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**Growth Performance of *Archachatina marginata* and
Achatina fulica Fed Ugwu (*Telfairia occidentalis*),
Cocoyam (*Colocasia esculenta*) African Spinach
(*Amaranthus cruentus*) Leaves and Soyabeans
(*Glycine max*) Concentrate**

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GROWTH PERFORMANCE OF *ARCHACHATINA MARGINATA*
AND *ACHATINA FULICA* FED UGWU (*TELFAIRIA*
OCCIDENTALIS), COCOYAM (*COLOCASIA ESCULENTA*)
AFRICAN SPINACH (*AMARANTHUS CRUENTUS*) LEAVES
AND SOYABEANS (*GLYCINE MAX*) CONCENTRATE

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ABSTRACT: *Achachatina marginata* and *A.fulica* fed with four treatments and soyabeans concentrates supplement fed ad-libitum. T1 (Ugwu leaves and soyabeans concentrates), T2 (African spinach leaves and soyabeans concentrates), T3 (Cocoyam leaves and soyabeans concentrates) and T4 (Pawpaw leaves and soyabeans concentrates). Eighty (80) grower snails of *A.marginata* and (80) grower snails of *A.fulica* were randomly allocated to four treatments and soyabean concentrates supplement ad-libitum and snail was replicated 4 times with 5 snails per replicate and 20 snails per treatment. Snails in each replicate were fed 30g of each treatment on daily basis. Data was collected on growth parameters (shell weight gain, shell length increase, shell width increase and feed consumed) on a weekly basis. There was no significant ($P>0.5$) difference on the growth performance in the body weight, shell length, feed consumed and there was significant difference on the growth performance in the shell width for *A.marginata*. There was no significant ($P>0.5$) difference on the growth performance in the body weight, shell length, shell width for *A.fulica* throughout the duration of the experiment. For the two species of snails, Snails fed diet containing T3 and soyabeans concentrates had the highest mean weight (63.50 ± 4.66) while T1 and soyabean concentrate had the lowest mean weight (59.25 ± 2.50) and T4 and soyabean concentrates, for *A.marginata* T2 and soyabeans concentrates (4.13 ± 0.27) and *A.fulica* T2 (7.22 ± 0.38) had the highest mean length while *A.marginata* T3 and soyabeans concentrates (3.88 ± 0.03) *A.fulica* T4 (36.67 ± 0.56) had the lowest mean length, *A.marginata* T2 and soyabeans concentrates (3.46 ± 0.00) and *A.fulica* T1 (3.99 ± 0.11) had the highest mean width while *A.marginata* T4 and soyabean concentrates (3.36 ± 0.03) *A.fulica* T4 (3.67 ± 0.5) had the lowest mean width, *A.marginata* T3 and soyabeans concentrates (24.19 ± 10.49) and *A.fulica* T1 (28.00 ± 6.72) had the highest mean feed consumed while *A.marginata* T2 and soyabeans concentrates (22.26 ± 1.32) and *A.fulica* T4 (18.98 ± 3.39) had the largest feed consumed. At the end of the study, It was observed that all feed treatments fed to the two species of snails has higher growth performance and are recommended to snail farmers in Nigeria for optimal growth performance.

Keywords: *Archachatina marginata*, *Achatina fulica*, Growth, Performance, Concentrates

1. INTRODUCTION

Archachatina marginata and *A. fulica* are two species of the large land snails in West Africa. Snails are bilateral invertebrates with soft body and a slippery skin. They belong to the phylum mollusca typified with the possession of segmented exoskeleton in form of calcareous shells (Akinnusi, 1997; Okafor, 2001). *A.marginata* and *A.fulica* dwell mostly in the humid tropical forest where they are picked by snail gatherers for consumption and for sale. Both species are nocturnal in behaviour (Omole *et al.*, 1999). The bulk

of snails consumed in Nigeria are picked from the wild and sold in local markets or along roadsides. With the current economic situation in Nigeria today, there is a radical shift from total dependence on government for job to self-employment. One of such attractive activities for self-employment is snail rearing/snail farming (Elmsile, 1982; Agbogidi and Okonta, 2003; Agbogidi *et al.*, 2005). It is a money spinning business that has a potential of providing a substantial source of protein to complement Nigeria meals. Snails come to the Table as a gastronomic delight (Hodasi, 1982).

Snails are known to be rich in important minerals including - potassium, phosphorus, copper, iron and low in cholesterol and fats (Ayodele and Asimalowo, 1999). To solve some health and unemployment problem in Nigeria, snail farming becomes very vital (Ademosun and Omidiji, 1999; Agbogidi *et al.*, 2008). Besides, following the reported decline of wild snails consequent upon increased activities such as deforestation, pesticide application, slash-and-burn agriculture as well as over-exploitation of the species before they reach maturity, it has become necessary to go into heliculture as this becomes the only viable conscious effort by man to conserve this multipurpose animal species (Agbogidi, *et al.*, 2005; Agbogidi and Ofuoku, 2006; Agbogidi and Eshegbeyi, 2008).

In addition, the richness of snails in terms of nutrients has caused the demand for snails to soar over the years thereby outstripping supply hence the need to encourage its domestication is inevitable (Imevbore and Ademosun, 1988; Ejidike, 2002). Eruvbentine *et al.*, (1996) reported that snails are predominantly vegetarians and can utilize a number of feeds for growth. Although small-sale snail production is well documented, availability of adequate fresh natural feeding materials for their production seems to hinder large-scale production (Ajayi, 1987; Omole *et al.*, 1999; Wosu, 2003). The objective of this study was to evaluate the growth response of *A. fulica* and *A. marginata* as influenced by commonly found vegetables in Nigeria with a view to recommending same to farmers in order to boost small, medium and large-scale snail production in Nigeria.

2. MATERIALS AND METHODS

2.1 Description of the study area

The study was conducted in Abeokuta city in Ogun State. Ogun State is located between Long 4⁰³⁷ East of the Greenwich meridian and Lat 7⁰⁵⁸⁰¹ North of the Equator. Abeokuta is the capital city of Ogun State. Abeokuta is composed of Abeokuta North Local Government and Abeokuta South Local Government Areas; it lies between latitude 8⁰N and also between longitude 20⁰⁵⁰^{0E} and 40^{0E} (Ojo, 1998). The site has a gentle undulating landscape and mild slope. The zone has a fair terrain of not more than 300 metres above sea level. The area has an annual rainfall of 1200mm with its peak in June and July. The relative humidity of the area is 82.54% and an average monthly temperature of 35.8°C. The population in Abeokuta is 374,843 of which 183,281 are males and 191,586 are females (the National Population Commission 1992, a publication of the NPC. Abuja Census News 1992).

The research study was carried out in the Wildlife Domestication and Multiplication Unit of the Department of Forestry and Wildlife Management, Federal University of Agriculture Abeokuta

(FUNAAB) which lies within the rain forest vegetation zone of western Nigeria. The house which was a home to the snails for the period of the study was shaded with trees to protect the snails from excessive sunlight rays.

2.1.1 Experimental materials

The experimental materials used during the study include; Snail baskets, Experimental snails, Top soil, Digital sensitive weighing balance, measuring ruler, Paper tape, Maker, Snail diets (Ugwu leaves, Cocoyam leaves, Pawpaw leaves, African spinach and Soybeans concentrates).

2.1.2 Soil collection and treatment

Rich top soil was collected from the FOREST NURSERY with the use of shovel and sack. The soil was loosened and sterilized to kill possible pathogenic organisms. Sterilization was done by sun drying because pathogens and the sun dried soil was sieved to remove stones which might cause damage to the shell of experimental snails before it was introduced to the plastic baskets.

2.1.3 Experimental diets (treatments)

The experimental diets used during the study were Ugwu leaves, Cocoyam leaves, Pawpaw leaves, African spinach and soybeans concentrates and these diets served as the treatments. Pawpaw leaves, Cocoyam leaves were obtained outside the vicinity of the school premises ugwu leaves, African spinach and was gotten from market women. Soybeans concentrate was gotten from living feeds located at Km 4, Abeokuta-Ibadan Road, Eleweran, Abeokuta.

2.1.4 Experimental snail acquisition

A total of eighty (80) grower snails of *A. marginata* and *A. fulica* (80) grower snails were used for this study and they were purchased from the Wildlife Domestication and Multiplication unit of the Department of Forestry and Wildlife management. On arrival to the experimental site, all snails were allowed an acclimatization period of one (1) week and efforts were made to stimulate the natural environment by covering the snails with leaves. The set up was laid out in a complete randomized design replicated four times for each treatment. For *A. marginata* there were 5 snails per replicate and 20 snails per treatment i.e 20 out of 80 snails were subjected to feeding with pawpaw leaves with Soybeans concentrates, 20 were subjected to feeding with cocoyam leaves with soybeans concentrates, 20 were subjected to feeding with African spinach leaves with soybeans concentrates and the remaining 20 were subjected to feeding with ugwu leaves with soybeans concentrates and for *A. fulica* there were 5 snails per replicate and 20 snails per treatment i.e 20 out of 80 snails were subjected to

feeding with pawpaw leaves with soyabeans concentrates, 20 were subjected to feeding with cocoyam leaves with soyabeans concentrates, 20 were subjected to feeding with African spinach leaves with soyabeans concentrates and the remaining 20 were subjected to feeding with ugwu leaves with soyabeans concentrates.

Table 1: Soyabeans concentrates

Ingredients	soyabeans concentrates (supplement diet)
Maize	48
Soyabean	19.7
Fish meal	8
Wheat offal	16
Lime stone	2
Bone meal	6
Vitamin premix	0.3
Total	100

Table 2: Experimental design model for *A. marginata*

Replicate	Treatments				
	Diet 1	Diet 2	Diet 3	Diet 4	Total
1	T1R1(5 snails)	T2R1(5 snails)	T3R1(5 snails)	T4R1(5 snails)	20 snails
2	T1R2(5 snails)	T2R2(5 snails)	T3R2(5 snails)	T4R2(5 snails)	20 snails
3	T1R3(5 snails)	T2R3(5 snails)	T3R3(5 snails)	T4R3(5 snails)	20 snails
4	T1R4(5 snails)	T2R4(5 snails)	T3R4(5 snails)	T4R4(5 snails)	20 snails
Total	20 snails	20 snails	20 snails	20 snails	80 snails

Table 3: Experimental Design Model for *A. fulica*

Replicate	Treatments				
	Diet 1	Diet 2	Diet 3	Diet 4	Total
1	T1R1(5 snails)	T2R1(5 snails)	T3R1(5 snails)	T4R1(5 snails)	20 snails
2	T1R2(5 snails)	T2R2(5 snails)	T3R2(5 snails)	T4R2(5 snails)	20 snails
3	T1R3(5 snails)	T2R3(5 snails)	T3R3(5 snails)	T4R3(5 snails)	20 snails
4	T1R4(5 snails)	T2R4(5 snails)	T3R4(5 snails)	T4R4(5 snails)	20 snails
Total	20 snails	20 snails	20 snails	20 snails	80 snails

2.1.5 Management and care of experimental snails

The diets were given to the snails during dusk every day since snails are nocturnal and more active at night. 30g of each diet was weighed before it was introduced in the different replicates. The feeds were supplied in plastic baskets properly labeled to avoid any mix up. Water was sprinkled on the snails twice a day to keep them moist and prevent dehydration. The snails were regularly cleaned to remove droppings and waste in form of left over feeds before fresh feeds were supplied and the surrounding kept weed free and sprinkled with spent engine oil to avoid the invasion by ants and other predators following the procedure of Eruvbetine *et al.*, (1997).

2.2 Method of Data Collection

Parameters measured include; Body weight of snail, length of shell and width of shell, and daily feed consumed. Feed consumed was also calculated. Body weight of the snails was measured in grams using sensitive weighing balance obtained from the department of Forestry and Wildlife Management. The shell length was measured along the axis of the snails using the measuring tape to the nearest centimeter. The shell width was also measured around the largest position of the shell. The initial body weights, the

initial body weights, shell length and shell width were measured at the beginning of the study and at weekly intervals thereafter for a period of 12 weeks.

2.3 Data Analysis

The data collected from the experiments was analyzed using one-way analysis of variance (ANOVA). The different between the treatment means was separated using Post Hoc Test called Duncan's New Multiple Range Test (DMRT).

3. RESULTS

3.1 *A. marginata*, *A. fulica* weight, length, width and feed consumed

Table 4 show that the maximum weight of *A. marginata* was 36 while minimum was 24 with the mean value of 27.81 ± 3.08 . The maximum length of the species was 4.44 while minimum was 3.84 with the mean value of 4.01 ± 0.18 . The maximum width of the species was 3.46 while the minimum was 3.30 with the mean value of 3.42 ± 0.05 . The maximum feed consumed of the species was 38.95 while the minimum feed consumed was 15.90 with the mean value of 23.22 ± 5.55 . The maximum weight of *A. fulica* was 69 while minimum was 49 with the mean value of 60.94 ± 5.32 . The maximum length of the species was 7.54

while minimum was 6.30 with the mean value of 7.04±0.34. The maximum width of the species was 4.10 while the minimum was 2.84 with the mean value

of 3.90±0.30. The maximum feed consumed of the species was 37.95 while the minimum feed consumed 15.13 with the mean value of 23.10±5.26.

Table 4: *A. marginata*, *A. fulica* weight, length, width and feed consumed

	Minimum	Maximum	Mean	Std. Deviation
Weight (gm)	24 ^a 49 ^b	36 ^a 69 ^b	27.81 ^a 60.94 ^b	3.08 ^a 5.32 ^b
Length (cm)	3.84 ^a 6.30 ^b	4.44 ^a 7.54 ^b	4.01 ^a 7.04 ^b	0.188 ^a 0.34 ^b
Width (cm)	3.30 ^a 2.84 ^b	3.46 ^a 4.10 ^b	3.42 ^a 3.89 ^b	0.05 ^a 0.29 ^b
Feed consumed (gm)	15.90 ^a 15.13 ^b	38.95 ^a 37.95 ^b	23.22 ^a 23.10 ^b	5.55 ^a 5.26 ^b

^a*A. marginata* ^b*A. fulica*

3.2 *Archachatina marginata*, *A. fulica* fed with ugwu leaves and soyabeans concentrates.

minimum feed consumed 18.10 with the mean value of 23.91±4.18.

Table 5 shows that the maximum weight of *Archachatina marginata* fed with Ugwu and Soyabeans concentrates was 31 while minimum was 24 with the mean value of 28.25± 3.40. The maximum length of the species was 4.32 while minimum was 3.10 with the mean value of 4.11±0.18. The maximum width of the species was 3.46 while the minimum was 3.42 with the mean value of 3.45±0.02. The maximum feed consumed of the species was 27.10 while the

The maximum weight of *A. fulica* fed with Ugwu with soyabeans concentrates was 62 while minimum was 56 with the mean value of 58.25± 2.50. The maximum length of the species was 7.24 while minimum was 6.76 with the mean value of 7.07±0.21. The maximum width of the species was 4.10 while the minimum was 3.84 with the mean value of 3.99±0.11. The maximum feed consumed of the species was 37.95 while the minimum feed consumed 23.70 with the mean value of 28.00±6.72.

Table 5: *A. marginata*, *A. fulica* fed with ugwu leaves and soyabeans concentrates

	Minimum	Maximum	Mean	Std. Deviation
Weight (gm)	24 ^a 56 ^b	31 ^a 62 ^b	28.25 ^a 59.25 ^b	3.40 ^a 2.50 ^b
Length (cm)	3.96 ^a 6.76 ^b	4.32 ^a 7.24 ^b	4.11 ^a 7.07 ^b	0.18 ^a 0.21 ^b
Width (cm)	3.42 ^a 3.84 ^b	3.46 ^a 4.10 ^b	3.45 ^a 3.99 ^b	0.02 ^a 0.11 ^b
Feed consumed (gm)	18.96 ^a 23.70 ^b	27.97 ^a 37.95 ^b	23.90 ^a 28.00 ^b	4.18 ^a 6.72 ^b

^a*A. marginata* ^b*A. fulica*

3.3 *A. marginata*, *A. fulica* fed with african spinach and soyabeans concentrates

feed consumed 20.38 with the mean value of 22.26±1.32.

Table 6 shows that the maximum weight of *A. marginata* was 36 while minimum was 25 with the mean value of 28.25± 5.19. The maximum length of the species was 4.44 while minimum was 3.88 with the mean value of 4.13±0.27. The maximum width of the species was 3.46 while the minimum was 3.46 with the mean value of 3.46±0.00. The maximum feed consumed of the species was 23.26 while the minimum

The maximum weight of *A. fulica* was 68 while minimum was 55 with the mean value of 61.80± 6.24. The maximum length of the species was 7.54 while minimum was 6.76 with the mean value of 7.22±0.38. The maximum width of the species was 4.04 while the minimum was 3.86 with the mean value of 3.96±0.08. The maximum feed consumed of the species was 28.16 while the minimum feed consumed 18.33 with the mean value of 22.82±3.98.

Table 6: *Archachatina marginata* fed with african spinach and soyabeans concentrates

	Minimum	Maximum	Mean	Std. Deviation
Weight (gm)	25 ^a 55 ^b	36 ^a 68 ^b	28.25 ^a 61.76 ^b	5.188 ^a 6.24 ^b
Length (cm)	3.88 ^a 6.76 ^b	4.44 ^a 7.56 ^b	4.13 ^a 7.22 ^b	0.27 ^a 0.38 ^b
Width (cm)	3.46 ^a 3.06 ^b	3.46 ^a 4.04 ^b	3.46 ^a 3.96 ^b	0.00 ^a 0.09 ^b
Feed consumed (gm)	20.38 ^a 18.53 ^b	23.26 ^a 28.16 ^b	22.26 ^a 22.82 ^b	1.32 ^a 3.98 ^b

^a*A. marginata* ^b*A. fulica*

3.4 *A. marginata*, *A. fulica* fed with cocoyam leaves and soyabeans concentrates

feed consumed 15.90 with the mean value of 24.19±10.50.

Table 7 shows that the maximum weight of *A. marginata* was 31 while minimum was 26 with the mean value of 28.00± 2.16. The maximum length of the species was 3.92 while minimum 3.84 was with the mean value of 3.88±0.033. The maximum width of the species was 3.46 while the minimum was 3.38 with the mean value of 3.40±0.040. The maximum feed consumed of the species was 38.96 while the minimum

The maximum weight of *A. fulica* was 69 while minimum was 58 with the mean value of 63.50± 4.66. The maximum length of the species was 7.32 while minimum 6.30 was with the mean value of 6.97±0.46. The maximum width of the species was 4.08 while the minimum was 3.78 with the mean value of 3.97±0.01. The maximum feed consumed of the species was 27.24 while the minimum feed consumed 19.60 with the mean value of 22.60±3.28.

Table 7: *Archachatina marginata*, *A. fulica* fed with cocoyam leaves and soyabeans concentrates

	Minimum	Maximum	Mean	Std. Deviation
Weight (gm)	26 ^a 58 ^b	31 ^a 69 ^b	28.00 ^a 63.50 ^b	2.160 ^a 4.66 ^b
Length (cm)	3.84 ^a 6.30 ^b	3.92 ^a 7.32 ^b	3.88 ^a 6.97 ^b	0.033 ^a 0.46 ^b
Width (cm)	3.38 ^a 3.78 ^b	3.46 ^a 4.08 ^b	3.40 ^a 3.97 ^b	0.04 ^a 0.13 ^b
Feed consumed (gm)	15.90 ^a 19.60 ^b	38.96 ^a 27.24 ^b	24.19 ^a 22.59 ^b	10.50 ^a 3.28 ^b

^a*A. marginata* ^b*A. fulica*

3.5 *A. marginata*, *A. fulica* fed with pawpaw leaves and soyabeans concentrates

feed consumed 15.90 with the mean value of 22.53±4.57.

Table 8 shows that the maximum weight of *A. marginata* was 28 while minimum was 25 with the mean value of 26.75± 1.50. The maximum length of the species was 4.06 while minimum 3.84 was with the mean value of 3.93±0.10. The maximum width of the species was 3.4 while the minimum was 3.38 with the mean value of 3.36±0.04. The maximum feed consumed of the species was 26.39 while the minimum

That the maximum weight of *A. fulica* was 67 while minimum was 49 with the mean value of 59.25± 7.59. The maximum length of the species was 7.26 while minimum 6.44 was with the mean value of 6.91±0.34. The maximum width of the species was 4.06 while the minimum was 2.84 with the mean value of 3.67±0.56. The maximum feed consumed of the species was 22.43 while the minimum feed consumed 15.13 with the mean value of 18.99±3.39.

Table 8: *A. marginata* fed with pawpaw leaves and soyabeans concentrates

	Minimum	Maximum	Mean	Std. Deviation
Weight (gm)	25 ^a 49 ^b	28 ^a 67 ^b	26.75 ^a 59.25 ^b	1.50 ^a 7.59 ^b
Length (cm)	3.84 ^a 6.44 ^b	4.06 ^a 7.26 ^b	3.93 ^a 6.91 ^b	0.096 ^a 0.34 ^b
Width (cm)	3.30 ^a 2.84 ^b	3.38 ^a 4.06 ^b	3.36 ^a 3.67 ^b	0.038 ^a 0.56 ^b
Feed consumed (gm)	15.90 ^a 15.13 ^b	26.39 ^a 22.43 ^b	22.53 ^a 18.99 ^b	4.57 ^a 3.39 ^b

^a*A. marginata* ^b*A. fulica*

3.6 One-way analysis variance (anova) of *A. marginata* and *A. fulica* on weight, length, width and feed consumed

12) =0.182, P=0.5 There was no significant difference in the mean of the length of the species. There was significant difference in the mean of width of the species; There was no significant difference in the mean of the feed consumed of the species.

Table 9 shows that there was no significant difference in the mean of weight of the species; F (3,

Table 9: One-way analysis variance (anova) of *A. marginata*, *A. fulica* on weight, length, width and feed consumed

	Df	F	Sig.
WEIGHT	3	0.182 ^a 0.554 ^b	0.907 ^a 0.655 ^b
	12		
	15		
LENGTH	3	2.142 ^a 0.562 ^b	0.148 ^a 0.650 ^b
	12		
	15		
WIDTH	3	10.588 ^a 1.076 ^b	0.001 ^a 0.396 ^b
	12		
	15		
FEED CONSUMED	3	0.100 ^a 2.646 ^b	0.958 ^a 0.097 ^b
	12		
	15		

^a*A. marginata* ^b*A. fulica*

4. DISCUSSION

This study showed that snails can utilize a whole lot of feed materials for growth, Maduabuchi *et al* (20119). The results obtained showed that there was no significant difference on the growth performance in the (mean body weight gain) of *A. marginata*. This conforms to the observation of Ufele (2015). Also there was no significant difference on the growth performance in the (shell length and shell width increase) of *A. marginata*, which agrees with the result obtained by Maduabuchi and Ezewudo (2019). The results from the study on *A. fulica*, showed there was no significant difference on the growth performance in the (mean body weight gain) and (shell length increase) in line with the observations of Magbo *et al* (2014) and Maduabuchi *et al* (20119). *Achatina fulica* raised under intensive care and management showed better growth and performance than *A. marginata* when fed cocoyam leaves and soyabean concentrates.

5. CONCLUSION

1. *Archachatina marginata* and *A. fulica* can be raised on a variety of leafy materials.
2. *Achatina fulica* tend to perform better than *A. marginata* on cocoyam leaves and soyabean concentrates.
3. All the experimental diets are recommended for snail farming for optimal growth.

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