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Effects of Supplemented Leafy Diets on the Maturity of the Giant Land Snail (*Archachatina marginata*) Reared in Captivity

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Abstract

The giant land snail, *Archachatina marginata*, is an invertebrate Mollusc with high nutritional value. It is usually collected from the wild, but its culture in Nigeria is becoming widespread. However, farmers who have ventured into its farming are discouraged by its long maturity period of 12-20months. This study was undertaken to address the above problem by improving the vegetarian diets by the addition of feed supplements as done in livestock production and fisheries. To the leafy diets were added soybean, whole corn, vitamins and minerals. They formed the supplemented treatment diets. The unsupplemented leafy diets were the control diets. Both were differently fed to the two different snail groups in 3 replicates. Sexual maturity was attained in the supplemented dietary groups in 8 months in treatments T_2 and T_4. T_3 matured in 9 months, while the latest to mature in 9½ months was in T_1. All the controls did not grow well and did not mature. Statistical analysis showed that there was a significant difference ($P<0.05$) between the mean maturity values of all the treatments and the minimum standard number of 360 days (12 months) for the maturity of *A. marginata* in the wild. It is therefore recommended that farmers supplement the vegetarian diets of *A. marginata* to reduce the long maturity period.

Keywords: *Archachatina marginata*, Maturity, Supplemented, Captivity.

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Introduction

Maturity of animals in animal production is a major factor that determines whether or not a particular animal species is reared. Those with short maturity periods are usually preferred by farmers. This is because, as the animals mature early, the farmer sells them off to make his gain. He quickly restocks to sell off soon again. This way, there is a quick "return on investment" and the farmer is in business all-year–round. In snail farming, which is currently coming into vogue in Nigeria, farmers who have ventured into the business are highly discouraged by the long maturity period of snails. Sexual maturity for the giant land snail, *Achatina achatina* as recorded by Cobinah (1993) is between 14-20 months. Okorie (1995) recorded for *Archachatina marginata* a range of 9 -12 months. *Heliz aspersa*, Cobbinah (1993) is said to mature in 27 months, but said to have matured 10 months earlier when fed a supplemented diet containing calcium, phosphorus, sodium chloride, vitamins A,B_1, D, E and K.

This study investigated the effect of supplementing the leafy diets of snails, on the maturity of the giant land snail, *Archachatina marginata* to see if improved nutrition on what the snails eat in the wild is able to bring early maturity.

Materials and Methods

This study was conducted at a snail farm at Okigwe, Imo State, Nigeria. Okigwe is the rain forest zone of Southern Nigeria. According to Esonu and Nwoko (1999), the ecosystem in this part of Nigeria favours the existence of snails. Multi-purpose concrete cages with highly insulated and controlled environments were used to house the snails. Each cage measured 150.0cm x 70.0cm x 80.0cm. It was built of 5" solid blocks. The tops of the cages were covered with nylon mosquito gauze-framed lids that could open and close as well as locked at will. The floor base of each cage was covered with humus soil 30cm thick. Centrally placed inside the cages were flat feeding trays in which the snail feeds were placed. Over the trays were sheets of metal zinc on top of the cage lids to prevent rain from flooding and damaging the feeds.

Three plants leaves popularly utilized in the wild as feeds by the giant land snail, *Archachatina marginata* were used to formulate the diets. These leaves were cocoyam (*Xanthosoma sagittifolium)*, paw-paw (*Carica papaya*) and siam weed (*Chromolaena odorata)*. They were collected from the wild and dried under the sun. They were then squeezed between the palms to milled products. Their nutrient contents were determined by the methods of AOAC (1995)Table 1, before being combined with the supplements. Two versions of the snail feeds were formulated. The first version is the "Supplemented" treatment diet, while the second is the "Unsupplemented" control diet. Both had the three leaves, cocoyam, paw-paw and siam weed. 8 g each of the three leaves were separately added to 20g soybean as protein source, 70g whole corn as carbohydrate source (both ground to powder with Corona handbill) and 2g growth additives (calcium, vitamins A, B, Co, C and Tetracycline capsules), all thoroughly mixed to produce a 100g supplemented diet of each of the three. The three (3) unsupplemented (control diets) fed the control snails had only 100g of each of the three leafy bases to produce three unsupplemented control diets. The fourth 100g unsupplemented control diet was formulated from a combination of the three leaves in proportion of 0.523:43.75:55.0, representing paw-paw leaves, siam weed and cocoyam leaves, respectively. The four (4) control diets were designated CT_1, CT_2, CT_3 and CT_4. Both the supplemented and unsupplemented diets compositions are shown in Table 2.

A fourth supplemented leafy diet was formulated from a combination of the three leaves in proportion of 0.042:3:5.4, representing paw-paw leaves, siam weed and cocoyam leaves, respectively, with the supplements added. The four (4) supplemented leafy diets were designated treatments T_1, T_2, T_3 and T_4. Ten (10) snail hatchlings, a day-old, known as progeny1, the offspring of the parent stock bred on the farm with known hatching dates were stocked in each of the randomly assigned treatment and control cages. Each treatment and control groups were replicated 3 times with 10 hatchlings per replicate. 240 hatchlings in all were used in the experiment. After stocking, they were then covered with wet dried plantain leaves to provide cool cage environments.

Each treatment and control diets were fed to the snails in their appropriate cages. 100 g or multiples of it were fed at a time, depending on consumption rates. The feeds were moistened with clean water to a paste and placed inside the feeding trays. Feeding was mostly carried out in the evenings since snails are essentially nocturnal. Cage atmospheric and soil temperatures were monitored with Celcius thermometer daily during the dry spells, but every other day during the rainy season. Monthly rainfall during the culture period of 10 months was determined by means of a rain gauge placed in the farm. A summary of feed intake, feed conversion ratio, temperature and rainfall during the culture period is shown in Table 3. The first day eggs were laid in each treatment cage was taken as the maturity date of that treatment group. *Archachatina marginata* laid eggs in shallow burrows, at times 4-10.5 cm deep, made by the spawning snail. The eggs were deposited in clutches inside the burrow. They were then covered with earth by the spawning snail, leaving a small opening that could lead to identifying the egg spot.

Results and Discussion

The earliest to mature in 244 days (8months) was T_2 group, fed paw-paw leaves and supplements. Next was in 247 days (8months) by T_4 group, fed combined leaves and supplements, followed by 262 days (9 months) in T_3, fed Siam weed and supplements. The latest to mature in 285 days ($9^1/_2$ months) was T_1 group, fed cocoyam leaves and supplements. Their mean weights at maturity were 87.6g, 86.0g, 81.6g and 54.6g seen in T_2, T_4, T_3, and T_1, respectively. Statistical analysis showed that there was a significant difference ($P<0.05$) between the mean maturity values of the treatments and the minimum standard number of 360 days (12 months) for the maturity of *A. marginata*.

The unusual early maturity periods recorded in this study could be as a result of the supplements added to their leafy diets. This very much agrees with Amusan *et. al* (1999) that a combination of two or more feeds always resulted into better performance. The long maturity period for *A. marginata* was indeed reduced drastically in this work. Feeds of high nutrient value fed to these snails might have contributed to this early maturity compared with what had been known before. This also agrees with Bunce *et al*. (2005) that the availability of food and its adequate consumption/utilization are determinants in the reproductive performance of snails. This may have influenced early maturity especially in T_2 and T_4, the maturity index being the laying of eggs. Geisser and Reyer (2005), on the other hand, linked reproduction in snails to regular food availability and optimum temperatures. A combination of optimum temperatures and rainfall in the treatment cages (T_1 –T_4) of these snails and the regularly available high nutrient value feeds, adequately consumed (Table 3), might have contributed to their early reproduction (maturity). Availability of qualitative feeds to snails has been shown to illicit early maturity in them. Cobbinah (1993) reported that in France, *Helix axpersa* fed supplemented diet containing calcium, phosphorus, sodium chloride, vitamins A, B, D, E and K reduced the maturity period from 27 to 17 months. That is, 10 months earlier. Also responsible for this early maturity is efficient feed conversion. According to Maynard *et al*. (1980), efficient feed conversion ratio is less feed used per unit weight gain. The best feed conversion ratios in this study were seen in T_4 (3.2 g) and T_2 (3.31g), the worst being in CT_4 (9.73g) that never matured (see Table 3). It is therefore not surprising that *A marginata* fed the supplemented diets was able to attain maturity at a record time that appears unprecedented so far.

The sole survivor control-counterpart in CT_4, fed the combined leaves only, further buttressed the fact that quality nutrition has a very important role to play in the bionomics of snails. Indeed, this lone survivor in CT_4 did not grow well. It also did not mature as its treatment -counterparts did. At the time the treatment-counterparts (T_1- T_4) matured and almost weighed 100g, it weighed only 20.4g with high feed conversion ratio of 9.73g. These confirm the findings of Okonkwo *et al*. (2000) that growth of snails like other animals differs with respect to what they are fed.

Conclusion and Recommendations

Archachatina marginata, essentially a forest product and a vegetarian was successfully reared in captivity with supplemented diets, under optimum environmental conditions of temperature and rainfall. In this study, the supplements used were soybean as protein source, whole corn as carbohydrate (energy) source, with vitamins, minerals and antibiotics added as growth additives. The problem of long maturity period that has deterred farmers from venturing into snail farming was solved as the period was reduced from 12-20 months to 8 months. So, supplementing the snail vegetarian diets will enhance growth and early maturity as was achieved in this study. The problem of non-availability of standard feeds for snail farmers is also solved. Farmers can now supplement any of the leafy bases as there was no significant difference ($P>0.05$) between the mean effect of the treatments. On the other hand, there was a significant difference ($P<0.05$) between the mean effect of the treatment diets and the controls. It is therefore recommended that farmers supplement the vegetarian diets of *A. margmata* to reduce the long maturity period.

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Tables

Table 1: Proximate Compositions of the Leafy Diets Used in Feed Formulation

Sample	Mean % Crude Protein	Mean % Ash	Mean % Fat	Mean % Fibre	Mean % Moisture	Mean % Carbohydrate
Xanthosoma sagittfolum	12.20±0.08	13.10±0.17	3.12±0.03	3.88±0.03	11.90±0.12	38.80±04[c]
Carica papaya	0.43±0.04	10.5±0.02	4.68±0.02	4.62±0.03	16.70±0.02	63.07±0.02
Chromolaena odorata	15.30±0.01	12.50±0.02	4.24±0.02	3.93±0.07	12.80±0.02	52.23±0.02

Table 2: Compositions of the Treatment and Control Diets Fed to A. *marginata* in Captivity

Ingredients	**Treatment Diets**				**Control Diets**			
	T_1	**T_2**	**T_3**	**T_4**	**CT_1**	**CT_2**	**CT_3**	**CT_4**
Carbohydrate (g)	70	70	70	70	-	-	-	-
Protein (g)	20	20	20	20	-	-	-	-
Mineral/Vitamins (g)	02	02	02	02	-	-	-	-
***Xanthansoma sp* (g)**	08	-	-	-	100	-	-	-
***Carica sp*(g)**	-	08	-	-	-	100	-	-
Chromolaena sp (g)	-	-	08	-	-	-	100	-
Combined leaves (g)	-	-	-	08	-	-	-	100
Total (g)	100	100	100	100	100	100	100	100

Where:
Xanthosoma sp is cocoyam leaf
Carica sp is paw-paw leaf
Chromolaena sp is siam weed leaf
Combined leaves are the three leaves in combinations.

Table 3: Summary of Feed intake, Feed Conversion Ratio, Temperature and Rainfall during the Culture Period

Monthly Sample Group (ml)	Culture period (Months)	Treatments/ Controls	Mean Feed intake (g)/Snail	Feed Conversion Ratio	Mean Monthly Cage Atmos/Soil Temp"C	Mean Rainfall
4043.75		T_1	210.37	4.0	29.7	
4043.75		CT_2	28.45	-0.43	30.2	
Progeny 1	10	T_1	263.27	3.31	29.5	4043.75
		CT_2	66.41	-3.25	28.6	4043.75
		T_3	259.13	3.72	28.6	4043.75
		$CT_{3``}$	32.72	28.6	29.3	4043.75
		T_4	278.12	3.20	30.0	4043.75
		CT_4	36.58	9.73	30.4	4043.75