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EFFECTS OF DIFFERENT FRUIT DIETS ON GROWTH AND DEVELOPMENT OF *Archachatina marginata (*SWAINSON)

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Abstract
This study was conducted in Dennis Osadebay University Teaching and Research Farm in Delta State, Nigeria to evaluate the growth response of Archachatina marginata as influenced by two fruit species: Carica papaya (ripe and unripe) and Musa sapientum. Forty-five grower snails of Archachatina marginata species were sourced from a local market. Data were collected on the growth parameters (weight, length of shell and circumference of shell) of the snails arranged in a completely randomized design and replicated three times. A One-way Analysis of Variance (ANOVA) was used to analyses the data and the significant means were separated using the least significant difference (LSD). The results indicated significant differences among the diets in weight gained (P<0.05) and circumference of the shell (P<0.05). it was observed that banana fruit (Musa sapientum) recorded the highest mean in all the parameters measured and throughout the duration of the experiment. This study, therefore, concluded that banana is the best diet and was recommended to farmers both in Delta State and in Nigeria. This recommendation is not just because banana did well as a diet in the study but is also cheap and available all year round. This study provides insight into the impact of different diets on the growth and development of A. marginata, with potential implication for farming and animal nutrition.
Keywords: Archachatina marginata, Carica papaya, Musa sapientum, growth response.

Introduction

Archachatina marginata, commonly known as the Giant African Land Snail, is a species of terrestrial snail that is commonly kept as a pet or raised for its meat. As with any animal, nutrition plays a critical role in the growth and development of *Archachatina marginata.* One of the most important aspects of their diet is the consumption of fruits, which provide important vitamins and minerals for their growth and overall health. However, there is still much to be learned about the specific effects of different fruit diets on the growth and development of *Archachatina marginata*. This topic is of particular interest to snail breeders and pet owners, as understanding the impact of different fruit diets can help optimize the care and feeding of these fascinating creatures. This study explored the effect of different fruit diets on the growth and development of *Archachatina marginata,* highlighting the findings and implications for those interested in their care and breeding. There is growing body of literature on the effect of different fruit diets on the growth and development of *A. marginata*. In a study conducted by Afolabi *et al*. (2018), researchers examined the effect of different fruit diets on the growth and development of *A. marginata*. The study found that snails fed a diet of banana had the highest growth rate, while those fed a diet of pawpaw had the lowest growth rate. Another study by Ndueso *et al*. (2019), investigated the effect of different fruit diets on the reproductive performance of *A. marginata*. The study found that snails fed a diet off apple had the highest number of eggs laid, while those fed a diet of guava had the lowest. Furthermore, in a study conducted by Odeyemi *et al*. (2020), researchers examined the effect of different fruit diets on the survival and growth of *A. marginata* hatchlings. The study found that snails fed a diet of pineapple had the highest survival rate, while those fed a diet of mango had the highest growth rate.

These studies suggest that different fruit diets can have a significant impact on the growth, development and reproductive performance of *A. marginata*. Therefore, it is important for snail breeders and pet owners to carefully consider the composition of their snail's diet to optimize their growth and overall health. The study by Agbede and Oyewusi (2012) investigated the effect of three different diets on the growth performance and carcass characteristics of *Archachatina marginata*. The three diets included a commercial snail feed, an ad libitum diet of mango leaves and an ad libitum diet of water melon rind. The study found that the snails fed with the commercial snail feed had the highest growth rate and carcass yield, followed by those on the mango leaf diet, while those on watermelon rind diet had the lowest growth rate and carcass yield. Another study by Hebert *et al*., (2019) investigated the effect of different diets on the growth and development of the edible snail Helix aspersa. The study compared the impact of a diet consisting of corn meal, soyabean meal and wheat bran into a diet consisting of lettuce and carrots. The results showed that the snails fed with lettuce and carrot diet had a significantly higher growth rate

and survival rate than those on the corn meal, soyabean meal and wheat bran diet. While some of these studies are not specific to the impact of fruit diets on *Archachatina marginata,* they do suggest that diet plays a critical role in the growth and development of land snails. Afolabi *et al*. (2017) investigated the effect of different fruit diets on the growth and development of *A. marginata*. The results showed that the snails fed with pawpaw had the highest growth rate, followed by those fed with banana and watermelon. They fed the snails with three different fruit diets, namely pawpaw, banana and watermelon for a period of eight weeks. Udo *et al*. (2020) evaluated the growth performance and nutrient utilization of *A. marginata* fed with four different fruit diets, namely pawpaw, pineapple, mango and watermelon for a period of 12 weeks. The study showed that the snails fed with pawpaw had the highest weight gain, followed by those fed with mango, watermelon and pineapple. The snails fed with pawpaw also had the highest protein efficiency ratio, nitrogen retention, and nutrient digestibility compared to the other groups. Onwuka *et al*. (2018) investigated the effect of different fruit diets on the growth and nutrient utilization of *A. marginata*. The snails were fed with four different fruit diets, namely pawpaw, pineapple, banana and watermelon in that order for a period of 12 weeks. The study showed that the snails fed with pawpaw had the highest weight gain followed by those fed with pineapple, banana and watermelon. The snails fed with pawpaw also had the highest crude protein, crude fat, and ash content in the body tissues compared to the other groups. The activities of man such as illegal hunting, destruction of the natural habitat through deforestation, bush burning and indiscriminate use of agricultural pesticides have decimated wild snails to the point of rendering them extinct. Intensive rearing of the giant African Land snails as a micro-livestock would help to satisfy the demand for the meat and ensure the survival of the species (Agbogidi *et al*., 2008). Snails constitute the major and cheapest source of protein in Nigeria which boost and complement the protein intake of the people (Okonta and Agbogidi, 2011; Okonta, 2012). Thus, the main objective of this study was to evaluate the growth rate of *A. marginata* fed different fruit diets.

Materials and Methods

Area of Study

This study was carried out at Dennis Osadebay University, Asaba, Oshimili South Local Government Area of Delta State located between latitude $6^{o}14^{I}$N and longitude $6^{o}49^{I}$E of the equator. The climate is tropical, the rainy season runs from April to October. Annual rainfall ranges from 1,500mm – 2,000mm and temperature is 28±6^{o}C (Asaba Meteorological Station, 2022). The dry season runs from early November to the end of March.

Experimental Design

The snails were randomly divided into three groups with 15 snails in each group. Each group was watered on a daily basis to avoid desiccation and fed with a different fruit diet, as follows

Group 1: Ripe Pawpaw
Group 2: Unripe Pawpaw
Group 3: Banana

The fruits were cleaned and cut into small pieces before feeding. The snails were fed once daily (at night, being nocturnal animals), and the amount of fruit given was adjusted based on the snail's appetite. The experiment lasted for 12 weeks.

Measurement Taken

The snails were weighed at the beginning of the experiment and every two (2) weeks thereafter, with a weighing (digital) balance, until the end of the experiment. The length and circumference of the shell were also measured at the beginning of the experiment and every two weeks thereafter, with a tape rule, until the end of the experiment.

Statistical Analysis

The data obtained were analyzed using one-way analysis of variance (ANOVA) and significant means were separated using the Least Significant Difference (LSD)

Ethical Considerations

The welfare of the snails was taken into consideration throughout the duration of the experiment and they were handled with care to minimize any potential harm or distress.

Limitation

Some potential limitations of this study may include the limited number of snails used and the limited range of fruit diets used.

Results

Weight of *Archachatina marginata fed* for 12 weeks

Table 1 below shows the results of the weight of *snails* fed with different diets for a period of 12 weeks. It shows a gradual increase in the weight of the experimental snails throughout the duration of the study. Snails fed with ripe pawpaw had an initial mean weight of 197.22g and 207.34g after feeding them for 12 weeks, while those fed with unripe pawpaw had an initial mean weight of 188.17g and final mean weight of 198.74g. Banana fed snails, also had an initial mean of 182.51g and final mean weight of 196.90g. The snails fed with banana have the highest value of 14.39g as weight gained during this period. This is higher than the weight gained by those fed with ripe pawpaw (10.12g) and unripe pawpaw (10.57g). Table 1, therefore, shows that a significant difference ($P<0.05$) exists among the treatments in terms of weight gained.

Table 1: Mean weight of *Archachatina marginata* after 12 weeks feeding

Diets	Weeks of feeding (weeks)						
	Initial	2	4	6	8	10	12
Ripe Pawpaw	197.2^{a}	197.3^{a}	198.9^{a}	199.2^{a}	200.5^{a}	205.0^{a}	207.3^{a}
Unripe Pawpaw	188.2^{b}	188.2^{b}	188.8^{b}	189.5^{b}	193.4^{b}	195.8^{b}	198.7^{b}
Banana	182.5^{ab}	182.7^{ab}	183.9^{ab}	186.9^{ab}	190.7^{ab}	193.8^{ab}	196.9^{ab}
SEM±	24.59	24.59	24.28	23.62	24.33	24.31	24.27

ANOVA table of weight gain of *Archachatina marginata*

	DF	Sum of Square	Mean Square	F	Prob
Diet	2	166.023	83.012	8.7756	0.000654*
Error	42	397.295	9.459		
Total	44	563.318			

LSD for weight gain of *Archachatina marginata*

	Ripe Pawpaw	Unripe Pawpaw	Banana
Ripe Pawpaw			
Unripe Pawpaw	0.671267		
Banana	0.000430*	0.001507*	

Length of Shell of *Archachatina marginata* fed for 12 weeks

Table 2 below shows the result of the shell length of *Archachatina marginata* snails fed with different diets for a period of 12 weeks. A gradual but steady increase in the length of the shell was observed all through the duration of the experiment. Snails fed with ripe pawpaw had an initial mean length of shell of 13.93cm and final mean length of 15.01cm at the end of the study, while those fed with unripe pawpaw had an initial mean shell length of 13.59cm and final mean shell length of 14.78cm. Snails fed with banana had the initial mean shell length of 13.09cm and final mean shell length of 14.47cm and therefore, the highest shell length increase of 1.38cm compared to those fed with ripe pawpaw (1.08cm) and unripe pawpaw (1.19cm). Table 2 shows no significant difference ($P>0.05$) among the treatments in terms of increase in length of shells after 12 weeks of feeding.

Table 2: Mean shell length of *Archachatina marginata* after 12 weeks feeding

Diets	Weeks of feeding (weeks)						
	Initial	2	4	6	8	10	12
Ripe Pawpaw	13.9[a]	13.9[a]	14.2[a]	14.4[a]	14.8[a]	14.8[a]	15.0[a]
Unripe Pawpaw	13.6[ab]	13.6[ab]	13.8[ab]	14.0[ab]	14.2[b]	14.4[a]	15.8[a]
Banana	13.1[b]	13.2[b]	13.4[b]	13.7[b]	13.9[b]	14.2[a]	14.5[a]
SEM ±	0.31	0.32	0.27	0.27	0.23	0.26	0.32

ANOVA table of length increase of *Archachatina marginata*

	DF	Sum of Square	Mean Square	F	Prob.
Diet	2	0.19911	0.09956	1.4366	0.249187
Error	42	2.91067	0.06930		
Total	44	3.10978			

Shell Circumference of *Archachatina marginata fed* for 12 weeks

Table 3 below shows the results of the mean shell circumference of *Archachatina marginata snails* fed with different fruit diets for a period of 12 weeks. It also shows a gradual increase in the shell circumference of the snails throughout the duration of the experiment. Snails fed with ripe pawpaw had an initial mean shell circumference of 18.81cm and a final mean shell circumference of 20.59cm after 12 weeks of feeding. While those fed with unripe pawpaw had an initial mean shell circumference of 18.69cm and a final mean circumference of 20.23cm. The snails fed with banana had initial mean shell circumference of 17.95cm and a final mean shell circumference of 20.24cm. The snails fed with banana had the highest value of 2.29cm as circumference gained during the period in comparison with those fed with ripe pawpaw (1.78cm) and those fed with unripe pawpaw (1.55cm). Table 3 shows significant difference ($P<0.05$) among the treatments in terms of increase in length of shell circumference after 12 weeks of feeding.

Table 3: Mean circumference of *Archachatina marginata after* 12 weeks feeding(cm)

Diets	Weeks of feeding						
	Initial	2	4	6	8	10	12
Ripe Pawpaw	18.8[a]	18.4[a]	19.2[a]	19.5[a]	19.8[a]	20.2[a]	20.6[a]
Unripe Pawpaw	18.7[a]	18.7[a]	19.0[a]	19.2[a]	19.6[a]	19.9[a]	20.2[a]
Banana	18.0[a]	18.0[a]	18.4[a]	19.0[a]	19.4[a]	19.9[a]	20.2[a]
SEM ±	0.52	0.53	0.49	0.58	0.54	0.52	0.51

ANOVA for circumference of Archachatina *marginata*

	DF	Sum of Square	Mean Square	F	Prob
Diet	2	4.3773	2.1887	5.5541	0.007242*
Error	42	16.5507	0.3941		
Total	44	20.9280			

LSD for Circumference of *Archachatina marginata*

	Ripe Pawpaw	Unripe Pawpaw	Banana
Ripe Pawpaw			
Unripe Pawpaw	0.314532		
Banana	0.030477*	0.002229*	

Discussion

Archachatina marginata usually prefer fresh, juicy, succulent leaves and fruit. This preference can be observed in the feed intake which indicated that ripe pawpaw fruits and leaves were preferable to snails (Abakwam, 2016). Snails have been found to increase in weight and size (length and circumference) as shown by (Okonta, 2016). This shows that when snails are properly fed, they grow very well. This study

shows that snails have the potential to convert cheap feeding materials to attain appreciable weight increase over a period of time. This is in tandem with the findings reported elsewhere (Agbogidi *et al*., 2008; Okonta, 2012; Ani *et al*., 2014). The observed increase in both the shell length and shell circumference of the snails is not out of place. As the body weight increased, there seemed to be a corresponding increase in size of the shell to accommodate the growth of the fleshy mass. This observation is consistent with the findings of (Omole *et al*., 2011; Okonta, 2013) who noted an increase in the length and circumference of shell of snails fed on fruits. The increase in shell length and shell circumference of snails fed with banana compared with those fed with pawpaw could be attributed to the high calcium content of this fruit, since there is a positive correlation between shell growth and available calcium in the feed (Mogbo *et al*., 2014). The study also showed that snails fed with banana had a better growth response than those fed with pawpaw, however, this is at variance with the observation of Abakwam (2016) who reported that snails fed with pawpaw had a better growth response than those fed with banana.

Conclusion

The effect of three different fruit diets on the growth performance of *Archachatina marginata was* studied for twelve weeks. The results obtained showed that there was an increase in weight, length and circumference of the snails which shows growth. The responses of *Archachatina marginata* to the fruit diets are available throughout the growing season. The morphological parameters of the snails in all the treatments (diets) were observed to increase proportionally to their body weight, proving that the fruit treatments have positive effects on snail growth.

The results of the experiment have shown the relative effectiveness of different fruits in promoting the growth of African giant land snail (*Archachatina marginata*). It was observed that the growth performance of the snails fed with ripe and unripe pawpaw as well as banana in terms of body weight gain and shell circumference differed significantly while the shell length showed no significant difference. The higher values observed from the growth performance of the snails being fed with fruits show that fruits are more suitable for feeding snails than leaves and peels which also support the claims of Okonta (2012) and Abakwam (2016). In conclusion, Giant African Snails have voracious appetite. They are known to eat at least 500 different types of plants including peanuts, beans, peas, cucumber and melon (Agbogidi and Okonta, 2011), all the fruits tested in feeding *Archachatina marginata* are suitable feed that support the growth and development of the snails. The growth performance of the snails fed with the pawpaw and banana shows that snails can be fed with fruits that are attractive, juicy, succulent and sweet with good moisture content. Increase in the shell length and circumference of the snails in all the treatments (diets) indicate that the fruits aid the entire body growth of the snails.

Recommendation

The study has demonstrated that different edible fruits have a significant effect on the growth performance of *Archachatina marginata with* the snail performing better when fed on ripe banana fruits. Ripe banana fruits are therefore, recommended to snail farmers in the rural areas of Nigeria for optimum growth. The use of ripe pawpaw fruit could also be encouraged as it is a cheap source of feed for *Archachatina marginata.*

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