Journal of Experimental Agriculture International

40(3): 1-6, 2019; Article no.JEAI.51019
ISSN: 2457-0591
(Past name: American Journal of Experimental Agriculture, Past ISSN: 2231-0606)

Effect of Cassava by Product on Performance and Cost of Giant Land Snail (*Archachatina marginata*) Production

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Authors' contributions

This work was carried out in collaboration among all authors. Author KAS designed the study, performed the statistical analysis, wrote the protocol and wrote the first draft of the manuscript. Authors BTO and KOJ managed the economical and chemical analyses of the study. All authors actively participated in the research read and approved the final manuscript.

Article Information

DOI: 10.9734/JEAI/2019/v40i330367
Editor(s):
(1) Dr. Vincenzo Tufarelli, Professor, Department of DETO - Section of Veterinary Science and Animal Production, University of Bari "Aldo Moro", Italy.
Reviewers:
(1) Wafaa Abd El-Ghany Abd El-Ghany, Cairo University, Egypt.
(2) Idowu Peter Ayodeji, University of Fort Hare, South Africa.
Complete Peer review History: http://www.sdiarticle3.com/review-history/51019

Original Research Article

Received 25 June 2019
Accepted 30 August 2019
Published 06 September 2019

ABSTRACT

The present study was aimed to determine the effect of Cassava by Product on Performance and Cost of c Giant land Snail (*Archachatina marginata*) Production. A twelve-week feeding trial was conducted with (n=225 growing snails) with an average weight of 88.95 ± 8.10 g to access their growth response and nutrients digestibility. The snails were fed pawpaw leaf meal (PLM), cassava leaf meal (CLM), cassava peel meal (CPM), cassava sieviate meal (CSM) and cassava chaff meal (CCM) in a complete randomized design at 45 snails per treatment of five treatments, while each treatment was replicated three times. The proximate and fiber fractions of the feedstuffs were also determined and data were analyzed using ANOVA. The proximate evaluation showed highest crude protein in PLM (31.35%) and least in CSM (2.34%). The highest crude fiber was obtained for CPM (16.21%) and least in CCM (3.98%) CSM had the highest NFE (87.41%). Highest neutral

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detergent fiber (NDF) 59.33%, acid detergent fiber (ADF) 34.24%, acid detergent lignin (ADL) (9.18%), cellulose (25.59%) and hemicelluloses 25.06% was obtained for PLM. Outstanding (PL< 0.05%) weekly weight gain, weekly feed intake, nutrient digestibility and carcass yield were obtained in snails on PLM and CLM followed by CPM. Snails utilized Cassava by-product without any adverse effect.

Keywords: Snails; digestibility; fiber; carcass yield.

1. INTRODUCTION

The cost of animal production is high and has been computed to be about 60-80% of the total cost of animal production, this is because of the high cost of feed ingredients and irregular supply [1]. Conventional feed ingredients such as maize, soyabean, groundnut cake are expensive and there is a need to seek for alternatives [2]. The high cost of feed and animal protein has created a wide protein gap, the Nigerian food balance sheet of 4.82 g/caput/day of animal protein was much lower than the FAO minimum recommendation of 35 g/ caput/ day from livestock products [3,4] this was attributed to the inherent problem of lower production from conventional livestock, due to their poor growth rate, poor feed utilization and small mature body size [5,6].

Alternative sources of animal protein such as snails and other micro livestock are now domesticated for poverty alleviation and increased animal protein intake [7,8]. The meat of snail is cherished and regarded as a delicacy, due to its high-quality protein, low fat and its richness in mineral salts such as Iron, Calcium, Magnesium etc.

This study tried to evaluate the response of giant land snail (*Archachatina marginata*) to cassava leaf meal (CLM), cassava sieviate meal (CSM), cassava peel meal (CPM), cassava chaff meal (CCM) and pawpaw leaf meal (PLM) as the control treatment, due to its high nutritive value and snails have been found to have good performance response when fed with pawpaw leaf meal [9,10].

The choice of cassava based product is due to their all year round availability, cheapness and high level of carbohydrates [11,3]. Cassava peel was obtained after the peeling of the tubers, while the leaves are collected after cassava harvesting, cassava seiviate is a by-product of cassava flour sieving and the chaff is derived when cassava solution is sieved. Cassava by-products have been used previously to feed livestock by [12,13,14,3] and incorporated into poultry diets to reduce cost of production.

The cassava by-products used were derived from tropical manihot species (TMS) 30572 sourced from the Agroforestry farm of the forestry research institute of Nigeria and the main anti-nutritional factor in cassava (*Cyarogenic glucoside*) has reduced to a tolerable level by processes like drying, peeling, frying, retting and boiling [15,16].

The benefits of nail farming include easy handling, low cost of production, no pollution and low incidence of diseases [9,17]. The most common snail species in Nigeria is *Archachatina marginata*, it is the biggest snail species in Nigeria and its adoption in this trial will further promote snail rearing in captivity. Therefore, present study was aimed to determine the effect of Cassava by Product on Performance and Cost of Giant land Snail (*Archachatina marginata*) Production [18].

2. MATERIALS AND METHODS

2.1 Experimental Site

The trial was conducted at the Wildlife Department Snail Section of the Forestry Research Institute of Nigeria, Ibadan Oyo State, Nigeria.

2.2 Experimental Animals

Two hundred and forty growing snails of an average weight of (60±0.25 g) were sourced from the departmental farm, the snails were randomly allotted to the treatments (0,5,10 and 15% inclusion of cassava peel) at 60 snails per treatment, while each treatment was replicated thrice.

2.3 Management of Experimental Snails

The snails were housed in concrete pens of dimension 0.25 x 0.25. 1 m^3 for growing snails. The pen was provided with concrete drinkers and feeders. Water was offered throughout the trial, while known quantity of feed was offered, they were fed in the evening, due to their nocturnal nature. The trial lasted for fourteen weeks.

2.4 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 treatment was determined on a weekly basis, by using well calibrated electric weighing balance. FCR was evaluated by dividing the feed intake by the weight gain.

Shell morphological changes were determined by using vernier caliper to measure the shell length, while the shell thickness was determined with the use of micrometer screw gauge.

2.5 Nutrient Digestibility Determination

This was carried out at the end of the 12th week of a 14 week trial. Four snails from each replicate were moved to the constructed wooden metabolic cage of dimension 0.2 x 0.2 x0.5 m^3, which was lined with a thin foam, for easy collection of voided excreta, the excreta voided were accurately measured on a daily basis, dried in hot air oven at 105 bc until the moisture content was constant, then allowed to cool, ground and stored for subsequent proximate analysis determination, by the methods of AOAC [17].

2.6 Proximate and Macronutrient Analysis of Snail Meat

The proximate composition of snail meat was determined by the official methods of analysis of absorbed by the Association of Analytical Chemists (A. O. A. C 10^{th} edition 2005). This elicited the component crude protein, crude fiber, ether extract, Nitrogen free extract, and Ash . All analysis were done in triplicates

The level of calcium, potassium and sodium was determined by the method of A.C, Arc (995.11) by the use of the Jen way digital flame photo meter (PF86 model), Phosphorus content of the meat sample was determined by the use of spectro photometric method [17] and Magnesium by A.O.A.C (975.23).

2.7 Statistical Analysis

Data collected were subjected to Analysis of variance (ANOVA), using Complete Randomized Design while significant means were separated using [4] as explained by Sam et al. (2019).

3. RESULTS

Table 1 shows the proximate analysis of the feedstuff (PLM, CLM, CPM, CSM and CCM) shows that PLM the control diet had highest (P<0.05) crude protein (31.35%), ash (10.86%) and least NFE (45.61%). Highest crude fiber (16.21%) was recorded for CPM, while CSM had highest (P<0.05) NFE (87.41%) and least (P<0.05) in crude protein.

Table 2 elicited the fiber fraction cyanide and gross energy contents of the feedstuffs. CPM had the highest (P<0.05) NDF (59.83%), ADF (34.24%), ADL (9.18%), cellulose (25.59%) and hemi cellulose (25.06%), while CSM was least (P<0.05) in NDF, ADF, ADL cellulose, hemicelluloses and gross energy (2900 K Cal/Kg).

Table 3 had the performance of the snails in forms of growth, feed intake, shell morphology, nutrient digestibility and cost of feed per gram weight gain. Highest (P<0.05) average weekly weight gain was recorded for snails fed PLM (4.53 g) and CLM (4.44 g) followed by those on CPM and least and compared values in snails fed with CSM and CCM. Feed intake also followed the same trend. Highest shell length movement was recorded for PLM (0.95mm), while shell thickness was highest (P<0.05) in CPM. Digestibility of crude protein, crude fiber and ether extract was highest (P<0.05) and comparable in snails fed with PLM and CLM followed by CPM. Cost of feed per gram weight gain was ₦ 0.035, ₦ 0.035, ₦ 0.05, ₦ 0.05 and ₦ 0.06 for PLM, CLM, CPM, CSM and CCM respectively.

Table 1. Proximate composition of cassava by-products and pawpaw leaf

Parameters (%)	Treatments				
	PLM	CLM	CPM	CSM	CCM
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	4.25
Nitrogen Free Extract	45.61	57.39	78.09	87.41	81.66

CLM = Cassava Leaf Meal; CSM = Cassava Sieviate Meal; PLM = Pawpaw Leaf Meal; CPM = Cassava Peel Meal; CCM = Cassava Chaff Meal

Table 2. Fibre fraction analysis, cyanide and gross energy of cassava by-products and pawpaw leaf

Parameters (%)	Treatments					
	PLM	CLM	CPM	CSM	CCM	+ SEM
Neutral Detergent Fiber	54.79^b	59.83^a	44.2^d	46.54^c	54.79^b	0.26
Acid Detergent Fiber	30.40^c	34.24^a	20.67^e	22.92^d	32.68^b	0.16
Acid Detergent Lignin	8.29^b	9.18^a	4.21^d	5.16^c	8.29^b	0.02
Cellulose	24.39^b	25.59^a	23.57^c	23.62^c	24.39^b	0.13
Hemicellulose	22.11^c	25.06^a	16.46^c	17.76^d	24.39^b	0.03
HCN (mg/kg)	32.68^a	21.42^d	13.24^d	16.24^c	-	0.02
Gross Energy (Kcal/Kg)	2800^c	2834^d	2900^c	3116^b	3672^a	0.16

abcde: Means along the same row with different superscripts are significantly different (p<0.05)

Table 3. Growth performance, nutrient digestibility and economy of production of snails fed cassava by-products and pawpaw leaf

Parameter	Treatments					
	PLM	CLM	CPM	CSM	CCM	± SEM
Initial Body Weight (g)	88.75^a	89.71^a	88.68^a	89.01^a	89.56^a	0.97
Final Body Weight(g)	143.05^a	142.96^a	120.12^b	111.84^c	112.45^c	4.68
Average Weekly Weight Gain(g)	4.53^a	4.44^a	2.62^b	1.90^c	1.94^c	1.15
Average Weekly Feed Intake(G)	33.22^a	32.47^a	25.36^b	21.48^c	21.58^c	1.89
Feed Conversion Ratio	7.32^c	7.43^c	9.68^b	11.29^a	11.31^a	0.25
Average Weekly Shell Length Increment(mm)	0.95^a	0.72^b	0.61^c	0.56^d	0.57^d	0.01
Average Weekly Shell Thickness Increment(mm)	0.03^b	0.03^b	0.07^a	0.02^b	0.02^b	0.01
Average Weekly Shell Width Increment(mm)	0.54^a	0.53^a	0.52^a	0.46^b	0.46^b	0.04
Ether Extract Digestibility%	80.05^a	81.09^a	79.09^b	75.00^c	75.04^c	0.20
Crude Protein Digestibility%	76.25^a	75.25^a	74.28^b	72.15^b	72.12^b	2.98
Crude Fiber Digestibility%	60.86^a	60.05^a	59.86^a	57.75^b	57.28^b	1.14
Cost Feed/Kg (₦)	5.00	5.00	5.00	5.00	5.00	-
Cost Of Feed/Gramme Weight Gain (₦)	0.035	0.035	0.05	0.05	0.06	-
Carcass Yield (%)	38.47^a	38.41^a	36.90^b	36.85^b	36.82^b	1.0

abcde: Means along the same row with different superscripts are significantly (p<0.05) different

4. DISCUSSION

The feedstuff adopted for this feeding trial are cheap and available, the choice of pawpaw leaf meal as the control diet is because it is the most preferred diet of snail [13] the proximate analysis of the feedstuff revealed CLM and PLM as protein rich feedstuffs, with 19.42% and 31.75% respectively, the others (CPM, CCS and CSM) are by products of cassava tuber processing and they had low protein content which ranged from 1.82% to 3.94%, this confirmed the findings of [19] that cassava by products are low in crude protein and any diet with cassava based needs protein fortification through the addition of protein concentrate or by fortification with limiting amino acid. CPM, CCM and CSM are good energy substrates [18,20].

Cassava by products and PLM fiber fraction were determine to ascertain quantitative and qualitative fiber content and compost ion. Neutral D***** fiber (bulk fiber) (59.83%), ADF (34.24%) ADL (9.18%), cellulose (25.39%) and hemicelluloses were highest (p<0.05) in CPM, the ADL level is very important for fiber utilization, source it is the part of fiber that is not digestible and also impair the digestibility of other nutrients, this corroborates the findings of [2] that utilization of fiber is influenced by its content of lignin.

Nutrition is to have previously adopted different processing methods to improve fiber utilization, such as boiling soaking grinding and fermentation, which reduced fiber content of feedstuffs and improve their levels of crude protein, in this trial the cassava by products had passed through, drying and soaking in some instances to reduce anti nutritional factors [14,13]. Stated that processing of cassava by products reduced cyanide and made it safe for consumption by monogastrics. Evaluation of cyanide in this trial revealed that PLM does not contain cyanide, while CLM, CPM, and CSM had cyanide below lethet dose of 100 ppm [11,10].

The significant ($p<0.05$) high feed intake, weight gain and shell morphological changes obtained for PLM and CLM could be attributed to their higher crude protein contents, which improve feed palatability and feed intake [14,12]. Average weekly feed intake in PLM (7.43 g) compared and higher ($p<0.05$) then the values for snails fed with CLM, CSM and CCM. The crude protein content of the feedstuffs is important and has been known to affect feed intake and consequently weight gain and feed conversion ratio, which were best in snails fed PLM and CLM.

[7] reported that the bioavailability of calcium and phosphorus for shell thickness increment depended on crude protein content, fiber ADL and ADF and feed intake, which were more favourable in PLM. CLM and CPL followed by compared ($p<0.05$) in PLM (0.54 mm), CLM (0.53 mm) and CPL (0.53 mm) and were better ($p<0.05$) then (0.46 mm) obtain for CCM and CSM. Improved shell thickness in CPL was attributed by [7] to the high level of hemicelluloses in CPM, which enhanced calcium and phosphorus utilization, unlike growth in snail which is directly related to protein and feed intake, shell thickness is regulated by shell mineralization. This trial corroborated the findings of [1,15,10] that high level of dietary to crude protein include feed palatability and digestibility in monogastrics, this was exemplified by superior ($p<0.05$) digestibility of other extracts, crude protein and fiber recorded for snails fed PLM and CLM. Reduced cost of production was achieved in snails fed PLM and CLM. These two forages were outstanding in snail feeding.

5. CONCLUSION

The most common snail species in Nigeria is *Archachatina marginata*, it is the biggest snail species in Nigeria and its adoption in this trial will further promote snail rearing in captivity. Average weekly feed intake in PLM (7.43 g) compared and higher ($p<0.05$) then the values for snails fed with CLM, CSM and CCM. The crude protein content of the feedstuffs is important and has been known to affect feed intake and consequently weight gain and feed conversion ratio, which were best in snails fed PLM and CLM. Outstanding (PL< 0.05%) weekly weight gain, weekly feed intake, nutrient digestibility and carcass yield were obtained in snails on PLM and CLM followed by CPM. Snails utilized Cassava by-product without any adverse effect.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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Peer-review history:
The peer review history for this paper can be accessed here:
http://www.sdiarticle3.com/review-history/51019