WEIGHT RESPONSE AND PROXIMATE ANALYSIS OF AFRICAN GIANT LAND SNAIL, *ACHATINA ACHATINA* (LINNAEUS, 1758) FED WITH MIXTURE OF MORINGA LEAF POWDER AND BREWERY WASTE.

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Abstract
The study was conducted to determine weight gain and proximate composition of African giant land snail (*Achatina achatina)* fed with mixture of moringa leave powder (MLP) and brewery waste (BW). This trial was carried out at the Department of Forestry and Wildlife Technology Laboratory, Federal University of Technology, Owerri. A total of 144 three-week old giant snails were purchased from Songhai Farm, Ediba, Abi Local Government Area of Cross River State, and used for the experiment. Feed (treatments) compounded for the snails are T_1 (80g MLP:120g BW), T_2 (120g MLP:80g BW), T_3 (160g MLP:40g BW) and T_4 (control - 0g MLP:200g BW). Proximate analysis of snail meat from each treatment was carried out to obtain the nutrient composition. The study adopted a Complete Randomized Design (CRD) experimental procedure with three replicates. Fisher's least significant difference (F-LSD) was used as a follow up test to separate the mean weight gain of snails in relation to treatments. The weight gain per snail was measured using sensitive digital weighing balance for a period of 6 weeks. The average weight gain per snail for the treatments is in the order T_3 (10.14g) > T_2 (9.33g) > T_1 (6.50g) > T_4 (6.25g) at $p > 0.05$. Proximate analysis of snail meat showed that meat obtained from T_3 had better nutritive values as indicated by crude fat (0.80%), crude fibre (0.35%), ash (4.90%), protein (74.94%) and Nitrogen free extract (11.40%). The result obtained indicated clearly that incorporating high levels of moringa in the snail diet is acceptable to snails and will meet the growth requirement thereby eliminating the need for costly energy supplements.
Keywords: Weight gain, proximate analysis, giant snail, moringa leaf powder, brewery waste

Introduction

The African giant snail or giant tiger land snail, *Achatina achatina* (Linnaeus, 1758), is the second largest land snailin West Africa. It is a bilateral invertebrate with a soft body and a slippery skin, typified with the possession of a segmented exoskeleton in form of calcareous shells (Akinnusi, 1997; Okafor, 2001).This species of air-breathing tropical land snail is a terrestrial pulmonate gastropod mollusk in the family *achatinidae* that can grow up to 18cm long and live up to 10years. In scientific classification, it belongs to the kingdom-Animalia, phylum-mollusca, class- gastropoda and genus - achatina. The name *'Achatina achatina'* is derived from "achates", Greek word for agate.

African giant snail is one of the most important minor forest products in West Africa and Nigeria in particular. Snail production serves as a cheap source of animal protein supply with the meat having high protein content of about 83-93% according to Imevbore and Ademosum (1998). It is also high in iron (45-50mg/kg), low in fat, and contains almost all the amino acids needed by humans (Cobbinah *et al*., 2008). Snail meat has been consumed by human worldwide since prehistoric times and is highly appreciated as a delicacy in many countries. In many developing countries, meat production from domestic livestock is not sufficient to meet the high demand for animal protein (Adedire *et al*., 1999). The cost of conventional protein food sources such as beef, milk, pork, mutton, chicken and fish has so skyrocketed that most of them have almost gone out of reach of common man, due to economic down turn (Adenegan and Bolaji-Olutunji, 2012) or what is termed recession in economic parlance. This situation has progressively worsened in Nigeria. In view of the present poor economic situation, the ever increasing population and subsequent storage of these animal protein sources, this strongly suggests the need to explore all possible source of animal protein, especially the non-conventional ones such as snails in order to increase protein supply.

Achatina achatina dwells mostly in the humid tropical forest where it is picked by snail gatherers for consumption and sale (Okonta and Agbogidi, 2011). Apart from its use as human food, the snail is a valuable source of nutrition to poultry, fish and livestock. According to Cobbinah *et al*. (2008) glandular substances in edible snail meat causes agglutination of certain bacteria, which could be of value in fighting a variety of ailments, including whooping cough. The author further noted that snail plays an important role in treating aneamia and combating ulcers as well as asthma.

In terms of environmental friendliness, snail farming could be of choice. The low technical, capital, labour and financial inputs required for its rearing makes the venture attractive to both urban and rural dwellers (Cobbinah *et al*., 2008; Ojebiyi *et al*., 2011). With the growing awareness of the role of cholesterol in various heart and arterial disease, the demand for low cholesterol meat like snails has even become more appreciated. It is therefore important to encourage commercial snail farming (heliculture) in order to conserve and exploit the vast economic

importance of this resource (Cobbinah *et al*., 2008; Abdussamad *et al*., 2010) by rearing in farms like other livestock. However, rearing of snails in captivity is faced with the problem of feeding and nutrition (Ademolu *et al*., 2013).

Moringa is considered one of the most complete nutrient dense plants on earth, very rich in protein. Its leaves have been eaten for thousands of years as a super food nutritional supplement containing abundance of minerals used to combat malnutrition. A small dosage of moringa leave powder provides a substantial amount of iron, calcium, vitamin A, vitamin C, minerals (Madukwe *et al*., 2013). Moringa leaf powder and moringa seed meal have been used as feed ingredients with a high level of a variety of nutrients in feeding animals. As a fodder, it is among the most effective nutrient additives for animal feed because of its relatively low cost exceptional nutrient density and high nutrient absorption rates. Moringa is an ideal choice for adding to the food supply of common farm animals such as cattle, dogs, pigs, sheep and other livestock. Recent studies show that nursing animals love moringa powder.

The availability of feeds is one of the major problems in many livestock productions including snails. Snails feed on leaves, vegetables, fruit, as well as compounded feeds and kitchen wastes. Most conventional feedstuffs used in compounding the feed like maize, sorghum, soya beans and guinea corn are very costly during dry season. It is therefore very pertinent to seek for a possible solution to this problem by sourcing for alternate feed ingredients that would be locally available and affordable all year round for the farmers. Moringa leaf powder is rich in nutrients and quite affordable. Also noted for livestock feeding is brewery waste (often made up of malted barley, rice, maize, mallet, wheat etc.). Thus brewery waste could be of nutritional benefit to snails and cost effective to farmers, since it source is cheap and affordable.

Regardless of increase number of snail farmers in recent times, most farmers still complain that slow growth rate of the animal and the high cost of procuring feeds is making the venture uninteresting, tiresome and capital intensive. To solve these problems in snail farming, there is need to pay great attention to factors affecting the growth of snails, like feed. Snails like any other livestock respond differently to various feeds and feed combination, and snail farmers are always interested in an alternate feed that will be of low cost and will be readily available.

Hence, this research is designed to investigate the effects of moringa leaf powder and brewery waste on the growth performance of *Achatina achatina*. The study also took into cognizance the proximate composition of snail meat obtained from a mixture of moringa leaf powder and brewery waste.

Materials and methods

Study area. The study was carried out at the Snailry Section of the Wildlife Domestication Unit, Department of Forestry and Wildlife Technology, School of Agriculture and Agricultural Technology, Federal University of Technology, Owerri. The area falls within the tropical rainforest belt with daily temperature of 25^oC - 35^oC. The area is characterized by two distinct seasons; wet (April - October) and dry (November – March), average rainfall of 1250 – 3000 mm and relative humidity of about 90%.

The materials used for this study are:

i. *Moringa oleifera* leaf powder (MLP)
ii. Brewery waste containing wheat bran (BW)
iii. Weighing balance
iv. Baskets
v. Polythene
vi. Masking tape

Experiment

A total of one hundred and forty four 3-week old African giant land snails (*Achatina achatina*) were purchased from Songhai Farm, Ediba, Abi Local Government Area of Cross River State. The snails were allowed to acclimatize for one week during which feed was not given for that period.

The experiment was a Completely Randomized Design (CRD) (Akindele, 1996) with three replicates. The experiment involved random assignment of snails to four treatments with three replications each. Thus 12 experimental units (baskets) each with 12 snails assigned were used for the experiment.

Experimental treatments contained a mixture of *Moringa oleifera* leaf powder (MLP) and brewery waste (BW) as follows:

80g MLP : 120g BW (T_1)
120g MLP : 80g BW (T_2)
160g MLP : 40g BW (T_3)
0g MLP : 200g BW (T_4)

Table 1: Experimental layout showing treatments and replicates

T_1	T_2	T_3	T_4
$T_{1.1}$	$T_{2.1}$	$T_{3.1}$	$T_{4.1}$
$T_{1.2}$	$T_{2.2}$	$T_{3.2}$	$T_{4.2}$
$T_{1.3}$	$T_{2.3}$	$T_{3.3}$	$T_{4.3}$

Note: T_1, T_2, T_3, T_4 are treatments and $T_{1.1}$, $T_{1.2}$……$T_{4.3}$ are replicates

Data collection

Data on weight gain of snails per treatment were collected weekly for a period of six weeks. At the end of the experiment, proximate analysis was carried out on snail meat in other to know its nutritive content.

Data analysis

Data collected were subjected to one way analysis of variance (ANOVA) as described by Akindele (1996). The statistical model for this design is given as follows:

$Xij=\mu + Tj + \sum ij$

Where:

X_{ij}= individual observation (i.e. observation of j^{th} treatment in j^{th} observation)

μ= the population mean

T_j= the effect of the T_j treatment

$\sum ij =$ The random error present in the i^{th} on the j^{th} treatment

The difference between the treatment means was separated using Fishers' Least Significant Difference (F-LSD).

Results and Discussion

As shown in Table 2, there was an increase in weight across all the replicates when the snails were fed the various treatments for a period of six weeks. The implication is that the treatments had effect on snail growth.

Table 2:Data on total weight (g) per week for 6 weeks

	$T_{1.1}$	$T_{1.2}$	$T_{1.3}$	$T_{2.1}$	$T_{2.2}$	$T_{2.3}$	$T_{3.1}$	$T_{3.2}$	$T_{3.3}$	$T_{4.1}$	$T_{4.2}$	$T_{4.3}$
0 WBT	273.6	250.5	226.7	246.2	230.8	280.0	286.7	217.0	232.1	202.8	241.5	224.6
1 WAT	310.4	290.9	250.4	272.7	296.4	310.4	300.1	285.4	272.7	239.0	269.5	242.2
2 WAT	328.5	314.8	270.2	300.2	304.9	328.5	327.1	298.4	300.2	254.0	275.4	268.3
3 WAT	330.0	329.7	290.1	325.4	312.8	343.9	359.5	302.8	314.0	268.7	297.2	287.6
4 WAT	340.4	330.1	320.4	329.8	319.4	361.1	378.5	315.3	329.8	271.5	315.8	295.5
5 WAT	349.7	335.6	328.5	339.4	327.7	379.8	394.2	329.9	339.9	287.8	326.7	304.3
6 WAT	350.2	339.2	343.9	354.0	331.2	387.7	401.0	348.7	347.8	299.2	334.5	311.5

WBT= Week before treatment, WAT = Week after treatment

The average weight per snail per snail for the three replicates is shown in Table 3 where T_3 performed better than other treatments. Though slight differences exist among the various means (weight), there are no significant differences ($p > 0.05$) among the treatments with respect to average weight of the snails for a period of six weeks. The increase in weight gain in T_3 which contain 160g MLP and 40g BW (i.e a ratio 4:1) could be as a result of lower fiber content in moringa (7.9%) and higher fibre content in brewery waste (12.9 %) which is known to limit the availability of nutrient energy and protein in livestock (Maynard and Loosli, 2000). These limit apparent nutrient digestibility and nutrient retentions.

Table 3: Average weight(g) per snail per treatment after 6 weeks

Replicate	T_1 (80g MLP/120gBW)	T_2 (120g MLP/80gBW)	T_3 (160MLP/40gBW)	T_4 (200g BW)
1	29.2	29.5	33.42	24.93
2	24.24	27.6	29.06	27.88
3	28.66	32.31	28.98	25.96
Mean	27.37^a	29.80^a	30.49^a	26.26^a

Means with the same superscript are not significantly different from each other

The average weight gain per snail for the three replicates across treatments is shown in Table 4 where replicate 2 in T_3 had the highest average weight gain. Though there are increments in average weight gain per snail after 6 weeks of treatment, there is no statistical difference ($p > 0.05$) among the treatments in relation to average weight gain.

Table 4:Average weight gain (g) per snail after 6 weeks

Replicate	T_1	T_2	T_3	T_4
1	6.40	10.61	9.53	6.94
2	3.33	8.37	10.96	7.75
3	9.77	9.01	9.64	4.06
Mean	6.50^a	9.33^a	10.14^a	6.25^a

Means with the same superscript are not significantly different from each other

The result of the proximate analysis in Table 5 shows that differences occur among the means per treatments in respect to nutritive content of snails. T_3 had the lowest in crude fat and crude fibre, though with a relatively high crude protein content. When this treatments are compared among each other in relation to their nutritive content, treatment three (T_3) with lowest fat and crude fibre content will be better for human consumption since it has appreciable protein and carbohydrate content when compared to other treatments.

Moringa oliefera leaf powder (MLP) is a good source of protein that can be conveniently used to compound snail feed thus implication incorporating moringa and brewery waste up to the level of 4:1 in snail diet is acceptable to snails and will meet the growth requirement thereby eliminating the need for costly energy supplements. This is in support with findings of (Ani *et al*., 2014) that the use of MLP did not impair the growth performance of snails rather high performance in relation to weight gain of snails are obtained when fed with high levels of moringa leaf meal.

Table 5: Proximate composition (%) of snail meat after 6 weeks of treatment

Treatment	Crude fat	Crude fibre	Ash	Moisture content	Crude protein	NFE
1: (80gMLP/120g BW)	0.824^{a}	0.525^{a}	4.767^{a}	7.052^{a}	51.348^{a}	35.484^{a}
2: (120g MLP /80g BW)	0.814^{b}	0.754^{b}	5.329^{a}	8.442^{b}	62.441^{b}	22.220^{b}
3: (160g MLP / 40g BW)	0.804^{a}	0.345^{ab}	4.898^{a}	7.608^{ab}	74.940^{c}	11.405^{c}
4: (200gBW)	1.393^{c}	0.632^{c}	4.615^{a}	7.393^{b}	40.167^{ab}	45.799^{ab}

Means with the same superscripts are not significantly different from each other

Conclusion

The results as earlier discussed showed the performance data on weight gain of the African giant snail when fed with a mixture of Moringa leaf powder (MLP) and brewery waste (BW). Though there is no significant difference in weight gain of snails in relation to the various treatments, ordinary differences occur in mean weight gain of the snails when fed with mixture of MLP and brewery waste in the following decreasing order: T_3 (10.14g) > T_2(9.33g) >T_1 (6.500g) > T_4 (6.260g) at (P> 0.05). This shows the preference of T_3 diet (160g MLP : 40g BW) by snails to other treatments.

Recommendation

- Micro-livestock farmers, animal nutritionists and researchers are encouraged to use MLP in compounding ration for snails and other micro-livestock.
- From the aforementioned, snail farmers are advised to feed their snails with moringa and brewery waste in ratio 4g: 1g respectively. Any other agricultural waste or by-products like rice husk, soya beans / beans husk, groundnut husk, millet husk etc can be used in place of brewery waste.
- Period of the experiment should be extended beyond six weeks so as to obtain more information on the growth performance of snails in relation to the diets used for this study. Thus the experiment should be repeated taking into cognizance the length of period of research, the metabolizable energy (ME) values for each treatment.
- Furthermore, experiment should be carried out prior to the commencement of the research in other to determine the nutritional value of the feed stuff i.e. moringa and brewery waste.

References

Abdussamad, M. A., Osinowo, A. O., Smith, F. O. and Onadeko, S.A. (2010). Live Weight Changes and Mortality Rate in the Giant African Land Snail *Archachatina marginata / Achatina* During Six-Week Aestivation Period. *W. J. Zool*. 5(2): 75-81.

Adedire, C. O., Imevbore, E. A., Eyide, E. O., and Ayodele. W. I. (1999). Aspects of digestive physiology and the complementary roles of the microbial enzymes in the intestinal tract of the giant land snail, *Archachatina marginata* (swainson). *J. Technoscience,* 3:6-13.

Ademolu, K. O., Fakeye, O. D., Dedeke, G. A., Ajayi, O. A. and Idowu, A.B.(2013). Digestive enzymes in African giant land snail *(Archachatina marginata),* during aestivation*. Arch. Zootec*. 62(237):73-77

Adenegan, K. O. and Bolaji-Oluntunji, K. A. (2012). Analysis of edible snail (*Archachatina marginata*) marketing in Ibadan metropolis, Oyo State, Nigeria. *International Journal of Applied Research and Technology*. 1(2): 100-108.

Akindele, S. (1996). Basic Experimental Designs in Agricultural Research. Montem Paperbacks, Akure, Nigeria. Pp 10-25.

Akinnusi, O. (1997). Introduction to snail farming. Omega Publishers Lagos, Nigeria.

Ani, A. O., Ogbu, C. C and Okonkwo, A. M. (2014). Growth Response of African Giant Land snails (*Archachatina marginata*) to varying

dietary levels of *Moringa oleifera* leaf meal. *Advances in Life Science and Technology*. Vol. 27.Pp 21- 27

Cobbinah, J. R., Vink, A. and Onuwuka, B. (2008). Snail farming in West Africa: A practical Guide. Agrodok 47, snail farming production, processing and marketing. Centre for Tropical Agriculture (CTA) Publishing, U.K. Pp 56.

Imevbore, E. A. and Ademosum, A.A. (1988 or 1998).The Nutritive value of the Africa giant land snail *Archachatina marginata*, *Journal of Animal Production Research*, (2)76-87.

Madukwe, E. U., Ezeugwu, J. O. and Eme, P. E. (2013).Nutrient Composition and Sensory Evaluation of Dry *Moringa oleifera* Aqueous Extract. *International Journal of Basic & Applied Sciences*.Vol.13 No.03.Pp 100-102

Maynard, L.A and Loosli, J.K. (2000). Animal Nutrition, 11th edition. McGraus Hill Book Co. New York. Pp 542.

Ojebiyi, O. O., Jejelola, O. O., Oladunjoye, I. O. and shittu, M. D. (2011). Performance characteristics of African Giant Land snail (*Archachatina marginata*) fed diets containing soya bean milk residue-cassava sievate meal mixtures, *World Journal of Life Science and Medical Research*, 1(5):105-10.

Okafor, F. U. (2001).Edible Land snails: A manual of Biological Management and Farming of Snails. Splendid Publishers, Badagry, Lagos, Africa.

Okonta, B. C and Agbogidi, O. M. (2011).Growth response of *Achatina achatina (Linn.)* and *Archachatina marginata* (Swainson) as influenced by three vegetable feeds. *ARPN Journal of Agriculture and Biological Science*, 6(9): 72-75