

## EVALUATION OF DIFFERENT DIETARY TREATMENTS ON GROWTH PERFORMANCE OF AFRICAN GIANT SNAIL (*ARCHACHATINA MARGINATA*)

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### ABSTRACT

A three-month feeding trial was conducted at the National Root Crops Research Institute, Umudike (NRCRI), to investigate the effects of different dietary treatments on the growth performance of African giant snails (*Archachatina marginata*). Ninety snails were randomly assigned to three treatments: concentrate (control, T<sub>1</sub>), sweet potato-based diet (T<sub>2</sub>), and cocoyam-based diet (T<sub>3</sub>). Each treatment was replicated three times. A completely randomized design (CRD) was used for the experiment. The results showed that T<sub>1</sub> had the highest feed intake but the lowest feed efficiency (i.e., highest feed conversion ratio [FCR]), suggesting that while the snails consumed more, they did not convert feed as efficiently as those in the other groups. T<sub>2</sub> exhibited the best FCR (2.14), indicating superior feed efficiency and balanced growth, with moderate shell weight and low mortality. T<sub>3</sub> produced the highest dressing and shell weights but also recorded the highest mortality rate (22.2%), suggesting that while this diet supported shell and body development, it may have had adverse effects on survival. Overall, T<sub>2</sub> appeared to be the most optimal diet, as it provided efficient feed utilization, stable growth, and lower mortality compared to T<sub>3</sub>.

**Keywords:** African giant snails, growth performance, Sweet potato, cocoyam, snail farming

### INTRODUCTION

The global demand for sustainable and healthy protein sources has become increasingly pressing, driven by concerns over the environmental impact, animal welfare, and human health implications of traditional livestock farming (Nijdam *et al.*, 2012; Godfray *et al.*, 2018).

Furthermore, the high cost of conventional feed has exacerbated the need for alternative, cost-effective solutions. Snails, as a valuable source of protein, offer a promising alternative (Akinnusi, 2002; Adeyeye, 2019). Rich in essential amino acids, low in fat and cholesterol, and utilized in the treatment of anemia (Imerbore & Ademosun, 1988; Adegbola, 1998; Wosu, 2003), snails are an underappreciated yet vital component of a healthy and balanced diet.

This study aims to investigate the potential of using sweet potato and cocoyam peels and leaves as alternative feed ingredients for snails, evaluating their effects on growth performance and economic viability. By exploring these alternatives, the research seeks to contribute to the development of a more sustainable and resilient snail farming industry. Specifically, the study aims to assess the growth performance of the African giant snail fed sweet potato- and cocoyam-based diets, as well as the economic viability of such feeding regimes.

### MATERIALS AND METHODS

The trial was conducted at the traditional yam ban of National Root Crops Research Institute, Umudike between November 2024 and February 2025.

## EXPERIMENTAL ANIMAL, MANAGEMENT AND EXPERIMENTAL DESIGN

Ninety snails (*Archachatina maginata*) of uniform size and age were purchased locally. Concentrate was used as control (T<sub>1</sub>). Sweet potato leaves and peel (*Ipomoea batatas*) was used as T<sub>2</sub> and Cocoyam leaf and peels (*Xanthosoma sagittifolium*) was used as T<sub>3</sub>. Experimental unit was a wooden hutch with three compartments. Each compartment was further divided into three for the replicates. Snails were acclimatized to the experimental environment for two weeks before the start of experiment. Snails were fed *ad libitum* and water was provided daily and it lasted for 90 days experimental period. The experiment was conducted in a Completely Randomized Design (CRD) with three treatments (T<sub>1</sub>, T<sub>2</sub> and T<sub>3</sub>). Each treatment was replicated three times.

## ETHICAL APPROVAL

The 2024 proposals and report review committee of National Root Crops Research Institute, (NRCRI) Umudike, reviewed and approved this research work months before the study was carried out. Hence, it is part of NRCRI 2024 approved works.

## FEED FORMULATION

Grower mash formulation was Maize 45%, Soybean meal 25%, Palm kernel meal 15%, Limestone 2%, Bone meal 2%, Premix 0.5%, Lysine 0.25, Methionine 0.25% and Wheat bran 10%. Sweet potato leaf/peel formulation was Sweet potato leaf 70% and Sweet potato peel 30% while Cocoyam leaf/peel formulation was Cocoyam leaf 70% and Cocoyam peel 30%.

## CHEMICAL COMPOSITION OF HERBAGE AND GROWER MASH

**TABLE I: PROXIMATE COMPOSITION OF EXPERIMENTAL DIETS**

COMPONENT	T1 (%)	T2 (%)	T3 (%)
Moisture	17.84	6.09	8.04
Crude Protein	15.09	10.30	12.5
Crude Fibre	12.09	12.19	11.41
Ash	5.60	4.04	5.69
Crude Lipid	6.12	5.11	4.60
Nitrogen free extract	49.04	41.10	40.90

T1 (Grower mash)

T2 (Sweet potato peel/leaf)

T3 (Cocoyam peel/leaf)

## EXPERIMENTAL PROCEDURE

The humous soil was taken from a local farm at Afara Ibeku, Umuahia North L.G.A. and moistened before introducing into the wooden hutch.

The concentrate, sweet potato and cocoyam peels and leaves were weighed daily before it was given to the snails. The snails were weighed monthly using a sensitive weighing balance throughout the duration of the experiment.

## DATA COLLECTION

Data were collected on the initial body weight at the commencement of the study as well as on monthly basis to determine their weight gain.

Daily feed allowance was weighed before introducing it to the snails. Feed conversion ratio, as well as mortality was obtained.

The following formulae were used for the calculation of the parameters:

Average feed intake (g/snail) = (quantity of feed given - left over) / (no of snail x no of days)

Average monthly weight gain (g) snail = (final weight - initial weight) / (no of snail x no of month)

Average monthly mortality % = (no of snail dead x 100) / (initial stock x no of months)

Feed conversion ratio = quantity of feed consumed / live weight

Shell percentage = weight of snail x 100 / live weight of snail

## Experimental design

Statistical model of CRD was

$$Y_{ij} = \mu + \tau_j + e_{ij}$$

where

$Y_{ij}$  = single observation

$\mu$  = overall mean

$\tau_j$  = Effect of treatment

$e_{ij}$  = random error

## DATA ANALYSIS

Data collected were subjected to percentages and analysis of variance (ANOVA) using general linear model procedure of statistical procedure for social science (SPSS) ( $P < 0.05$ ).

## RESULTS

The proximate composition of the experimental diets (T<sub>1</sub> – Grower mash T<sub>2</sub> – Sweet Potato leaf/Peel, and T<sub>3</sub> – Cocoyam leaf/Peel, Table I) is presented in Table I. The moisture content of the diets varied significantly, with T<sub>1</sub> (Grower Mash) having the highest value (17.84%), while T<sub>2</sub> (Sweet Potato leaf/Peel) had the

**TABLE II: BODY WEIGHT AND FEED INTAKE OF EXPERIMENTAL SNAIL**

T	AT 0 MONTH		AT ONE MONTH		AT TWO MONTHS	
	Weight(g)	Weight(g)	Feed intake (g)	Weight(g)	Feed intake (g)	
T1	267.5±15.4 <sup>a</sup>	285.3±19.3	103.8±4.5 <sup>a</sup>	310.1±16.2	103.5±5.4	
T2	257.4±12.2 <sup>b</sup>	277.3±12.1	85.6±3.2 <sup>b</sup>	301.0±9.4	102.6±5.2	
T3	261.7±17.6 <sup>a</sup>	278.9±7.8	75.5±14.2 <sup>b</sup>	306.5±15.4	93.5±6.7	

**abc** means on the same column with different superscripts are significantly ( $P < 0.05$ ) different

**TABLE III: BODY WEIGHT, FEED INTAKE, DRESS WEIGHT, SHELL WEIGHT AND MORTALITY OF GROWER SNAIL FED CONCENTRATE, SWEET POTATO PEEL/LEAVES AND COCOYAM PEEL/LEAVES AT THE THIRD MONTH.**

T	Wt (g)	F.I. (g)	FCR (g)	Dress Wt (g)	Shell Wt (g)	Mortality (%)
T1	330.8±13.9 <sup>a</sup>	102.6±3.3 <sup>a</sup>	2.58	32.9±1.0 <sup>b</sup>	18.9±0.9 <sup>c</sup>	11.1±0.0 <sup>b</sup>
T2	328.2±11.3 <sup>c</sup>	96.4±3.5 <sup>c</sup>	2.14	32.3±1.4 <sup>c</sup>	20.5±0.6 <sup>b</sup>	11.1±0.0 <sup>b</sup>
T3	329.8±11.9 <sup>b</sup>	97.1±2.9 <sup>b</sup>	2.20	33.7±3.1 <sup>a</sup>	22.2±1.0 <sup>a</sup>	22.2±1.0 <sup>a</sup>

**abc** means on the same column with different superscripts are significantly ( $P < 0.05$ ) different

lowest (6.09%). T<sub>3</sub> (Cocoyam leaf/Peel) recorded a moisture content of 8.04%.

The crude protein content was highest (Table I) in T<sub>1</sub> (15.09%), followed by T<sub>3</sub> (12.5%), while T<sub>2</sub> had the least (10.30%). However, the protein values of T<sub>2</sub> and T<sub>3</sub> were still within the acceptable range for supporting moderate growth performance in micro livestock.

Crude fibre content was highest in T<sub>2</sub> (12.19%), followed by T<sub>1</sub> (12.09%), and lowest in T<sub>3</sub> (11.41%). The ash content, which indicates the mineral composition of the diets, was highest in T<sub>3</sub> (5.69%), followed by T<sub>1</sub> (5.60%), while T<sub>2</sub> had the lowest value (4.04%).

The crude lipid content of the diets ranged from 4.60% in T<sub>3</sub> to 6.12% in T<sub>1</sub>. T<sub>2</sub> had an intermediate value of 5.11%. The nitrogen free extract of the diets was highest in T<sub>1</sub> (49.04%), while T<sub>2</sub> (41.10%) and T<sub>3</sub> (40.90%) had similar values.

The initial body weight of the experimental snails at the commencement of the study is presented in Table II. The results indicate that there were slight variations in the initial body weights among the different treatment groups. Snails in Treatment 1 (T<sub>1</sub>) had the highest initial body weight (267.5 ± 15.4 g), followed by those in treatment 3 (T<sub>3</sub>) (261.7 ± 17.6 g), while treatment 2 (T<sub>2</sub>) recorded the lowest initial body weight (257.4 ± 12.2g). This trend continued at one month and two months into the experiment (Table II).

The body weight and other performance parameters of grower snails fed different treatments of concentrate,

sweet potato, and cocoyam peels and leaves at three months are presented in Table III. In Table III, Feed intake was highest in T<sub>1</sub> (102.6±3.3g), followed by T<sub>3</sub> (97.1±2.9g) and T<sub>2</sub> (96.4±3.5g). Dress weight was significantly higher in T<sub>3</sub> (33.7±3.1g) than in T<sub>1</sub> (32.9±1.0g) and T<sub>2</sub> (32.3±1.4g). Shell weight was highest in T<sub>3</sub> (22.2±1.0g), followed by T<sub>2</sub> (20.5±0.6g) and T<sub>1</sub> (18.9±0.9g). In the feed conversion ratio (FCR), T<sub>2</sub> (2.14g) gave the best result, followed by T<sub>3</sub> (2.2g) and the least FCR was T<sub>1</sub> (2.58g).

## DISCUSSION

The lower moisture content in T<sub>2</sub> and T<sub>3</sub> (Table I) suggests that these diets may have a longer shelf life compared to T<sub>1</sub> due to reduced microbial activity and spoilage risks (Akinmutimi *et al.*, 2019).

The lower protein levels in T<sub>2</sub> and T<sub>3</sub> (Table I) could be attributed to the nature of the plant-based ingredients used, as tuber peels generally contain lower protein levels than conventional protein sources like soybean meal and fishmeal (Ekenyem & Madubuike, 2017).

The high fibre content in T<sub>2</sub> and T<sub>3</sub> indicates that these diets may enhance gut motility and improve digestive efficiency in monogastric animals (Omede *et al.*, 2020). However, excessive fibre levels could reduce nutrient digestibility and energy utilization. The slightly higher ash content in T<sub>3</sub> may suggest a higher presence of essential minerals such as calcium and phosphorus, which are crucial for bone development and metabolic functions (Fafiolu *et al.*, 2018).

The lower fat content in T<sub>3</sub> may indicate reduced energy density, which could impact energy supply to the

animals (Olomu, 2011). However, lower fat content may be beneficial in preventing lipid oxidation and rancidity, thereby improving diet stability and shelf life. The lower carbohydrate content in T<sub>2</sub> and T<sub>3</sub> is expected due to the fibrous nature of the tuber peels, which contain significant amounts of non-starch polysaccharides that may not be fully digestible (Adebiyi *et al.*, 2021). Nevertheless, the carbohydrate levels in all diets suggest that they can provide sufficient energy for animal maintenance and production. The observed variations in the initial body weight (Table II) might be due to genetic differences among the snails, environmental conditions prior to the study, and possible effects of maternal nutrition. This finding is consistent with the report of Adeyeye *et al.* (2021), who noted that variations in initial body weight among snails could influence their subsequent growth performance. Despite these initial differences, all snails were managed under uniform experimental conditions to ensure comparable growth potential among the treatment groups. According to Omole *et al.* (2019), maintaining uniform management practices helps to reduce environmental influences on growth performance and ensures that dietary effects are accurately assessed.

At three months (Table III), the body weight of snails in T<sub>1</sub> (330.8±13.9g) was significantly higher than those in T<sub>2</sub> (328.2±11.3g) and T<sub>3</sub> (329.8±11.9g). This suggests that the nutritional composition of T<sub>1</sub> might have been more conducive to optimal growth. The higher body weight observed in T<sub>1</sub> could be attributed to the higher quality or more favorable balance of nutrients present in the treatment combination, which likely supported better growth performance in the snails (Ola & Akinmoladun, 2015).

The higher feed intake (Table III) in T<sub>1</sub> could be due to better palatability and digestibility of the feed mix, leading to increased consumption (Adeyemo *et al.*, 2017). Feed intake is a critical determinant of growth, and the higher feed intake in T<sub>1</sub> is consistent with the observed increase in body weight. In Table III, Feed intake was highest in T<sub>1</sub> (102.6±3.3g), followed by T<sub>3</sub> (97.1±2.9g) and T<sub>2</sub> (96.4±3.5g). Dress weight (meat weight after removing the shell) was significantly higher in T<sub>3</sub> (33.7±3.1g) than in T<sub>1</sub> (32.9±1.0g) and T<sub>2</sub> (32.3±1.4g). This indicates that despite T<sub>1</sub>'s higher total body weight, T<sub>3</sub> had a more favourable proportion of edible meat, which could be linked to differences in treatment composition and the nutritional value for muscle development (Olayemi *et al.*, 2020). Snails fed T<sub>3</sub> showed a tendency for stronger, heavier shells, which might be due to the presence of adequate calcium

sources in the treatment mix. Calcium is essential for shell development, and the higher shell weight in T<sub>3</sub> could be due to an optimal ratio of nutrients that support shell formation (Abiola & Ogundipe, 2019).

In evaluating the feed conversion ratio (FCR) among different diets for snail rearing (Table III), T<sub>2</sub>, which incorporated sweet potato leaves and peels, demonstrated the lowest FCR value at 2.14g. This indicates that T<sub>2</sub> was the most efficient in converting feed into snail biomass. T<sub>3</sub>, containing cocoyam leaves and peels, had a slightly higher FCR of 2.2g, yet still performed better than the control diet, T<sub>1</sub>, which had a FCR of 2.58g. These results suggest that utilizing sweet potato leaves and peels (T<sub>2</sub>) in snail diets can lead to reduced production costs compared to using cocoyam leaves and peels (T<sub>3</sub>), while the control diet resulted in the highest production cost. These findings are consistent with Ola & Akinmoladun (2015) who evaluated performance of snails fed different dietary combinations. Additionally, research on evaluation of tuber peels as alternative feed ingredients in livestock nutrition reported improved feed utilization (Ekenyem & Madubuike, 2017). Mortality was lowest in T<sub>3</sub> (22.2±1.0%) compared to T<sub>1</sub> and T<sub>2</sub> (both at 11.1±0.0%). While the mortality rate in T<sub>3</sub> was higher, it still reflected relatively good survival rates, particularly when compared to conventional mortality rates in snail farming. This could be attributed to the specific nutritional content that may have enhanced the snails' resilience against diseases and other stress factors (Igwe *et al.*, 2018).

## CONCLUSION

The study demonstrated that dietary treatments significantly influenced the growth performance, feed intake, and survival of experimental snails. While all treatment groups exhibited similar final body weights, differences in feed intake, feed conversion efficiency, dressing weight, shell weight, and mortality were observed.

### Key Findings:

T<sub>1</sub> had the highest feed intake but lower feed efficiency (higher FCR), suggesting that while snails consumed more; they did not convert feed as efficiently as other groups. T<sub>2</sub> exhibited the best feed conversion ratio (FCR = 2.14), indicating superior feed efficiency and balanced growth with moderate shell weight and low mortality. T<sub>3</sub> had the highest dressing and shell weights but also the highest mortality (22.2%), suggesting that while this diet supported shell and body development, it may have had adverse effects on survival. Overall, T<sub>2</sub> appears to

be the most optimal diet as it provided efficient feed utilization, stable growth, and lower mortality compared to T<sub>3</sub>.

### RECCOMENDATION

Future studies should explore the specific factors contributing to the higher mortality in T<sub>3</sub> and the potential for optimizing feed formulation for improved snail production.

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