Growth Performance, Qualitative and Economic Evaluation of Snails (*Archachatina marginata*) Fed Cassava Byproducts

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ABSTRACT

A fourteen-week feeding trial was conducted with (n=300) snails to evaluate the growth response and quality of meat and haemolymph of growing snail fed on pawpaw leaf meal (PLM), cassava leaf meal (CLM), cassava sieviate meal (CSM), and cassava chaff meal (CCM). The snails were offered water freely and a known quantity of feed on a daily basis and their weight was taken on a weekly basis. The proximate and fiber composition of the feedstuff were determined before the trial commenced, while the meat and haemolymph chemical analysis were carried out at the end of the feeding trial following standard procedures. All data were analyzed using ANOVA in a complete randomized design, there were five treatment at 60 snails each of 3 replicates.

The proximate composition of the feedstuff revealed highest crude protein (CP) 31.45%, ash (10.86%) and least NFE in PLM, while CLM had highest ($P<0.05$) neutral detergent fiber (NDF), acid detergent fiber (ADF), acid detergent lignin (ADL), cellulose and hemicellulose. The utilization of the feedstuff by snails resulted in best ($P<0.05$) and comparable carcass yield in PLM (38.47%) and CLM (38.41%) with resultant least cost (#0.35/g/weight gain) each for PLM and CLM. The snail meat ether extract was highest ($P<0.05$) and comparable ($P<0.05$) in PLM and CLM, while the level of meat phosphorus was highest ($P<0.05$) and comparable in PLM, CLM and CPM. The haemolymph recorded non-significant ($P>0.05$) variation in proximate constituents and most mineral elements, except copper that was higher ($P<0.05$) and comparable in PLM and CLM. All the feedstuffs (PLM, CLM, CPM, CSM, and CCM) were outstanding, without compromising the quality of snail meat. Adoption of all the cassava byproducts is advocated in snail farming.

(Keywords: haemolymph, snail meat, cassava byproducts, carcass yield)

INTRODUCTION

Snails are terrestrial shell bearing animals, that belong to phylum Mollusca and class gastropoda (Oyeleye et al., 2012). Their availability is seasonal; they are common during the wet season and scarce during the dry months of the year. The common breeds of snails in West and Central Africa are *Archachatina marginata*, *Achatina achatina*, and *Achatina fulica* (Kehinde et al., 2019 and Oropo et al., 2019).

Over 90% of snails in Nigeria are supplied by gatherers, who are seen in most rural communities collecting snails after rains. It is now evident that the supply of snail is inadequate, attracting high prices and are out of reach of the poor. In order to meet the protein needs of the ever-increasing human population, there is need to systematically breed snails to improve production in a controlled environment (Omole, 2002).

Snail farming is being promoted to ensure all year-round availability of snail. This will assist in bridging the chronic protein gap in most developing countries (Appiah et al, 2000). The experience in Ghana, Nigeria, and Benin Republic has shown the feasibility of snail domestication, there is need to ascertain the performance of snail in captivity and ensure that snails are raised with least cost ration.

Akinnusi et al. (2019) described snail as monogastric herbivores and they stated that snails can feed on forages without compromising the quality of snail meat. Snail meat and haemolymph have been consumed for their protein and medicinal importance. The essence of animal production should not only be focused on growth, feed intake and economic returns, care must be taken, to ensure the chemical composition of snail products are not compromised.

Many nutritionists have claimed that affordable animal protein can be achieved by shifting attention to micro-livestock production such as snail, due to their minimal cost of production and required equipment, unlike poultry, cattle, sheep and goat production that are capital intensive (Hamzat and Longe, 2002; Kehinde et al., 2008). The feeding of animal is vital to the production of quality meat and animal products. This cannot be achieved by depending on the use of conventional feed which are expensive, due to the competition between humans, industries and animals (Omole, 2002); this has resulted to the highest cost of animal production. Aguilie et al. (2019) affirmed that cost of feed accounted for about 60-70% of the cost of animal production, because they are cheap available and consumed by animals, without any side effect on the quality of animal products.

The choice of cassava leaf meal (CLM), cassava peal meal (CPM) ,cassava sieviate meal (CSM) and cassava chaff meal (CCM) was due to the leading position of Nigeria in global cassava production (Agimbiende et al., 2002) and these byproducts constitute waste in most societies, their full adoption in animal production may reduce their nuisance value in cassava food production industry (Ashaye et al., 2007). This trial will reduce cost of adding value to the cassava byproducts, because they were only sundried after collection, which was reported by (Aguilie et al., 2019) as adequate to significantly reduce cyanide, which is the most common antinutrition factor in cassava.

MATERIAL AND METHODS

Experimental Site

The trial was carried out at the Wildlife Department Snail Section of the Forestry Research Institute of Nigeria.

Experimental Animals

Three hundred growing snails of an average weight of (60±0.25g) were sourced from the departmental farm, they were randomly allotted to the treatments (PLM, CLM, CPM, CSM and CCM) at 60 snails per treatment, while each treatment was replicated thrice.

Management of Experimental Snail

The snails were raised in concrete cages of dimension 0.25 x 0.25 x 0.5m3/20 growing snails (Omole, 2002) the pen was provided with concrete drinkers and feeders. Water was offered without restriction, while known quantity of feed was offered, they were fed in the evening, due to their nocturnal nature. The trial lasted for fourteen weeks.

Growth Performance Evaluation

Known quantity of feed was offered to the snails everyday and the left over was measured to determine feed intake, weight change in the treatments was determined weekly, change in the treatment was determined on a weekly basis, by using a well calibrated electric weighing balance. While the feed conservation rate (FCR) was evaluated by dividing the feed intake by the weight gain.

Carcass Analysis and collection of haemolyrrph and meat samples. Five snails per replicate were randomly selected for carcass analysis, they were starved for twenty hours to achieve actual body weight by getting rid of feed undigested food in their intestine.

Qualitative and economics evaluation of cassava byproduct/material utilization by snails. They were de-shelled following standard procedure of Omole (2002). The carcass was separated into foot, visceral mass and shell, the weight of the different part was expressed as a percentage of the life weight. Haemolymph was also collected into bottle samples for subsequent analysis

5.0g and 5ml sample of snail meal and haemolymph respectively, were analyzed for their proximate constitutes, by the methods of A.O.A.C (2005). This elicited the percentage crude protein, crude fiber, ash, ether extract and NFE

Mineral salt determination in the meat and haemolymph of snails feed cassava byproducts. Calcium, potassium and sodium in the sample were determined by flame photometer method, phosphorus by spectrophotometric method, while the level of magnesium, iron and copper were determined by using Buck 210 VAP AAS.
Sourcing and processing of experimental feedstuffs.

PLM and CLM were sourced from the agro-forestry plot of the Forestry research institute of Nigeria, while the CPM, SCM and CCM were collected from cassava flour processing centers around Ibadan, Oyo State, Nigeria. All the feedstuffs were sun-dried and hammer milled and adopted for snail feeding

Statistical Analysis

Result obtained were subjected to Analysis of variance (ANOVA), while significant means were separated by the method of SAS (2009).

Result of the Performance of Snails Fed Cassava Byproducts

Five sole feedstuffs were adopted for this trail (PLM, CLM, CPM, CSM and CCM). Table 1 shows the proximate composition of the feedstuffs, this revealed, their, crude protein (2.34 – 31.35%), crude fiber (3.98 – 16.21%), ether extract (0.25 – 2.10%), ash (4.25 – 10.86%) and NFE (45.61 – 89.41%). PLM had highest CP (31.45) and ash (10.86%), it is also least in NFE. CLM had highest ether extract (2.10%), while CSM contained highest NFE (87.41%).

Table 2 revealed the fiber fraction of the feedstuffs, such as NDF, ADF, ADL, cellulose and hemicellulose, these variables were significantly ($P<0.05$) varied. CLM had highest ($P<0.05$) NDF (59.83%), ADF (34.24%), ADL (9.18%), cellulose (25.39%) and hemicelluloses (25.06%). The values of cyanide were below the safety limit of 100ppm.

Table 3 shows the growth performance of snail in the treatments, this consisted of average weekly weight gain (1.90 – 4.53g), average weekly feed intake (21.48 -33.22g), feed conversion ratio (7.32 – 11.29%), and carcass yield (36.82 – 38.47%), which were all significantly varied. Least coast of production was recorded in PLM and CLM.

Table 4 elicited the impact of the diets on the proximate and mineral composition of snail meat. Enhanced comparable ether extract (1.26 – 1.30%) was obtained for PLM and CLM, while highest NFE (65.04%) was recorded in snails fed with CPM. The levels of mineral, such as Ca, K, Fe, cu and Na in the snail meat, were not significantly ($P<0.05$) varied. Highest phosphorus in the meat of snail was recorded for PLM, CLM and CPM.

Haemollyph's proximate and mineral contents in Table 5 were not significantly ($P<0.05$) influenced.

DISCUSSION ON THE RESPONSE OF SNAILS FED CASSAVA BYPRODUCTS ON MEAT AND HAEMOLYMPH QUALITY

Cassava byproducts have been explored in the feeding of poultry (Tewe,1997), Swine (Akinfala et al., 2019) and ruminants. Its use in snail nutrition has not been properly documented, this necessitated this feeding trial. The choice of cassava is due to its all year-round availability and its compatibility with agro-forestry practices of farmers in the study area (Agunbiade et al., 2002).

The byproducts of cassava adopted for this trial have varied proximate and fiber composition. The proximate composition of cassava byproducts used for this trial revealed highest crude protein in PLM (31.35%) and it is regarded as the most cherished feed of snail (Ademolu et al 2004).

Table 1: Proximate Composition of Cassava Byproducts Fed to Snails.

	Treatments				
	PLM	**CLM**	**PCM**	**CSM**	**CCM**
Parameters					
Crude protein	31.35	19.45	3.94	2.34	3.62
Crude fiber	11.42	12,15	16.21	7.35	3.98
Ether extract	0.76	2.10	1.03	0.25	0.46
Ash	10.86	8.94	4.67	5.12	425
NFE	45.61	57.39	78.09	87.41	81.66

Note: PLM= pawpaw leaf meal, CLM = cassava leaf meal, CPM = Cassava Peel Meal, CSM = Cassava Sieviate Meal, CCM = Cassava Chaff Meal

Table 2: Fiber Fraction Analysis of Feedstuff Fed to Snails.

	Treatments					
	PLM	**CLM**	**PCM**	**CSM**	**CCM**	**SEM±**
Parameters						
Neutral Detergent Fiber (NDF)	54.79^{b}	54.79^{a}	59.83^{d}	44.24^{c}	46.54^{b}	0.26
Acid detergent Fiber (ADF%)	32.68^{b}	30.40^{c}	34.24^{a}	20.67^{b}	22.92^{d}	0.16
Acid Detergent Liqnin (ADL%)	8.29^{b}	8.29^{b}	9.18^{a}	4.21^{d}	5.16^{c}	0.02
Cellulose %	24.39^{b}	24.39^{b}	25.59^{a}	23.57^{c}	23.62^{c}	0.13
Hemicellulose %	24.39^{b}	22.11^{c}	25.06^{a}	16.46^{c}	17.76^{d}	0.03
Cyanide (mg/kg)	-	32.68^{a}	21.42^{a}	13.24^{d}	16.24^{c}	0.02

a, b, c, d, e – mean along the same row with different superscript are significantly different (P<0.05)

Table 3: Growth Performance of Snail Fed Cassava Byproducts.

	Treatments					
	PLM	**CLM**	**PCM**	**CSM**	**CCM**	**SEM±**
Parameters						
Initial body weight (g)	88.75	89.71	88.68	89.01	89.56	0.97
Final body weight (g)	143.05^{a}	142.96^{a}	120.12^{b}	111.84^{c}	122.45^{d}	4.68
Average Weekly weight gain (g)	4.53^{a}	4.44^{a}	2.62^{b}	1.90^{d}	1.94^{c}	1.15
Feed conversion ratio	7.32^{c}	7.43^{c}	9.68^{b}	11.29^{a}	11.31^{a}	0.25
Carcass yield (%)	38.47^{a}	38.41^{a}	36.90^{b}	36.85^{b}	36.82^{b}	1.00
Cost of feed/kg (₦)	5.00	5.00	5.00	5.00	5.00	-
Cost of feed/gramme weight (₦)	0.035	0.035	0.05	0.05	0.6	-

a, b, c, d – mean along the same row with different superscripts are significantly (P<0.05) different.

Table 4: Proximate, Mineral and pH of the Meat of Snails Fed Cassava Byproducts.

	Treatments					
	PLM	CLM	PCM	CSM	CCM	SEM±
Parameters						
Dry matter (%)	93.90	94.88	94.38	93.93	94.00	1.02
Crude protein (%)	18.15	18.46	18.20	19.00	18.20	0.20
Crude fiber (%)	0.13	0.14	0.14	0.15	0.13	0.02
Ether Extract (%)	1.30 [a]	1.26 [a]	1.19 [b]	1.23 [b]	1.23 [b]	0.05
Ash (%)	16.20	16.72	16.19	16.50	16.00	0.05
Nitrogen Free Extract (%)	64.22[ab]	63.45[b]	65.04 [a]	64.13[ab]	64.40[ab]	1.01
Calcium (mg/100g)	109.80	108.40	105.35	110.10	107.40	0.4
Potassium (mg/100g)	0.51	0.49	0.49	0.49	0.53	0.05
Iron (mg/100g)	2.00	2.10	1.99	1.95	1.98	0.21
Phosphorus (mg/100g)	28.15[a]	28.00 [a]	22.50[ab]	21.87[b]	22.05[ab]	1.02
Copper (mg/100g)	0.69	0.70	0.69	0.69	0.69	0.25
Sodium (mg/100g)	1.27	1.26	1.27	1.25	1.25	0.01
Ph	9.20	9.80	9.40	9.30	9.25	0.30

a, b, c – means along the same row with different superscript are significantly ($P<0.05$) different .

Table 5: Proximate, Mineral and pH Contents of Haemolyrrph of Snails Fed with Cassava Byproducts.

	Treatments					
	PLM	CLM	PCM	CSM	CCM	SEM±
Parameters						
Crude protein	3.78	3.70	3.60	3.60	3.60	0.33
Crude fiber	-	-	-	--	-	-
Ether Extract	0.02	0.02	0.01	0.01	0.01	0.01
Ash	0.56	0.55	0.54	0.53	0.53	0.04
Nitrogen free extract	4.55	4.54	4.03	4.03	4.03	1.0
Sodium	0.10	0.11	0.11	0.11	0.12	0.03
Potassium	0.14	0.15	0.14	0.14	0.15	0.02
Iron	3.30	3.90	2.50	2.40	2.40	0.20
Magnesium	0.16	0.17	0.08	0.07	0.07	0.04
Copper	4.10[a]	4.20[a]	3.50[b]	3.51[b]	3.52[b]	0.40
Calcium	45.00	44.00	43.00	44.50	44.00	2.50
pH	8.30	8.10	8.50	8.60	8.70	0.23

a, b: means along the same row with different superscripts are significantly ($P<0.05$) different.

CLM however contained (19.45%) CP, which agreed with the findings of Aguihe et al., 2019 and Akinfala et al., 2019, that cassava leaf is rich in CP and can be mixed with cassava tuber byproducts to improve their CP. The cassava tuber used were CPM, CSM and CCM. The essence of this study was to discover other feedstuffs that snail can feed on without compromising snail meat and haemolymph quality and promote agroforestry practices among snail farmers. The choice of cassava byproducts was due to their all year-round availability.

Further assessment of cassava byproducts fiber fractions revealed highest (P<0.05) NDF (59.83%), ADF (34.24%), ADL (9.18%), cellulose (25.59%) and hemicellulose (25.06%) in CPL, all the fiber fraction were significantly (P<0.05) varied. The determination of crude fiber and crude protein. Values of a feedstuff may not be adequate to predict the suitability of a feedstuff, the ADL is an important indices, because potential protein may not be utilized, if it is shielded from digestive enzymes by lignin, which prevents the available nutrients from being digested absorbed and assimilated.

Generally, the trial revealed that the carcass yield of snail was below 40%, which was lower than 63% for cane rat, 66% in broioler, and 55% each for rabbit and goat (Ukah et al, 2006). This is low trend has always been recorded in snails fed forages, while better performance was recorded, when snails were fed on supplemented growers mash (Omole, 2002). Snail farmers premised their interest in producing delicious and nutritious snail meat; consequently, evaluation of the meat quality revealed significant enhancement of the ether extract and NFE in PLM and CLM, however within standard values obtained by Babalola and Akinsoyinu (2009).

The mineral assessment of the meat revealed higher (P<0.05) levels of phosphorus in snails on PLM and CLM, followed by CPM. All mineral element in the haemolymph were not varied (P>0.05), their value was lower than that of the snail meat, except for copper and iron, which were more abundant in the haemolymph. They have been reported to be important in blood and hemoglobin functioning, however, the intake of copper must be moderated since excess copper intake is toxic depending on individuals copper tolerance capacity (Kelvay et al., 1980 and Mc Donald et al., 1998). It was evident from this study that the level of copper obtained in the snail products was within value obtained by Ebenso et al., (2019), Kehinde et al (2008) and Omole (2002). The assessment of the meat and haemolymph quality in this study, when compared with reported standards by Ngenwi et al., 2010, Maduabuchi at al., 2019, Babalola and Akinsoyinu 2009, and Ademolu et al., 2004, it could be suggestive that snail wellbeing was not compromised with the intake of cassava byproducts.

CONCLUSION AND RECOMMENDATION

The utilization of CLM, CPM, CSM and CCM is not deleterious to growth performance, economic returns, proximate and mineral composition of snails produced. Farmers should explore their all year-round availability and adopt them in snail nutrition.

All cassava byproducts (CLM, CPM, CSM, and CCM) were utilized by snails, without compromising growth performance, meat and haemolymph proximate and mineral composition. However, more outstanding performance was recorded in snails fed PLM, CLM and CPM. Further trial can be carried out to evaluate the adoption of cassava byproducts as feedstuffs in the formulation of rations for snail feeding.

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