa, the most predominant giant land snail species include: *Achatina achatina*, *Achatina fulica* and *Archachatina marginata*. The *Archachatina marginata* is the most accepted and highly cherished snail specie in Nigeria. However, snail rearing (Heliculture) has become very important in recent time because of increased animal protein shortage in Nigeria. Also, the availability of some edible snails in Nigeria, their popularity and acceptability nationwide, the potential for exports including the emerging

technologies of their production have largely contributed towards the present renewed interest in snail farming (Amusan and Omidiji, 1998). Ebenebe (2000), highlighted the need to look inward and integrate into our farming system some non-conventional meat source like snails. Kehinde *et al.*, (2002) reported that the protein consumption in Nigeria is below 67 g recommended by the World Health Organization. Rebecca and Sheldon (2004) reported that snail production has gone to an advanced stage in American, Europe and Asia but in Africa, much research work has not been carried out. Snail meat favorably competes with poultry egg and flesh in essential amino acids and digestible proteins (Imevbore, 1990). It is essentially rich in lysine, leucine, Isoleucine, phenylalanine, arginine and tryptophan and

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contains high level of iron, calcium and phosphorus (Dada *et al.*, 1999). The galactans present in its abdominal gland serves as a medicinal substance of high immunological value, which cures tuberculosis, ulcer, asthma and circulatory disorders. Okonkwo *et al.*, (2000) also pointed out that snail meat is useful in the treatment of some human diseases like anaemia, hypertension, and asthma e.t.c. while its shell can be used in the production of buttons, rings and other jewelry. It is unequivocally clear that the importance of improving snail production cannot be overemphasized. According to Olumo (1995), protein function mainly in tissue growth, carbohydrate (in Nitrogen-free extract) provides the necessary energy for metabolic activities while calcium functions in shell growth (Akinmusi, 1998). Stievenart (1992), Omole *et al.*, (2000) and Ejidike (2001), pointed out the need to use complete balanced food in snail production.

Snail farmers however, believe that inclusion of table salt in the diet of snails will have an adverse effect and may result in mortality. In a study to assess the effect of common salt (NaCl) inclusion in the diet of the growing snail (Omole, 2008). Four dietary treatments of the same energy and protein values; S1, S2, S3 and S4 were formulated to contain 0%, 0.1%, 0.2% and 0.3% NaCl, respectively. The results showed that feed intake and weight gain were better in the diet containing 0.2 percent salt than the control with 0 per cent salt inclusion (Omole, 2008). The feed was better utilized in all the treatments than in the control diet. The digestibility was also better in all the treatments than the 0 percent salt inclusion. It was observed that no mortality was recorded in any of the treatments. The results suggested that inclusion of salt up to 0.3 percent in the diet of growing snails did not have an adverse effect on feed intake, weight gain and

survivability as against the belief of some farmers that salt should not be included in the diet of snails.

Sodium chloride induces animal to consume other less palatable minerals and feeds. It improves ration palatability. Deficiency of sodium chloride includes slow development, unthrifty appearance and impaired performance (Arthur, 1975). The study will therefore ascertain the effect of graded levels of salt on the growth performance of snail, determine the effect of salt inclusion on the feed intake of snail and determine the effect of salt in the shell circumference, shell length and shell thickness of snail. The study will help farmers know the specific quantity of salt that should be added in the diet of snail and to enlighten farmers to know the positive impact salt has in the diet of snails when the right quantity is added.

Materials and methods

Institutional animal care and use committee

The institutional animal care and use standard of Nnamdi Azikiwe University Awka were strictly adhered to during the experiment.

Location of study

The study was carried out at the Teaching and Research snailry Unit of the Department of Animal Science, Faculty of Agriculture, Nnamdi Azikiwe University, Awka, Anambra state. The location lies within the coordinate 6°12'25" N and 7°04'04" E of the tropical rainforest zone of Nigeria and experiences two distinct seasons brought about by the two predominant wind. The climate of the study area is typically tropical with relative humidity ranging from 70% to 90% and mean temperature of 25-27 °C. The experiment was carried out during the rainy season and it was from June to August.

Experimental diet

Four different feeds were prepared and the

experimental diets were represented with T1, T2, T3, and T4 containing 0%, 0.25%, 0.5%, and 0.75% dietary inclusion of

sodium chloride (NaCl), respectively. Table 1 and 2 show the percentage composition and proximate composition of experimental diets, respectively.

Table 1: Percentage composition of feed fed to the experimental snails (24.5% CP).

| Ingredients | T1 | T2 | T3 | T4 |
|----------------------|--------------|--------------|-------------|-------------|
| Maize | 30.00 | 30.00 | 30 | 30 |
| Soya beans | 15.00 | 15.00 | 15 | 15 |
| PKC | 17.00 | 17.00 | 17 | 17 |
| Fish meal | 3.50 | 3.50 | 3.50 | 3.5 |
| GNC | 25.00 | 25.00 | 25 | 25 |
| Bone meal | 5.75 | 5.75 | 5.5 | 5.25 |
| Oyster shell | 3.00 | 3.00 | 3 | 3 |
| Vit/premix | 0.5 | 0.5 | 0.5 | 0.5 |
| Salt | 0 | 0.25 | 0.5 | 0.75 |
| Total | 100 | 100 | 100 | 100 |
| Crude protein | 24.50 | 24.50 | 24.5 | 24.5 |

Table 2: Proximate Analysis of the experimental diets

| NUTRIENTS | T1 (0%) | T2 (0.25%) | T3 (0.50%) | T4 (0.75%) |
|-----------------------|----------------|-------------------|-------------------|-------------------|
| Dry matter | 88.91 | 89.0 | 88.78 | 89.12 |
| Crude protein | 24.50 | 24.41 | 24.50 | 24.50 |
| Crude fibre | 5.26 | 5.29 | 5.31 | 5.34 |
| Ether extract | 3.50 | 3.51 | 3.50 | 3.52 |
| Ash | 9.23 | 9.21 | 9.30 | 9.18 |
| Nitrogen free extract | 57.91 | 57.86 | 57.77 | 57.83 |
| Sodium (g/100g) | 0.04 | 0.11 | 0.17 | 0.24 |
| Chlorine (g/100g) | 0.025 | 0.09 | 0.18 | 0.28 |

Experimental snails and management

A total of 120 growing, medium-sized *Archachatina Marginata* snails were randomly assigned to the four experimental diets (T1, T2, T3, and T4) using a completely randomized design (CRD). Dietary treatment 1, which contains 0% inclusion of sodium chloride (NaCl), served as the control diet. Each diet constitutes a treatment and each treatment was replicated three times with ten snails per replicate. Ten snails were reared in plastic bowl inside the snailery unit. Each bowl was filled with loamy soil of 5cm deep. The soil used was sun dried to a certain temperature of about 30-35 minutes. The purpose of drying the soil is to kill some micro organism in the soil. Net was cut to the size of the bowl and tied around the bowl to prevent the snails from

crawling out, allow ventilation for the snails and prevent some flying insects from introducing diseases to the animals. All snails were kept under the same environmental conditions.

Feeding and watering

Food and water were given to the snails *ad libitum*. The feed was moistened before supply to allow for easy ingestion and to prevent respiratory difficulty that can be caused by dusty feed.

Sanitation

Fresh feed that was free from mould was given to the snails every day. Leftover feed was removed from the feeding trough. Clean water was also supplied to them. The plastic trays used for food and water supply were cleaned and washed each day before placing feed or water. Their faeces were scooped out of the bowl to prevent

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microbial infestation.

Growth performance parameters measured

The measured parameters were Initial body weight, final body weights, shell length, shell width, shell thickness, shell circumference while average daily weight gain, total weight gain, average daily feed intake, feed conversion ratio, feed cost, feed cost per kg weight gain were calculated.

Statistical analysis

Data collected were subjected to analysis of variance as described by Steel and Torrie (1980) using Statistical Package for the Social Sciences (SPSS 2003), windows version 17. Significantly different means were separated using Duncan's New Multiple Range Test (Duncan, 1955) as outlined by Obi *et al.*, (2002).

Results and discussion

Proximate analysis of the experimental diets

Samples of the four experimental diets containing varying level of sodium Chloride were analysed for their proximate compositions according to AOAC (2006).

The result of the analysis shows that the diets were iso-caloric and iso-nitrogenous. Sodium and chlorine quantities also increased progressively from T1 to T4.

The effect of inclusion levels of sodium chloride on the growth performance of Archachatina marginata

The effect of inclusion levels of sodium chloride on the growth performance of *Archachatina marginata* is shown in Table 3. From the result below, there were no significant ($p > 0.05$) differences in the initial body weight, final body weight, feed conversion ratio and feed cost per kg weight. However, there were significant ($p < 0.05$) differences in their average daily weight gain, total weight gain and average

feed intake with treatment 2 having the highest mean value and treatment 1 with 0% inclusion of sodium chloride having the lowest mean value. This supports the observation made by (Omole, 2008) who stated that *Archachatina marginata* feed was better utilized in all the treatment containing sodium chloride. The significant difference in feed intake is comparable to that of the result obtained by Omole (2008) that *Archachatina marginata* snails have voracious appetite which is the ability to eat large varieties of feed. From Table 4, *Archachatina marginata* snails fed more on treatment 2 diet which contains 0.25% sodium chloride than the control diet which led to the increase in weight gain in treatment 2 than the control diet. It has been reported that there is a positive correlation between feed intake and the weight gain (Omole, 2008). Feed conversion ratio was better for *Archachatina marginata* snails fed with 0.25% inclusion of sodium chloride when compared with those fed other dietary treatments. The improvement in performance of snail at 0.25%, 0.50% and 0.75% salt inclusion in this experiment may be as a result of improved palatability which enhanced feed consumption and enhanced growth which is also in line with (Gbadamosi, 1998).

Economic implication of feeding snail with varying inclusion levels of sodium chloride.

The result in Table 4 shows that there was no significant ($p > 0.05$) difference in the feed cost per kg weight gain but there was difference in the feed cost.

Highest cost price of feed (N7.19) was observed in treatment 2 while treatment 1 had the lowest cost (N5.54). This implies that as the level of sodium chloride increased, the feed intake increased and the cost of feed also increased.

Table 3: The effect of inclusion levels of sodium chloride on the growth performance of *Archachatina marginata*

| Parameters | T1 (0%) | T2 (0.25%) | T3 (0.5%) | T4 (0.75%) |
|------------------------------|------------------------|------------------------|-------------------------|------------------------|
| Initial Body weight(g) | 41.23±3.09 | 40.87±2.76 | 41.40±3.20 | 41.00±2.01 |
| Final body weight(g) | 43.70±3.02 | 44.93±3.15 | 44.57±3.50 | 43.93±1.27 |
| Feed conversion ratio | 15.86±0.50 | 13.15±61.76 | 14.06±2.77 | 14.32±3.02 |
| Average daily weight gain(g) | 0.04±0.01 ^b | 0.07±0.01 ^a | 0.06±0.01 ^{ab} | 0.05±0.02 ^b |
| Total weight gain(g) | 2.47±0.15 ^b | 4.07±0.04 ^a | 3.17±0.64 ^{ab} | 2.93±0.75 ^b |
| Average daily feed intake(g) | 0.70±0.20 ^b | 0.91±0.08 ^a | 0.77±0.02 ^b | 0.73±0.03 ^b |

Means on the same row with different superscript are significantly different (p<0.05)

Table 4: Economic implication of feeding snail with varying inclusion levels of sodium chloride

| Parameters | Treatment1 | Treatment 2 | Treatment3 | Treatment4 |
|------------------------------|------------------------|-------------------------|------------------------|------------------------|
| Feed cost per kg weight gain | 21.39±0.34 | 19.86±2.86 | 20.19±2.86 | 20.06±2.94 |
| Feed cost in Naira | 5.54±0.18 ^b | 7.19 ±0.64 ^a | 6.13±0.02 ^b | 5.74±0.12 ^b |

Means on the same row with different superscript are significantly different (p<0.05)

The effect of inclusion levels of sodium chloride on the shell characteristics of *Achachatina marginata*

There were no significant (p > 0.05) differences in the initial shell

circumference, final shell circumference and initial shell length. However, there were significant (p < 0.05) differences in final shell length and the shell thickness as shown in table 5.

Table 5. The effect of inclusion levels of sodium chloride on the shell characteristics of *Archachatina marginata*

| Growth parameters | T1 (0%) | T2 (0.25%) | T3 (0.50%) | T4 (0.75%) |
|----------------------------------|-------------------------|-------------------------|-------------------------|------------------------|
| Shell circumference (cm) Initial | 3.47±0.03 | 3.82±0.15 | 3.75±0.02 | 3.62±0.01 |
| Shell circumference (cm) Final | 3.53±0.02 | 3.98±0.13 | 3.85±0.01 | 3.66±0.02 |
| Shell length (cm) Initial | 7.42±0.13 | 7.53±0.02 | 7.48±0.13 | 7.36±0.31 |
| Shell length (cm) final | 7.51±0.24 ^{ab} | 7.68±0.14 ^a | 7.58±0.06 ^{ab} | 7.51±0.19 ^b |
| Shell thickness (mm) | 2.18±0.62 ^a | 1.66±0.26 ^{ab} | 0.70±0.88 ^b | 2.45±0.41 ^a |

Means on the same row with different superscript are significantly different (p<0.05)

The highest mean weekly shell length was recorded in T2 (7.68 ± 0.14) which was similar to T3 (7.58 ± 0.06) and T1 (7.51 ± 0.24) but different from T4 (7.51 ± 0.19). The mean weekly shell width increment followed the same pattern with shell length. No significant difference (p > 0.05) was observed in mean weekly shell thickness. No mortality was recorded in all treatments which indicated that 0.75 per cent salt in their diet did not kill the snail but reduced

their feed intake and weight gain. This could be as a result of the ability of the snails to utilize the balanced nutrients. The result showed a significant difference (P < 0.05) in the shell thickness between treatments as treatments 1, 2 and 4 were statistically the same.

Conclusion and recommendation

The results of this experiment established that inclusion of sodium chloride up to

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0.25% in the diet of the growing snails did not have any adverse effect on the feed intake and the weight gain of the growing snails. Thus, they showed preference for the feed that contained sodium chloride than the feed that did not contain sodium chloride. Therefore, I recommend to farmers, researchers and other personnel to include 0.25% sodium chloride in snail diets.

Conflict of interest

There is no conflict of interest.

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Received: 20th June, 2020

Accepted: 29th September, 2020