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GROWTH RESPONSE OF *Archachatina marginata* (Swainson) TO BROWN PAWPAW LEAVE MEAL (BPLM) AND GROUNDNUT CAKE (GNC) MIXTURE

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ABSTRACT
A ten (10) weeks experiment was conducted to evaluate the growth response of sixty (60) Black skinned Ecotype Giant African Land Snail GALS (*Archachatina marginata*) of weight rage (50 - 55g) on brown pawpaw leave meal and Groundnut cake mixture in a Completely Randomized Design feeding trial experiment. Brown pawpaw leaves were collected within the compound of (National Biotechnology development Agency, South West Bioresources Development Centre (BIODEC) Owode –Yewa South Ogun state. The leaves were picked, sundried, and macerated with hand. It was then sieved into leaf meal (BPLM) and mixed with Groundnut cake to form dietary treatment *viz*. T1 (75% GNC: 25% BPLM), T2 (50% GNC: 50% BPLM), T3 (25% GNC: 75% BPLM) and T4 (fresh pawpaw leaf) which served as control. Each treatment was replicated three times with 5 snails per replicate. Feed and water was supplied *ad-libitum*. Increase in weight, shell length, aperture radius and shell width were measured. All data collected were subjected to One-way (ANOVA) using IBM SPSS statistics version 21 and significance mean differences were separated using fisher's Least Significant Difference (LSD).The results showed that significant differences ($P< 0.05$) existed on the snails in terms of all the parameters measured. Dietary treatment T3; (25%GNC + 75% BPLM) mixture was considered best and recommended for snail farmers.

KEY WORDS: Brown pawpaw leaf meal, *Archachatina marginata*, growth response.

INTRODUCTION

Snails are bilaterally symmetrical invertebrates with soft segmented exoskeleton in the form of calcareous shells; they belong to the phylum mollusca. In West Africa, snails dwell in humid forest areas from where they are gathered by villagers for consumption and other uses (Ademosu and Omidiji, 1999). Snail meat commonly known as 'Congo' meat is one of the common protein source in the southern Nigeria where the prevalent ecology favours their continuous existence and survival. The meat is high in protein (12–16%) and iron (45–50mg/ kg), low in fat (0.05 –0.08%) and contain almost all the essential amino acid needed for body growth. (Chinaka and Wilson, 1995). Snail farming constitutes a major part of the income (42 - 62%) of rural farmers, who are predominantly women and have limited alternative sources of livelihood. (Ngenwi *et al.*, 2010). According to Malik *et al.* (2011), nutritionally the crude protein and ash content of fresh snail meat is higher than those of rabbit, chicken and beef. Artificial diet 25% crude protein and green *Carica papaya* leaves could play a vital role in aborting snails plant food scarcity due to seasonal nature of plant food material, and it as well seems to have high potential for mass production of Giant Africa land snail *A. marginata* for augmenting animal protein supply in the diet of the people especially in West Africa (Ejidike, 2007). This valuable bioresource is gradually going into extinction (Ngenwi *et al*, 2010). Okpeku and Omueti (2003), opined that environmental factors and human activities such as deforestation, increasing temperatures, low rainfall, bush fires, indiscriminate harvesting, high use of agrochemicals and lack of training on intensive snail rearing were identified as impediments to increased snail supply from the wild and in captivity. Today, there is an increasing interest in the rearing of snails to make them available in commercial quantities for marketing at all seasons of the year. To really boost this interest, the cost of production need to be reduced via the use of different feed combinations available in our immediate environment with expected increase in returns. Kalio and Etela (2011) reported that the nutritional quality of snail meat is greatly influenced by the type and quality of diet supplied to the snail. Diet of African giant land snail can be safely supplemented with 15% fern (*Asplenium barteri)* leaves meal (FLM) for better performance *(*Alikwe *et al.*, 2013). According to Agbogidi *et al.* (2008), snails perform better when fed with ripped banana (*Musa accumulate*) and pawpaw fruits (*Carica papaya*). Pawpaw leaves would be more nutritious base on the very low crude fibre (CF) and relatively higher crude protein (CP) contents. A notable increase in aperture radius, weight gain and shell length of has been recorded by Hamzat *et al.* (2003) in snail fed with 75% dried kola nut testa and 25% palm kernel cake mixture as a simple concentrate formulae for GALS *A. marginata.* Freshlly

harvested water leaf (*Talinium triangulae*) causes significant decrease in weight gain and growth rate of snail reared in confinement. However, air-dried *Talinium triangulae* under shade for 24 hours slightly but significantly reduces the rate of lost in weight gain and growth (Ojelade *et al.*, 2013). Soybean meal residue/ cassava sievate mixture are potential feed resources for replacing maize in snail feed. This will lower production cost, increase the farmer's profit margin and stimulate more snail production thus making more protein available for consumption (Ojebiyi *et al.*, 2011). The use of pawpaw leave especially during the raining season has been well embraced because it gives the best shell increase and second best weight gain. (Odo and Orji, 2010). However, there is a paucity of information on the use of brown pawpaw (*Carica papaya*) leaf meal (BPLM) in the diet of snails despite its nutrient content (Nwofia *et al.*, 2012). Hence this study was conducted to investigate the growth performance of *A. marginata* fed (BPLM) as a supplement.

MATERIALS & METHODS

Location and duration of the trial

The study was conducted over the periods of ten (10) weeks May to July at National Biotechnology Development agency, South West Bioresources Development Zonal Centre Owode Yewa South Local Government area, Ogun State, Nigeria. Owode –Yewa is a town located between latitude 6^0 48^1 N, 2^0 57^1 E and longitude 6.8^0 N 2.95 E (Wikipedia). Ecologically, the area lies in the rain forest zone with two raining seasons February- July and September –November. The daily minimum and maximum temperature inside the experimental pen were 21^0C and 25^0C respectively, while the relative humidity was between 85% and 95%.

Experimental snails

Sixty growing Black skinned Ecotype Giant African Land Snail (*A marginata*) with weight ranging from 50g to 55g was purchased from Owode -Yewa market at snail and agricultural produce unit. The snails were acclimatized for two (2) weeks to get them familiar with the experimental diets.

Experimental lay out

The experimental snails were housed in a deep litter pen 2m x 2m x 2.5m previously constructed with surrounding gutter filled with water and spent engine oil under pawpaw trees to provide shades, protect them from hatch weather and predators. Twelve (12) rounded weaving baskets with lid made of palm front each with dimension 30 cm in diameter and height of 35 cm were purchased from Owode –Yewa South market. New wood shavings was collected from a near- by saw mill industry, solarised by sprinkled with water and spread over black poly ethene bag in the sun for 9 hours. The wood shavings were then tied inside the bag and allowed to stay over-night to conserve the heat; it was then spread under building with cross ventilation the next day to dissipate the heat before used as bedding substrate for the experimental snail in the basket. The experimental snails were weighed individually to get the initial body weight, shell length, aperture radius and width before randomly distributed into the experimental treatments.

Experimental diets

The experimental diet consisted of naturally fell dried pawpaw leaves from pawpaw tree. The leaves were picked and further sundried, macerated with hand and allowed to pass through an 0.2mm sieve mesh to remove the laminas and form a leaf meal (BPLM) (Figure 1).The sieved dried leaves were measured and mixed with groundnut cake (GNC) as a protein source to get the following compositions as dietary treatment for the trial; T1 (75% GNC: 25% BPLM), T2 (50% GNC : 50% BPLM), T3 (25% GNC : 75% BPLM) and T4 (100% fresh pawpaw leaves) as control.

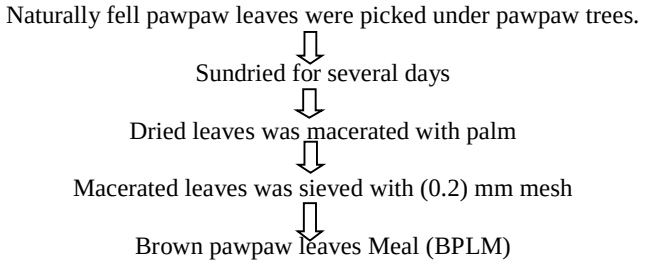

FIGURE 1: Flow chart for the Production of Brown Pawpaw leaves Meal (BPLM)

Experimental procedures and management

The pen was fumigated three (3) weeks prior to the commencement of the trial, the solarised wood shavings was spread moderately on the floor of the pen and to 2 cm deep inside four (4) baskets that were arranged in a Completely Randomised Design (CRD) and replicated three (3) times. The diet combinations were moistened slightly to soften the feed mixtures and increase the water contents thus facilitate easy consumption. Droppings were picked, the feeding troughs with left overs were cleaned properly before fresh feed combinations were provided for the snail at 17 - 18 hour daily. Substrates were replaced fortnightly. The water level with spent engine oil in the surrounding gutter was maintained and the surrounding kept weed free following the procedure of (Eruvbetine, 1997). Proximate analysis of the diets (Table 5) was carried out at Biochemistry Laboratory of Covenant University Ota, Ogun state following the standard procedure of AOAC (1990).

Data collection and statistical analysis

The parameters measured were weight of the snail, shell length, aperture radius and shell width, temperature and relative humidity of the experimental pen. Body weights were measured with digital sensitive balance (CAMRY, Model EK 5055) in grammes. The shell lengths were

measured along the axis, aperture radii were measured using measuring tape, shell widths were measured round along the largest side of the shell all with the aid of thread and ruler. The data were taking fortnightly. The data collected were subjected to One-way (ANOVA) using IBM SPSS Statistics version 21 while specific significant mean were separated with fisher's Least Significant Difference (LSD) at 0.5% level of probability.

RESULTS & DISCUSSION

The mean bi-weekly weight of *A. marginata* (Table 1) indicates that there was a progressive increase in weight gain over time in all the groups. The results also showed that the weight of *A. marginata* fed with 25% GNC + 75% BPLM mixture was significantly higher (P<0.05) compared to those fed with 50% GNC+ /50% BPLM; 75% GNC + 25% BPLM and 100% fresh pawpaw leaves. Snail fed with T3 has the highest weight of 65.0g. This may be as a result of high ash content in the diet combination (Table 5) while those fed with fresh pawpaw leaves had the least 59.0g. This is in agreement with Amata, (2014) who reported that growth performance in terms of weight gain was higher in snails fed *Carica papaya leaves as well as* with (Agbogidi 2008; Okonta and Ezeana (2008) who also observed a progressive increase in body weight, shell length on snails fed with ripped and unripe banana and pawpaw, but contrary to Ojelade *et al.* (2013) who recorded significant loss of weight among snails fed with fresh and dried water leaf. No significant differences (P > 0.05) was observed on shell length in week 2, but significant differences (P<0.05) were observed in the length of snail shell fed on the feed mixtures and the control in week 4, 6, 8 and 10 respectively (Table 2). For example, in week 6 and 8, the value of shell length for snail fed with T1 (75% GNC + 25% BPLM) mixture and T2 (50% GNC + 50% BPLM mixture were (12.3; 12.6cm and 12.8; 13.3cm).

TABLE 1: Mean body weight (g) of *A. marginata* as affected by different feed mixtures

	Weight (g) over time(wks)					
Feed mixtures	2	4	6	8	10	Mean
T1	55.7c	57.4c	60.8c	63.0c	66.6c	60.7
T2	56.2b	58.8b	62.5b	66.0b	70.9b	62.9
T3	57.0a	60.5a	64.4a.	68.3a	75.0a	65.0
T4	55.3c	57.0c	57.7d.	61.5d	63.7c	59.0
Mean	56.1	58.4	61.4	64.7	69.1	
SEM	0.21	0.45	0.82	0.96	1.38	
(P –Value)	0.003	0.002	0.002	0.020	0.001	

Mean with same letter within the same week are not significantly different at 0.05 probability level using the Least Significant Difference (LSD), SEM - Standard error of the Mean

TABLE 2: Mean shell Length (cm) of *A. marginata* as affected by different feed mixtures

	Shell Length (cm) over time (wks)					
Feed mixtures	2	4	6	8	10	Mean
T1	11.3a	16.7b	12.3c	12.6c	13.3c	12.2
T2	11.5a	12.0b	12.8b	13.3b	13.9b	12.7
T3	11.8a	12.7a	13.7a	14.5a	15.4a	13.6
T4	11.7a	11.9b	12.4c	12.7c	13.9d	12.5
Mean	11.6	12.1	12.8	13.3	14.2	
SEM	0.09	0.13	0.18	0.23	0.29	
(P –Value)	0.087	0.009	0.000	0.000	0.000	

Mean with same letter within the same week are not significantly different at 0.05 probability level using the Least Significant Difference (LSD), SEM - Standard error of the Mean

TABLE 3: Mean aperture radius (cm) of *A. marginata* as affected by different feed Mixtures

	Aperture radius (cm) over time (wks)					
Feed mixtures	2	4	6	8	10	Mean
T1	6.0a	6.2a	6.4a	6.6a	6.7b	6.4
T2	6.1a	6.2a	6.5a	6.7a	6.9b	6.5
T3	6.1a	6.4a	6.7a	7.1a	7.5a	6.8
T4	6.1a	6.3a	6.6a	6.8a	6.9b	6.5
Mean	6.1	6.3	6.6	6.8	7.0	
SEM	0.07	0.08	0.08	0.09	0.11	
(P –Value)	0.908	0.794	0.666	0.215	0.028	

Mean with same letter within the same week are not significantly different at 0.05 probability level using the Least Significant Different (LSD), SEM - Standard error of the Mean

TABLE 4: Mean width (cm) of *A. marginata* as affected by different feed mixtures

	Width (cm) over time (wks)					
Feed mixtures	2	4	6	8	10	Mean
T1	14.4a	14.9a	15.4a	16.0b	16.6c	15.4
T2	15.2a	15.7a	16.2a	16.9b	17.6b	16.2
T3	15.1a	16.1a	17.0a	17.8a	18.7a	16.8
T4	14.9a	15.5a	15.6a	16.0b	16.3c	15.6
Mean	14.9	15.6	16.0	16.7	17.3	
SEM	0.16	0.20	0.24	0.28	0.33	
(P –Value)	0.292	0.132	0.052	0.020	0.006	

Mean with same letter within the same week are not significantly different at 0.05 probability level using the Least Significant Difference (LSD), SEM - Standard error of the Mean

TABLE 5: Proximate Composition of the diet mixture fed to the snails *Archachatina marginata* (%)

Nutrient	T1	T2	T3	T4
Dry Matter	96.12	96.65	95.63	91.45
Crude Protein	0.58	0.54	0.52	0.78
Crude fibre	8.40	0.40	1.20	5.80
Fat	5.36	7.58	4.93	3.99
Ash	6.00	4.00	7.00	5.00
Organic Matter	94.00	96.00	93.00	95.00
Moisture	3.88	3.35	4.37	8.55
Total Carbohydrate	75.88	84.13	81.98	75.88

These values differ significantly ($P < 0.05$) from those obtained for T3 (25% GNC + 75% BPLM) mixture and T4 (100% fresh pawpaw leaves) (13.7; 14.5 cm and 12.4; 12.7cm) respectively (Table 2). There were no significant differences ($P > 0.05$) on the aperture radius of the snail fed with the feed mixtures in weeks 2, 4, 6 and 8. But significant differences ($P < 0.05$) were observed among all the groups in week 10. Generally the mean bi-weekly change in aperture radius (Table 3) shows that snail fed with T3 (25% GNC +75% BPLM) had the highest value of 6.8 cm while those fed with 75%GNC + 25% BPLM had the least 6.4 cm. There were no significance difference ($P > 0.05$) on the response of the snail to the feed mixtures in term of width in weeks 2, 4 and 6 but significance difference ($P<0.05$) were observed among all the treatments in week 8 and 10 (Table 4).

CONCLUSION

To sustainably encourage snail farming, boost farmers interest and reduce the challenges of global feed insecurity most especially malnutrition in term of animal protein in Nigeria, this type of study is very critical. Thus the study has demonstrated that best growth performance could be achieved on black skinned Ecotype Giant African Land snail when fed with Brown pawpaw leave meal and groundnut cake mixture, with feed mixture of (25% Groundnut cake GNC + 75% Brown pawpaw leave Meal (BPLM) mixture being the best and recommended as a simple and very cheap concentrate for snail farmers especially in the rural areas and peri – urban communities. More advantageously, the pawpaw leave meal does not pose any competition treat between human beings and animals as an additive to groundnut cake to form a simple diet combination for the animal.

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