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Research Article

Growth Performance of *Archachatina archachatina* Snails Fed Different Vegetable Diets with Concentrate Feed Under Intensive Management System

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Abstract

Knowledge on feed sources for snails is limited to a few and the nutrient compositions of these sources have not been evaluated, with the effects of different feed sources on growth and reproduction performances still not well-known. In some peri-urban and urban areas, snail farmers are faced with the difficulty in not finding some grass or plant species to use as feeding materials. Where they are available, growth rate observed in snail is slow and not able to reduce the gap between demand and supply. A study was carried out to: establish a compendium of snail feed sources; determine the nutrient composition of the identified feed sources; and evaluate the performance of feed sources, sole or in combination on growth characteristics. A desk study to compile feed sources and their preferences from published articles on the nutrition of snails from west and Central Africa was carried out. Proximate analysis was performed on samples of water leaf, pawpaw leaves, wild *Telferia* leaves and concentrate. Snails of similar weights and ages were fed vegetable diets in combination with concentrate and data collected for performance evaluation. The experimental design was completely randomized design with 3 replicates.

Common forage sources for snail nutrition are potato, spinach, Talinum, Zehneria, cabbage and pawpaw leaves. Among these forages, Zehneria is the only forage with less competitive uses with humans and the least known. The forage sources, waterleaf, Z. scabra and pawpaw leaf have similar effects on growth performance in snail. The energy value of pawpaw leaf is close to concentrate feed frequently used in snail nutrition in Cameroon. High feed intake and conversion ratios are obtainable with Z. scabra forage combined with concentrate feed. Feed intake increased with increase in protein and fibre contents. Daily forage intake for 200 snails was 52g for waterleaf, 54g for pawpaw leaves and 58g for Z. scabra. Snails fed Z. scabra have lower mortality rates compared to waterleaf and pawpaw leaf. The insight gained in this study on forage feed sources and growth performance of snails could guide the selection and introduction of good innovations that fit into current feeding regimes to enhance adoption.

Keywords: *Archachatina archachatina; Growth Performance; Nutrition and Vegetables*

Introduction

Although snails are not always available and affordable all year round, they constitute a huge part of diets in many parts of Africa. Snails sold in rural markets are mainly gathered from the wild by women and children. Major gathering sites are plantations, secondary forests and to a lesser extent arable farmlands. This practice provides protein and income to many rural dwellers. There is increasing evidence that the snail value chain is controlled by women [1].

In the past, snail production was given little or no attention because of limited awareness of its nutritional and medicinal potentials. It is a vital animal species of good protein source of high biological value, generates high income, and has high market demand [1]. Snails contain almost all the amino acids needed by the body and most of its by-products are used for cosmetics. Their high protein, low fat and cholesterol content make them a nutritional favorite.

Snails will easily feed on leaves, fruits, household and industrial remnants which will hardly be consumed by man. Snail rearing is a good source of income and less capital is used in setting it up compared to other livestock species such as poultry, fish farming, cattle and goat production, etc. Snail meat has a low fat and cholesterol level which makes it good for vascular diseases such as heart attack, cardiac arrest, and hypertension and stoke. Soup prepared with snail meat is good for pregnant women for easy movement of the foetus, easy delivery and good source of iron for nursing mother. The shell could be used to replace bone meal and oysters shell in compounding ration for animals. Snail farming could be combined with other businesses and reared at the backyard [2]. The feeds are cheap and could be locally sourced [3].

Because of the aforementioned, there is a growing interest in rearing and domesticating snails [3]. Information on housing methods abound [4,5]. In addition, accelerated deforestation has rendered local gathering of snails from the wild a very difficult task because of rapidly declining snail populations. The consequence is that local communities are not able to satisfy demand for both subsistence and commerce. Although alternative strategies are being sought to boost production, they are also plagued with some difficulties. For example, knowledge on feed sources is limited to a few [6], the nutrient compositions of these sources have not been evaluated, and the effects of different feed sources on growth and reproduction performances are still not well-known. In some peri-urban and urban areas, snail farmers are faced with the difficulty in not finding some grass or plant species to use as feeding materials. Where they are available, growth rate observed in snail is slow and not able to reduce the gap between demand and supply.

Identification of feed sources and their combination in the formulation of feed rations for use in urban and peri-urban areas will boost snail production in both quantity and quality and reduce tremendously, the gap between demand and supply.

Global objective

To boost Snail farming in rural and urban households through the use of high quality diets.

Specific objectives

1. To establish a compendium of snail feed sources.
2. To determine the nutrient composition of the identified feed sources; and
3. To evaluate the performance of feed sources, sole or in combination on growth characteristics.

Materials and Methods

Objective 1: To establish a compendium of snail feed sources

A desk study to compile feed sources and their preferences from published articles on the nutrition of snails from west and Central Africa were carried out and the result is shown on table 1 and 2 on a portion of feed sources and their preference, respectively.

Objective 2: To determine the nutrient composition of identified feed sources

Proximate analysis were carried out on samples of water leaf, pawpaw leaves, wild *okongobong* leaves and concentrate.

Objective 3: To evaluate the performance of snails fed vegetable diets in combination with concentrate Collection of snails

Archachatina archachatina species of snails were collected from the wild in some parts of the South west Region, precisely Fako, Meme, and Manyu Divisions.

Location and duration of the study

The study was conducted at IRAD Ekona South west region. Located at longitude: 040 12’ 799’’N and latitude: 0090 12’ 921’’E. It covers a surface area of about 55000km.The area possesses such factors that could favour growth of snails. These include availability of shade and cover, good radiation and availability of water and feed resources. The study lasted for eight weeks (May to July 2016).

Experimental animals, design and management

Composition of Concentrate Feed

Ingredients	Quantity /kg
Maize	31.3
Groundnut cake	10
Soy bean meal	25
fish meal	4
wheat bran	16
palm kernel cake	4.2
Oyster shell	8.05
bone meal	1.2
premix vitamin	0.25

Data Collection

Snails (200) of approximately the same size were randomly allotted to cages (experimental units) using the Completely Randomized Design. There were three treatments (Water leaf (*Talinum triangulare*) – T1, Wild Okongobong (*Zehneria scabra*)– T2 and Pawpaw leaf (*Carica papaya*)– T3) and each treatment had three (3) replicates. Two hundred juvenile snails were used in each experimental unit. All treatments received concentrate feed (the diets were isocaloric and isonitrogenous). Water was sprinkled on snails daily using a watering can in order to maintain their body temperature and to prevent dehydration. Twenty snails were marked for data collection. The snails were fed (1kg of forage and 500 g of concentrate) every 3 days in the morning at 7.00 am for 8 weeks. Proximate analysis of the diets was carried out at the Animal Science Laboratory of the University of Dschang following the standard procedure of AOAC [7]. Weight changes were measured on weekly basis. Feed intake was measured after every 3 days with an electric weighing balance. Shell length and width were measured on weekly basis with the use of a vernier caliper. Feed conversion ratio was calculated for the 8 week period by dividing feed intake by average daily weight gain. Data collected were analysed by One-way Analysis of variance (ANOVA). Significant differences were separated by Duncan Multiple Range Test.

Tagged snails on which growth data were monitored.

***T1:** Water leaf (Talinum triangulare)* ***T2:** Wild Okongobong (Zehneria scabra)* ***T3:** Pawpaw leaf (Carica papaya)*

Figure 1

Results and Discussion

A compendium of snail feed sources compiled from relevant literature is presented in Table 2. Feed sources ranged from more general presentations (vegetables, kitchen wastes fresh fruits) to more specific plants and plant parts (*Telferia* leaves, potato leaves, waterleaf, Amaranthus leaves, pawpaw leaves, cabbage, palm nuts, Moringa leaf meal, soybean meal etc plus caloric diets).

SN	Feed sources	Reference
1	Vegetables, plant leaves, kitchen wastes, fresh fruits, fruit peel, tubers and market wastes	Chah and Inegbedion, 2012
2	Live and rotten vegetable fruits, and salad foodstuffs	CLEAPSS, 2006
3	Fluted pumpkin (*Telferia occidentalis*) leaves, African spinach (*Amaranthus sinensis*) leaves, papaw (*Carica papaya*) leaves, formulated mash	Odo and Orji, 2010
4	Elaeis guinensis fruits, potato (*Ipomea batatas*) leaves, growers marsh	Okonta, 2012
5	Moringa oleifera leaf meal (MOLM) plus caloric diets; maize, wheat offal, groundnut cake, soybean meal, fish meal, palm kernel cake, bone meal, methione, limestone, lysine, vitamin premix	Ani., *et al*. 2014
6	*Molringa oleiferam Carica papaya, Talinum tiangulare* leaf meals incorporated into snail diets.	Mogbo *et al*., 2014
7	Vegetable (water leaf, pawpaw leaf, *Amaranthus*, cabbage and goat weed) diets with concentrate	Isikwemu, 2015
8	Cocoyam, cassava, potato and water leaves	Akeredolu and Adeyemo, 2014 Mayaki., *et al*. 2013
9	Yam, sweet potato, cocoyam and cassava tubers	Okon., *et al*. 2012; Freeman, 2013
10	Milk leaf (*Euphorbia heterophylla*)	Babalola., *et al*. 2015

***Table 2:** Feed sources from published articles on the nutrition of snails from west and Central Africa.*

Preferred diets were waterleaf, cabbage, goat weed and pawpaw leaves mixed with concentrate. *Z. scabra* has been reported by few authors as a preferred diet. Most of the preferred forage sources for snails have competitive uses with humans, and whose harvesting could jeopardize other direct consumption by humans. These forages include spinach, pawpaw leaves, waterleaf, Telferia, cabbage and potato leaves [8-10]. Potato, spinach, Telferia and cabbage leaves are cooked and eaten as vegetables year round [11]. *Z. scabra*, although used for different medicinal purposes by humans, is less consumed in many communities and thus is a suitable alternative forage for snail nutrition to other forages. *Z. scabra* has been reported to be consumed in very few communities in India [11]. Abew., *et al*. [12] evaluated the antibacterial activities of crude leaf extract of *Z. scabra* against *Escherichia coli*.

Preferred feed sources	Reference
Zehneria scabra and pawpaw leaves	Odo and Orji, 2010
Palm fruits	Okonta, 2012
20% inclusion of MOLM plus caloric diets	Ani., *et al*. 2014
Vegetable (water leaf, pawpaw leaf, *Amaranthus* leaf, cabbage and goat weed)	Isikwemu, 2015

Table 3: *Some preferred feed sources.*

The proximate analysis of concentrate feed and forage sources used in the experiment is presented in Table 4. Percentage dry matter (DM) ranged from 90% to 94% in the order *Z. scabra* > pawpaw leaf > water leaf > concentrate. Ash content was highest in water leaf (32%) and least in pawpaw leaf (13.44%). Crude protein was highest in pawpaw leaf (32.65% DM) and least in water leaf, while ether extract was highest in pawpaw leaf (4.03% DM) and least in concentrate (2.51% DM). Crude fibre ranged from 7% DM (concentrate) to 26% DM (*Z. scabra*). ME was in the order concentrate > pawpaw leaf > *Z. scabra* > water leaf. ME reported for all diets were much lower than 3.0 – 3.2 Mcal/kg reported as best for the growth of *Achatina achatina* in the humid tropics [9]. No forage was consistently high in all the parameters evaluated. Water leaf and *Z. scabra* are low energy forages compared to pawpaw leaf.

Feeding Material	DM (%)	Ash (%)	Crude protein (% DM)	Ether extract (%DM)	Crude fibre (% DM)	ME (kcal/kg DM)
Concentrate	89.94	14.40	29.45	2.51	7.06	2874.03
Water leaf	91.23	32.53	20.24	2.91	23.45	701.42
Paw paw leaf	92.06	13.44	32.65	4.03	13.02	2467.12
Zehneria scabra	94.04	19.83	22.22	2.54	26.05	969.28

Table 4: *Proximate analysis of feeding materials.*

The proximate analysis for pawpaw leaf is much closer to that of the concentrate used, making it a suitable alternative for concentrate as an energy source. The DM, ash, crude fibre and ether extract contents of pawpaw leaves in this study were higher than those reported by Omolara and Olaleye [13], Mogbo., *et al* [10]. However, the crude protein contents were comparable. The crude protein content of waterleaf in this study was comparable with that reported by Akeredolu and Adeyemo (2014). However, crude fibre and ash contents were higher, while ether extract was lower than those reported by Akeredolu and Adeyemo (2014).

Forage source, had no effect on shell width and shell length (Table 5). Increase in shell length was 0.5 cm with water leaf and *Z. scabra* and 0.6 cm with pawpaw leaf. Change in shell length was slow irrespective of forage source (Figure 2). Increase in shell width was 0.35 cm with waterleaf and pawpaw leaf and 0.46 cm with *Z. scabra*. Percentage weight gain was in the order waterleaf (38.21%) > pawpaw leaf (34.4%) > *Z. scabra* (34.2%). The differences in weight gain were significant ($p < 0.05$). The result obtained in this study on weight gain is different from that reported by Owoseni and Adetunji [14], who reported similar performance of snails fed waterleaf and pawpaw leaves. Mogbo., *et al*. [10] also observed similar performances in snails fed pawpaw and waterleaf diets with respect to growth characteristics.

	Forage sources		
Growth parameters	Water leaf	*Zehneria scabra*	Pawpaw leaf
Initial shell length (cm)	6.66	6.58	6.64
Final shell length (cm)	7.16	7.08	7.24
Increase in shell length (cm)	0.50a	0.50a	0.60a
Initial shell width (cm)	3.74	3.67	3.73
Final shell width (cm)	4.09a	4.13a	4.08a
Increase in shell width (cm)	0.35	0.46	0.35
Initial weight (g)	32.50	32.50	32.50
Final weight (g)	52.60	49.36	49.56
Percentage weight gain	38.21a	34.16b	34.4b
Percentage mortality	7.33a	5.67a	7.67a

Table 5: *Effect of forage source on growth and yield parameters in snail.*

Means in rows followed by same letters are not significantly different at 5% probability.

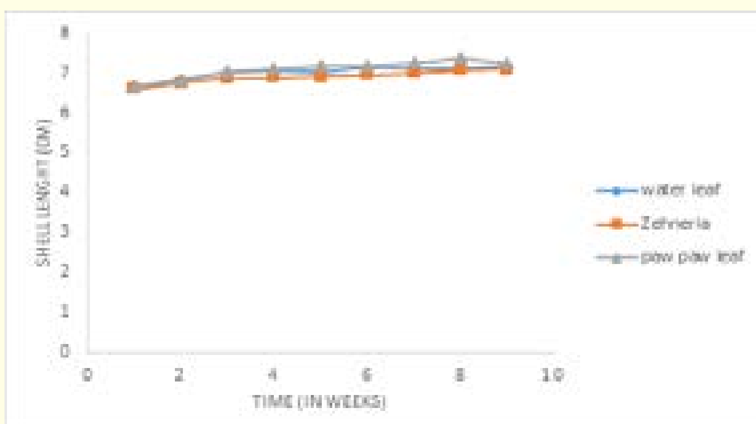

Figure 2: *Changes in shell length of snail fed different forages.*

Percentage mortality was in the order pawpaw leaf (7.67%) > waterleaf (7.33%) > *Z. scabra* (5.67%), even though the differences were not significant. Lower mortality in *Z. scabra* treatments could be attributed to its antibacterial properties [12].

Forage intake (Table 6) was in the order *Z. scabra* (58 g/day) > pawpaw leaf (53.75 g/day) > water leaf (52.25g/day). With respect to concentrate intake (Figure 3,4), the order was: *Z. scabra* (121.67 g/day) > waterleaf (114.56 g/day) > pawpaw leaf (101.98 g/day). The differences in feed intake were not significant. Both forage and concentrate intakes were highest with *Z. scabra* treatment. Feed intake increased with increase in protein and fibre contents. Feed conversion ratio (Table 4) for both forage and concentrate was in the order *Z. scabra* treatment > pawpaw leaf > waterleaf [15-17].

Treatment	Forage intake (g/day)	Concentrate intake (g/day)	Daily weight gain (g)	FCR_c	FCR_forage
Water leaf	52.25a	114.56a	0.36	318.22	145.14
Zehneria scabra	58.00a	121.67a	0.30	405.57	193.33
Pawpaw leaf	53.75a	101.98a	0.30	339.93	179.17

Table 6: *Feed conversion ratios for forages and concentrate*

FCR_c is Food conversion ratio for concentrate

Means in columns followed by the same letter are not significantly different at 5% probability.

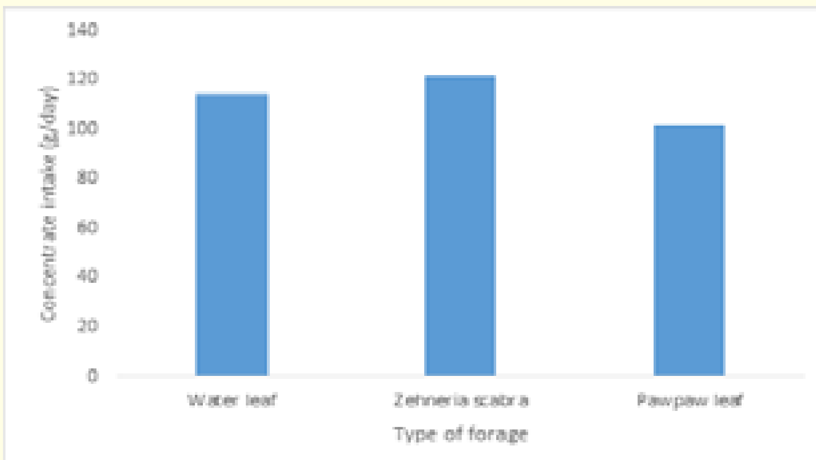

Figure 3: *Effect of forage diet on concentrate intake.*

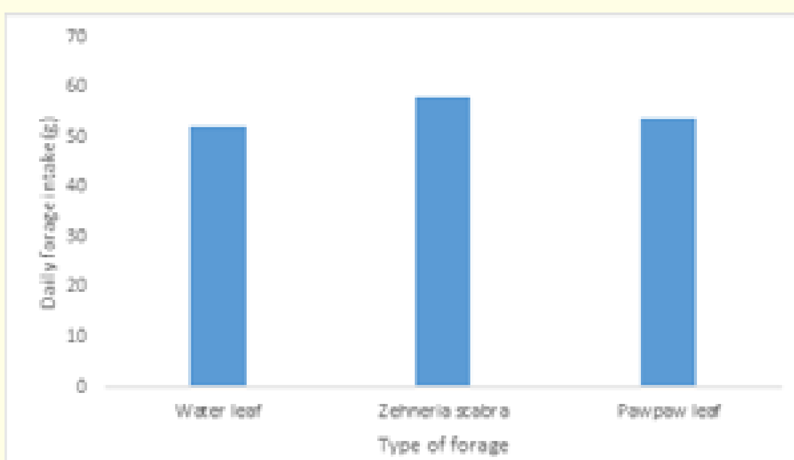

Figure 4: *Daily intake of selected forages.*

Citation: Kingsley A Etchu., *et al*. "Growth Performance of Archachatina archachatina Snails Fed Different Vegetable Diets with Concentrate Feed Under Intensive Management System". *EC Microbiology* 8.4 (2017): 234-242.

Conclusion

Common forage sources for snail nutrition are potato, spinach, Talinum, *Zehneria*, cabbage and pawpaw leaves. Among these forages, *Zehneria* is the only forage with less competitive uses with humans and the least known. The forage sources, waterleaf, *Z. scabra* and pawpaw leaf have similar effects on growth performance in snail. The energy value of pawpaw leaf is close to concentrate feed frequently used in snail nutrition in Cameroon and as such, could be a suitable source of energy. High feed intake and conversion ratios are obtainable with *Z. scabra* forage combined with concentrate feed. Feed intake increased with increase in protein and fibre contents. Daily forage intake for 200 snails were 52g for waterleaf, 54g for pawpaw leaves and 58g for *Z. scabra*. Snails fed *Z. scabra* have lower mortality rates compared to waterleaf and pawpaw leaf. The insight gained in this study on forage feed sources and growth performance of snails could guide in the selection and introduction of good innovations that fit into current feeding regimes to enhance adoption.

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