Open Access

Eurasian Animal Science Research Journal
Vol. 1, No. 1, July 2015, pp. 1-12
Available online at http://www.erepub.com/Journals.php

Research article

Effect of Replacing Enzyme Supplemented Rumen Content for Maize on the Diet of Juvenile Snails (*Archachatina marginata)*

Adeniji, A. A., Okunrotifa, I.I and Oluwafemi, R.A

Department of Animal Science, Faculty of Agriculture, University of Abuja, P.M.B 117, FCT-Abuja, Nigeria.

Email: oluwafemi.adebisi@uniabuja.edu.ng*


Abstract

A Total number of 270 Juvenile snails *Archachatina marginata* were used in the course of the experimental study to determine the effect of replacing enzyme supplemented rumen content for maize in the diet of juvenile snails. A 3 x 4 factorial experiment was adopted such that there were 3 replacement levels 0, 25, 50% of enzyme supplement, which lasted for a period of 10 weeks. The result showed that increase in the inclusion level of rumen content had significant effect ($P<0.05$) on the rate of weight gain, feed intake, feed to gain ratio, rate of shell length, and cost per weight gain but had no significant effects ($P<0.05$) of the rate of gain of shell thickness. There were significant effect of the supplementation on the feed intake, rate of weight gain, feed to gain ratio, rate of gain of shell length and cost per weight gain but no significant effect on the supplementation of shell thickness the interaction between the varying levels of rumen content and supplements had significant effects ($P<0.05$) on the final body weight, rate of weight gain, daily feed intake, feed to gain ratio and gain of shell length but had no significant effect ($P>0.05$) on rate of shell thickness. This study shows that juvenile snails fed 50% inclusion level of rumen content supplemented

Open Access

Eurasian Animal Science Research Journal
Vol. 1, No. 1, July 2015, pp. 1-12
Available online at http://www.erepub.com/Journals.php

with Maxigrain enzyme is the best replacement level for maize when compared to 25% replacement level as it gave the best growth performance characteristics, snail shell parameters and financial implication.

Key words: Rumen content, Maize, Diet, Enzyme, Supplement, Juvenile snail.

Introduction

Snail is an edible animal scientifically called *Molluscs* in the clan of invertebrate (without backbone) named *Gastropoda.* This shell-bearing animal has a single, usually spirally coiled shell. It has a high reproductive rate and nocturnal in nature experiencing weakness in the day, but quite active and strong in the night, though passive or inactive during the day; they are usually found in cool places. Snail has reproductive organs of both male and female which categories them as hermaphrodites. They are oviparous and can lay eggs between 10-30 days after mating. Eggs are laid in clutches mostly during the raining season under natural condition. They lay 200-400 eggs in a batch 2 to 3 times a year and it takes 11days for the egg to hatch in humus rich soil.

The major limiting factor in the production of protein from animal sources including snail is the high cost of feed ingredients in the diet. Major ingredients used in the formulation of commercial feeds are conventional which are also used by humans, hence the resultant competition leading to high cost. Alternatively, cheaper and non-conventional feed stuffs are abundantly like abattoir wastes are available and can be used to replace maize which is one the most expensive conventional feed ingredients. One of such abattoir waste is Bovine Rumen Content (BRC). Rumen content is the waste found in the largest part of the ruminant. Rumen is the first chamber of the alimentary canal of ruminant animals.

The by-product (waste), is removed from cattle in the slaughter slab (Dominguez *et al,*1994). Rumen content from different animals varies in composition (Ghosh, 1993). For cattle it is high in fiber containing about 31.90% crude fiber, 13.56% crude protein and 2686.42kcal/kg energy value (Adeniji and Balogun 2001). Rumen content is a non-conventional feedstuff but highly fibrous. The fibre content of BRC is one of the limiting factors that could hinder its utilization especially in monogastric animal nutrition. However, enzymes supplementation has been found to improve the nutritional value of the rumen content.

Maize is an essential staple food (Zubed, 2004) with 9% crude protein, 3434kcal/kg energy value with 2% crude fiber. Nigeria is the largest African country producing maize (FAO, 2007), maize is also a dominant crop, thereby causing its demand to be very high as it is mostly consume by man for pap, maize flour, etc. Maize production is commonly affected by natural and social effect. In the natural effect; drought, flood, wind, diseases and pest (Amusa *et al.,* 2005) like weevil reduce the nutritive content of maize. And in the social effect bush fire, invasion of farm by cows, theft. All this factors contributes to the shortage of production of maize, making the demands to be higher than the supply and at the same time, it is the major ingredient in the feed composition of livestock.

Open Access
Eurasian Animal Science Research Journal
Vol. 1, No. 1, July 2015, pp. 1-12
Available online at http://www.erepub.com/Journals.php

This high level of consumption leads to increase in the price of maize. The high fiber content and low crude protein of rumen content necessitates the use enzyme as feed additive .in the digestive tract of animals; Enzymes are natural tools for the transformation of complex feed components into absorbable nutrient. The use of enzymes breakdown cellulose for more energy and release locked nutrients in the fibrous rumen content. Also presence of enzymes in the feed compensate the anti-nutritive effect and increase nutrient utilization for maximum feed performance which will result in both economic benefits and reduction in nutrient excretion by the animal.

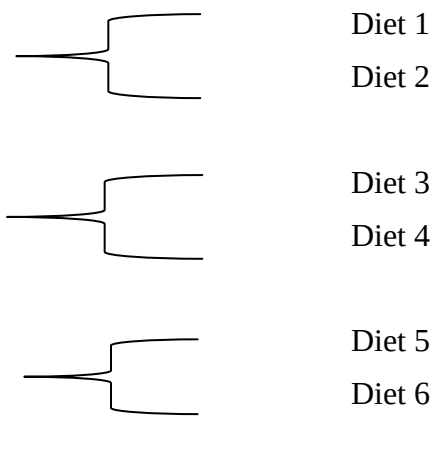
Materials and methods

A total of 270 Juvenile snails were used for this experimental study; which was conducted in the University of Abuja, Abuja, Nigeria. The juvenile snails were distributed into 6 dietary treatments, such that each treatment had three replicates and there were 15 snails on each replicate. There were 6 experimental diets (table 1). A 3x2 factorial experiment was adopted such that there were 3 replacement levels of rumen content and 2 supplementation..The juvenile snails were housed in aluminium drum with wire netting at the top. The top was built of mosquito netting reinforced with wire mesh. The bottom of the drum were perforated to allow free drain of water, the soil is wet as dryness inhibits growth and even stops activity.

Sandy loam soil was collected and heated for two (2) hours so as to kill some injurious insect such as soldier ant and the sand is used as bedding materials for the snails inside the drum. During the one week adaption preiod, the snails were given control diet. The rumen content was collected from the abattoir and then subjected to boiling in a large aluminium drum for about (4) hours with constant stirring for equal heat distribution to kill pathogenic micro – organisms available in the rumen content. After heating, the rumen content was sundried to reduce the moisture content to below 12%, grinded and package for experimental diet formulation.

Figure 1: Experimental layout

Levels of Rumen contents (%)



Open Access

Eurasian Animal Science Research Journal
Vol. 1, No. 1, July 2015, pp. 1-12
Available online at http://www.erepub.com/Journals.php

3 x 2 factorial experiment = 6 diets

+ means enzyme: Maxi grain enzyme: 100g/ton of feed

The initial live weight of the snails were recorded at the commencement of the experiment. The weight gain was measured on weekly basis with the use of weighing balance likewise the feed intake. The shell length and the shell thickness were measured on a weekly basis using vernier caliper and micrometer screw gauge respectively. Feed conversion ratio was calculated and 10% mortality was recorded. Proximate analysis of the six dietary treatments was carried out using the method described by Association of Official and Analytical Chemists (AOAC, 1990). All data obtained was subjected to Analysis of Variance (ANOVA) using factorial experiment of completely Randomised Design (CRD). Significant differences between means were compared using Duncan's Multiple Range Test (steel and Torrie, 1980). The cost of feed per kilogram of the diets and the cost of feed per kilogram of the body weight gain was determined using the price of feed ingredients as at the time of purchase, in order to estimate the value of substituting rumen content supplemented with or without enzyme for maize in the diets of juvenile snails *of Archachatina marginata.*

Open Access

Eurasian Animal Science Research Journal
Vol. 1, No. 1, July 2015, pp. 1-12
Available online at http://www.erepub.com/Journals.php

Table 1: Composition of Experimental Diet (kg/100kg)

	Levels of Rumen contents replacement for Maize (%)					
	0%		25%		50%	
Ingredients	T1	T2	T3	T4	T5	T6
Maize	32	32	24	24	16	16
Rumen content	0	0	8	8	16	16
Enzyme	0	+	0	+	0	+
GNC	41	41	41	41	41	41
Maize offal	8.3	8.3	8.3	8.3	8.3	8.3
Fishmeal	3.0	3.0	3.0	3.0	3.0	3.0
Limestone	15	15	15	15	15	15
Bone meal	0.25	0.25	0.25	0.25	0.25	0.25
Methionine	0.1	0.1	0.1	0.1	0.1	0.1
Lysine	0.1	0.1	0.1	0.1	0.1	0.1
Premix	0.25	0.25	0.25	0.25	0.25	0.25
Total	100	100	100	100	100	100
Analyzed proximate values						
Crude protein (%)	24.323	24.323	24.319	24.320	24.232	24.234
Crude fiber (%)	3.55	3.68	6.02	6.07	8.45	8.46
Ether extract (%)	3.69	3.66	3.60	3.58	3.53	3.50
M.E cal/kg	2473.65	2473.50	2414.40	2414.48	2354.50	2354.67
Moisture (%)	7.44	7.43	7.11	7.11	6.79	6.79
Total Ash	22.25	23.73	22.17	23.30	21.20	18.65

*BioMixGrower(BIOORGANICS)Primixusedcontainedthefollowingperkg:VitA=8,000,000IU,VitD3=1,500,000,vitE=7,000mg, vitk=1,500mg, vitB1=2000mg,vitB2=2,500mg,Niacin=15,000mg,pentatonicacid=5,500mg,VitB6=2,000mg,VitB12=10mg, folicacid=500mg,BiotinHg=250mg cholinechloride=175,000mg,cobalt=200mg,copper=3,000mg,iodine=1,000mg,iron=21,0000mg,manganese=40,000mg,selenium=200mg, zinc=31,000mg,Antioxidant=1,250mg*Recommended inclusion level of enzyme: Enzyme: Maxigrain: 4kg/tone of feed (0.4g/100kg)*

Open Access

Eurasian Animal Science Research Journal
Vol. 1, No. 1, July 2015, pp. 1-12
Available online at http://www.erepub.com/Journals.php

Results

Table 2: showed the growth performance characteristics of juvenile snails fed different levels of rumen content with enzyme supplementation to replace maize. The initial weight of the juvenile snails were not significantly different (P>0.05) from one another across all experimental diets, all values were 60.0g. There were significant effects (P<0.05) of the treatment on the rate of weight gain per day. The highest value of 0.595 was obtained at 0% rumen content inclusion (control diet) which was similar (P<0.05) to the value obtained at 25% inclusion of rumen content (0.610g) and significantly similar (P<0.05) to (0.615g) recorded on juvenile snails fed 50% rumen content level. Similarly the rate of gain at the two rumen content levels are comparable (P>0.05). There were significantly effect (P<0.05) of supplementation on the rate of weight gain per day. There was increase in the rate of weight gain with enzyme supplementation. All values were significantly different (P<0.05). However, the interaction between levels of rumen content and supplement showed no significant different (P>0.05) on the rate of weight gain per day although the value were similar numerically.

Table 2: Growth Performance Characteristics of Juvenile Snails fed rumen content with Enzyme Supplementation in replacing Maize

	Initial weight (g)	Final weight (g)	Rate of gain (g/day)	Daily feed intake (g)	Feed to gain ratio
Level of Rumen content (%)					
0	60.00	101.65^{c}	0.565^{b}	2.165^{a}	3.63^{b}
25	60.00	102.70^{b}	0.610^{ab}	2.155^{a}	3.65^{ab}
50	60.00	102.05^{a}	0.615^{a}	2.15^{a}	3.67^{a}
SEM	0.2887	0.2006	0.0039	0.0022	0.0242
SIGNIFICANCE	NS	*	*	*	*
SUPPLEMENTS					
No supplements	60.00	102.53^{b}	0.590^{b}	2.12^{b}	3.58^{a}
Added Enzyme (Maxigrain)	60.00	103.40^{a}	0.62^{a}	2.19^{a}	3.53^{b}
SEM	4.2308	1.0248	0.0174	0.3797	0.0274
SIGNIFICANCE	NS	*	*	*	*
Rumen content*supplement	NS	*	*	*	*

Treatment means with different superscript along the same column and significantly different (P<0.05)

Open Access

Eurasian Animal Science Research Journal
Vol. 1, No. 1, July 2015, pp. 1-12
Available online at http://www.erepub.com/Journals.php

NS – Not significantly different (P>0.05)

SEM – Standard error of means

*- Significant

Table 3: showed the snail shell parameters of juvenile snail fed different levels of rumen content with enzyme supplementation to replace maize. The initial shell length of the juvenile snails showed significant difference (P<0.05), the value range between 6.18 to 6.31cm. The trend of rate of gain of shell length per day is opposite to that of weight gain. Rate of gain of shell length increased as the rumen content increased and values recorded were 0.05, 0.06, 0.063cm at 0, 25, 50% BRC inclusion respectively. Hence, the shell length increased with higher levels of rumen content in the snail diet, in terms of supplements, there was a significant increase (P<0.05) in rate of gain of shell length also with the inclusion of enzyme. Interaction between levels of rumen content and supplement showed no significant difference (P>0.05) in the rate of gain of shell length. In the rate of shell thickness per day, there was increase in the rate of gain in shell thickness at 50% inclusion of rumen content. There was no significant difference (P>0.05) across 0 and 25% of the experimental diets with supplement (use of enzyme) and there was no significant effect on shell thickness, though the values differed numerically. Throughout the period of the experiment, 10% mortality was recorded.

Table 3: Snail Shell Parameters of Juvenile Snails fed Rumen content with enzymes supplementation in replacing Maize

	Initial Shell length (cm)	Final Shell Length (cm)	Rate of gain of Shell Length(mm/day)	Initial Shell Length (mm)	Final Shell length(mm)	Rate of gain ratio Shell Thickness
Level of Rumen content (%)						
0	6.31[b]	9.81[c]	0.05[c]	28.96[c]	29.38[b]	0.006[b]
25	6.35[a]	10.55[a]	0.060[b]	29.01[a]	29.46[a]	0.006[bb]
50	6.18[c]	10.38[b]	0.063[a]	27.82[c]	28.31[c]	0.007[a]
SEM	0.2573	0.1119	0.0017	0.1943	0.1825	0.0003
SIGNIFICANCE	*	*	*	*	*	NS
SUPPLEMENT						
NSA	6.29[a]	10.26[a]	0.060[b]	28.580[b]	29.023[b]	0.0063[a]
Enzyme (Maxigrain)	6.27[b]	10.23[b]	0.067[a]	28.613[a]	29.056[a]	0.0063[b]
SEM	0.0456	0.0068	0.0004	0.0070	0.0067	0.0071
SIGNIFICANCE	*	*	*	*	*	NS
Rumen Content*Supplement	NS	NS	NS	NS	*	NS

Open Access

Eurasian Animal Science Research Journal
Vol. 1, No. 1, July 2015, pp. 1-12
Available online at http://www.erepub.com/Journals.php

Treatment means with different superscript along the same column as significantly different (P<0.05).
NS-Not significantly different (P>0.05)
SEM-Standard Error of mean

Table 4: showed the financial implication of juvenile snails fed rumen content with enzyme supplementation to replace maize. The cost of producing 1kg of feed significantly decreased (P<0.05) with increased levels of rumen content from 0 to 50%. Values recorded were ₦102.19, ₦95.79, ₦89.38 at 0, 25, 50% inclusion of rumen content respectively. There was significant (P<0.05) diffenrence in terms of supplement, the cost of feed per kg recorded were in the range of 95.48 to 90.05. The cost of feed per kg consumed was similar to the cost of producing 1kg of feed. The cost of feed decreased (P<0.05) with increased level of rumen content from 0 to 50%, values recorded were ₦15.49, ₦14.45, ₦13.45 at 0, 25, and 50% inclusion of rumen content respectively. There were significant effects (P<0.05) of supplementation on the cost of feed consumed. Cost of feed consumed ₦14.18) recorded in diet with no supplement was significantly lower than cost of feed consumed by snails fed enzymes supplementation (₦14.74). There was significant decrease (P<0.05) in the rearing cost as the level of rumen content in the diet increased from 0 to 50%. Values recorded were ₦74.49, ₦73.45, ₦72.45 at 0, 25, and 50% respectively. In relation to supplements, rearing cost increased in this sequence; Diet with no supplement< Enzyme supplement.With values of ₦74.18, ₦74.74, the values were significantly different (P<0.05) selling price was ₦120.00 across the experimental diets.Hence, no significant difference (P>0.05) in the selling prices across all experimental diet.

There was significant effect (P<0.05) of treatments on the profit made in this experiment. The profit increased as rumen content level increased from 0 to 50%. Values recorded were ₦44.53, ₦45.55, ₦46.54 at 0, 25, 50% inclusion respectively. In terms of supplement, the profit was higher ₦46.54) at snails fed with no supplement and different levels of rumen content had significant effect (P<0.05) on the gross profitability that increase (P<0.05) as rumen content increased from 0 to 50%. Values recorded were 37.09, 37.96 and 38.79 at 0, 25, and 50% respectively. The cost efficiency increased (P<0.05) with increased level of rumen content from 0 to 50%, values recorded were 2.62, 3.15 ad 3.46 at 0, 25 and 50% respectively.

There were significant effect (P<0.05) of supplementation on the feed cost efficiency. Feed cost efficiency was lesser (3.07) when snails were fed with no supplement (P<0.05) than that of snails fed with enzyme supplementation (3.091). All values were significantly different (P<0.05). The cost per weight gain increased (P<0.05) with increased level of rumen content from 0 to 50%, values recorded were ₦1.71, ₦1.74, ₦1.82 at 0, 25 and 50% inclusion levels respectively. There were significant effects (P<0.05) of supplementation on the cost per weight gain. Cost per weight gain (N1.72) recorded in snail feed enzyme supplementation was significantly lower (P<0.05) than that of snails fed no supplement (₦1.78).

Open Access

Eurasian Animal Science Research Journal
Vol. 1, No. 1, July 2015, pp. 1-12
Available online at http://www.erepub.com/Journals.php

Table 4: Financial Implication of Juvenile Snails fed rumen content with Enzyme Supplementation in replacing Maize

	Cost of feed Per kg(₦)	Cost of feed consumed(₦)	Rearing cost (₦)	Selling price (₦)	Profit (₦)	Gross (₦)	Profitability	Feed cost efficiency	Cost per Weight gain
Level of Rumen content(%)									
0	102.19[a]	15.49[a]	75.49[a]	120.00	44.53[c]	37.09[c]	2.62[c]	1.71	
25	95.79[b]	14.45[b]	74.45[b]	120.00	45.55[b]	37.96[b]	3.15[b]	1.74[b]	
50	89.38[c]	13.45[c]	73.45[c]	120.00	46.54[a]	38.79[a]	3.46[a]	1.82[a]	
SEM	1.855	0.293	0.293	0.288	0.298	0.244	0.273	0.016	
SIGNIFICANCE	*	*	*	NS	*	*	*	*	
SUPPLEMENTS									
NSA	95.48[a]	14.18[b]	74.18[b]	120.00	45.81[a]	38.18[b]	3.07[a]	1.78[a]	
Enzyme (Maxigrain)	90.05[b]	14.74[a]	74.74[a]	120.00	45.25[b]	37.71[a]	3.091	1.72[b]	
SEM	0.08	0.11	0.12	0.36	0.12	0.10	0.24	0.014	
SIGNIFICANCE	NS	*	*	NS	*	*	*	*	

Treatment means with different superscript along the same column as significantly different (P<0.05).
NS-Not significantly different (P>0.05)
SEM-Standard Error of mean

Discussion

The increment in the rate of weight gain per day as observed with increased level of rumen content from 0 to 50% could be attributed to the concomitant increase in the level of crude fibre content in the diet which may not allow proper utilisation of nutrients. The trend of rate of weight gain per day at different level of rumen content in this experiment is in conformity with several reports which indicated that rate of gain increase with increased amount of fibre in the diet. The use of supplements (enzyme) proved to yield significantly higher rate of weight gain values 0.62g when compared to juvenile snail fed no supplements (0.590g). Study has shown that fungal enzyme degraded non- cellular wall of polysaccharide of rumen content, it improved the nutritional value of feed, hence increased rate of weight gain. (Aderolu *et al.*, 2007).

In terms of supplements, there was higher feed intake in snail fed supplement when compared to snails fed no supplement. The improvement in feed intake may be due to reduction in bulkiness and intestinal viscosity as proven efficacy of enzyme, hence feed intake to satisfy the nutritional requirement. (Babalola *et al.*, 2001). The similarity in values of feed recorded at all levels of rumen content could be due to the effect of age and size of the snails since the snails were of the same age and initial body weight and this could also be due to similarity in the management

Eurasian Animal Science Research Journal
Vol. 1, No. 1, July 2015, pp. 1-12
Available online at http://www.erepub.com/Journals.php

practices. There is increment in the feed to gain ratio as observed with increased level of rumen content at 50% and at 25%, the value is similar to both a and b, this indicate that fibre encourage utilisation of essential nutrients (Li *et al.*, 2006).

The rate of gain of shell length followed the trend with weight gain per day. The rate of shell length per day increased with increased level of rumen content from 0 to 50%. The result showed that there was increase in the rate of gain of shell length when consider snails fed with supplements or no supplement. The result is in conformity with the degraded fibre functions of rumen content and mineral present in the diets made available for absorption for the snails. The higher rate of gain of shell length recorded on snails fed supplements (enzyme) when compared to snails fed no supplement seems to confirm the hypothesis that an acidic environment created in the digestive tract by the synthetics supplements (microorganism) facilitate the ionisation of minerals and improve their absorption.

The result showed that there was no significant difference in the rate of gain of shell thickness per day across all experimental deits. The values recorded were almost the same ranging from 0.006 to 0.007mm. This result is in agreement with the observation of omole (2003) when juvenile snails were fed different level of crude protein and metabolisable energy. But some literature explained that excessive use of dietary fibre in monogastrics may increase viscosity of the intestinal content with a resulting decrease in bioavailability of essential minerals. (Selah, 2012).

The cost of producing 1kg of feed significantly decreased with increased level of rumen content from 0 to 50%. The decreasing cost with the increasing level of rumen content can be linked to the lower price of rumen content (₦5/kg) as against maize (₦80/kg). The low cost attributed to rumen content was due to the fact it is always left in the abattoir and it only constitute nuisance. The high cost of maize is because it is a convectional feedstuff which is consumed by both man and livestock. This report is in agreement with (Ugwu *et al,* 2008) who reported that fibrous feed inclusion as partial replacement for maize in the diets of broiler as a monogastrics decreased the cost of feed per 1kg.

The cost of feed consumed showed similar trend as observed with cost of feed per kg. This implies that the higher the cost of feed per kg, the higher the dry matter intake which result to high cost of feed consumed. This could be as a result of increased palatability of the feed as low cost feed and fibrous feedstuff (rumen content) is of low palatability. This is in agreement with the observation of Aderolu (2000) and Oyedokun *et al*., (2008) who reported that fibrous feedstuff like rumen content inclusion level to replace conventional feedstuff like groundnut cake, soybeans meal, maize, palm kernel cake, etc.) in the diet of monogastrics (poultry, snails, pigs, fish) reduce the cost of feed consumed. The result showed the cost of feed consumed (₦14.18) recorded in diet with no supplement was comparable with that obtained on snails fed enzyme supplementation (₦14.7).

Result showed that increase in level of rumen content resulted into decreased in the rearing cost of the juvenile snails, this could be linked to the lower price of rumen content (₦5/kg) as against maize (₦80/kg) and also the resultant decreased in cost of feed consumed with increased level of rumen content. Result showed that juvenile snails fed diet supplemented with enzyme had higher rearing cost when compared to juvenile snails fed no

supplement. This is a result of additional cost of purchasing the supplements and higher feed intake value recorded on snails fed supplements.

The juvenile snails across all experimental diet were sold for ₦80 each. The result showed the increased with increased level of rumen content (₦37.09, ₦37.96, ₦38.79) at 0, 25, 50% inclusion level rumen content respectively. This was expected as the cost of rearing the juvenile snails decreased with increased level of rumen content. Addition of supplement reduced the profit value and the addition of supplement now increases the rearing cost of juvenile snails. The trend was similar for gross profitability as with profit. The result showed that gross profitability increased as rumen content increased from 0 to 50% and there was higher gross profitability on snail fed no supplement when compared to snails fed supplement (enzyme).

The determination of cost of production is best indicated by the cost per weight gain. The cost of rearing per weight gain increased with increased level of rumen content at 0 to 50% respectively. This result is in conformity with the findings of (Ugwu *et al*,.2008) and (Bhat *et a.*,2005) who reported that there was an increase in the cost of rearing per weight gain with increased level of rumen content to replace maize in the diet of monogastrics like broilers and in the diet of rabbit respectively.

Though the result of this experiment showed that enzyme supplementation improved the nutritional value of rumen content, growth performance and efficiency of the snails (rate of weight gain, feed intake, feed to gain ratio, rate of gain of shell length and thickness), the increase in cost of production was not much felt because of the profit made after sales. The growth performance characteristics, shell parameter and financial implication of the juvenile snails fed 50% rumen content to replace maize was better than that of 25%.

References

[1] Adejuyigbe, A.P. (1999). Snail production potential for increasing animal protein intake in West Africa. In: Proceedings of the 26th Annual Conference of the Nigerian Society of Animal Production held in Ilorin, Nigeria between 21st and 25th of March, (1999). Pp. 393-401.

[2] Aduku, A.O. (1993). Tropical Feedstuff Analysis Table. Faculty of Agriculture, Department of Animal Science, Ahmadu Bello University. Samaru – Zaria, Nigeria.

[3] Agboola, F.K., Fagbohunka, B.S. and Adenuga, G.A. (2008). Activities of Archachatina marginata heamolymph enzymes: clues to terrestrial snails' salt intolerance. International Journal of Biological and Chemical Sciences (2)1: 6 – 71

[4] Akinnusi, O. (1998). Introduction to snail farming. Omega Publishers, Lagos.

[5] Akinnusi, O. (1998). Snail production – The harvest. Business livestock echo 1(3): 12- 14.

[6] Akinnusi, O. (2004). Introduction to snails and snail farming. Triolas Exquisite Venture. Abeokuta, Nigeria.

[7] Akintomide, I.A. (2004). Tropical snail farming. Oak Ventures Publishers. Lagos.

[8] Amusan, J.A., Oluokun, A. J., ogundola, F. I.and omole A. J. (1998). Snail Farming Guide: Technical Bulletin, I.A.R.&T., Ibadan.

[9] Ani, A. O., Elufidipe, C. O. and Okeke, G. C. (2009). Effect of Dietary protein and Energy Levels on the growth performance of African giant Land Snail (Achatinaachainta). Proceedings, 34th Annual Conference of Nigerian Society for Animal Production (NSAP). March 15 – 18, (2009). University of Uyo, Uyo, Nigeria. Pp. 134 – 139.

[10] A.O.A.C. (1990): Association of Official Analytical Chemists: Official methods of analysis. 15th Edition, Washington DC.

[11] Copper, C., Schafer, D. and Gregg, K. (1995) Use of engineered rumen bacteria to degrade fluroacetate. Proceedings of the Recent Advances in Animal Nutrition in Australia (1995). pp.104-107.(Rowe,

[12] J.B. and Nolan,. J.V., eds.), University of New England. Armidale, NSW 2351. Australia.

[13] Odukoya, A.A., (1998). Comparative effect of four different leaves on growth performance of growers snails (A.marginata). M.sc. Thesis, University of Ibadan, Nigeria. (unpublished)

[14] Omole, A.J., Oluokun, J.A., Oredein, A.O., Tiamiyu, A.K.,Afolabi, A.O., Adetoro, F.O. and Sogbesan, A. O. and Ugwumba A.A.A. (2006). Bionomics evaluations of Garden snail (Limicolaria aurora Jay) meal in the dist of Clariasgariepinus (Burchell) Fingerling, Nigerian Journal of Fisheries Vol. 213 (12): 358-371.

[15] Toibipont, K.,Kermanshahi, H. (2004). Effect of levels of tallow and NSP degrading enzyme supplements on nutrient efficiency of broiler chickens. In: Proceedings of the Annual Conference of the British Society of Animal Science. University of York, York, UK, 5-7 April, 2004. p. 273.

[16] Yu, Li and Peter, W.S.C. (2005). Effects of crude fibre level in the diet on the intestinal morphology of growsing rabbits. Animal Science 30: 143-148 (SCI).