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Performance Characteristics of African Giant Land Snail (*Archachatina marginata*) Fed Diets Containing Soya Bean Milk Residue-Cassava Sievate Meal Mixtures

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ABSTRACT [ENGLISH/ANGLAIS]

Thirty six growing African giant land snails (*Archachatina marginata*) with average initial live weight of 73.40±5.58 and 75.94± 4.70g were used in this study to evaluate the effect of diet containing soya bean milk residue (SBMR) and Cassava Sievate (CS) in ratio 3:2 on *Archachatina marginata.* The snails were randomly assigned to two treatments of eighteen snails each. The SBMR-CS mixture was included at 0 and 30% levels. Evaluated performance characteristics showed that daily feed intake, weight gain, feed-gain ratio, mortality, carcass analysis (foot weight, visceral weight, shell weight), shell characteristic (such as shell length, shell width), and mortality were not significantly ($p > 0.05$) affected by dietary treatments. The feed cost per weight gain (Nigerian Naira N/g) showed the low value of N 0.32 (0.002 USD) and high value of N 0.42 (0.003 USD) for the diets 2 and 1 respectively. It was concluded that SBMR/CS mixtures (3:2) can be included the diets of snails up to 30% without adverse effect on performance. The use of these agro by-products will support the ventures of increasing animal protein sources through cheaper snail production.

Keywords: Snails, soybean milk residue, cassava sievate, performance

RÉSUMÉ [FRANÇAIS/FRENCH]

Trente-six de plus en plus les escargots géants africains (Archachatina marginata)avec une moyenne de poids vif initial de 73,40 ± 5,58 et 75,94 ± 4.70g ont étéutilisées dans cette étude pour évaluer l'effet de l'alimentation contenant des résidusde lait de soja haricot (SBMR) et le manioc Sievate (CS) 03h02 au ratio surArchachatina marginata. Les escargots étaient assignés au hasard à deux traitements de dix-huit escargots chacun. Le mélange SBMR-CS a été inclus à 0 et les niveaux de 30%. Caractéristiques de performance évalués ont montré quel'ingestion quotidienne, gain de poids, l'alimentation du gain ratio, de mortalité,l'analyse des carcasses (poids du pied, le poids viscéral, poids de la coquille), coquille caractéristique (comme la longueur de la coquille, la largeur de coquille), et la mortalité n'étaient pas significativement (p> 0,05) affectées par les traitementsdiététiques. Le coût d'alimentation par le gain de poids (nairas nigérians N / g) a montré la faible valeur de N0.32 (0,002 $) et la valeur élevée de N0.42 (américains Dollars 0,003 $) pour les régimes 2 et 1 respectivement. On a conclu que SBMR / CS mélanges (03:02) peuvent être inclus les régimes alimentaires des escargotsjusqu'à 30% sans effet négatif sur la performance. L'utilisation de ces sous-produitsagro soutiendra le joint d'augmenter les sources de protéines animales grâce à une production moins chers d'escargot.

Mots-clés: Escargots, les résidus de lait de soja, le manioc sievate, la performance

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INTRODUCTION

Quantitatively and qualitatively, meat and other animal foods are better sources of proteins than plant foods (with the exception of soybean products) [1]. However, there is a great demand on the conventional animal protein food leading to their exorbitant prices and thus becoming unaffordable to some average Nigerians [2]. The desire to increase animal protein intake therefore can be achieved through exploiting the potentials of non-conventional animal protein sources like snail. In terms of environmental friendliness, snail farming could be of choice. In addition, the low technical skill required for its rearing makes the venture acceptable to both urban and rural dwellers. The advocacy for snail rearing is becoming

more popular because of the potential usefulness of its meat as a good source of protein which is between 15.76 - 18.26 % [3, 4].The fat content which ranged between 0.96 and 3.0% is low when compared with 9.6, 21.4 and 23.0 % in chicken, egg and mutton respectively [5]. This quality makes snail meat a choice for hypertensive patients and the obsessed [6, 7]. Snail meat is also very rich in Iron, magnesium, phosphorus, calcium and nitrogen [8]. The high content of iron in snail meat according to [9] makes it useful in correcting the problem of iron deficiency in man. However, as more people become aware of the medicinal and other importance of snail meat, snail might go into extinction with time [10] because the major source of snail supply to most Nigerian consumers is from the wild, which are sold along roadsides and in local markets. Hence, efforts are being made to domesticate snails intensively [11]. It has been reported by [12] that giant land snails fed plant food materials supplemented with artificial diet performed better than their counterparts fed only plant food materials. Feeding cost in livestock which accounts for over 70% of the total production costs can be reduced to ensure profitability through the use of agro by–products. Two of such by–products are Cassava Sievate (CS) and Soya Bean Milk Residue (SBMR) which are obtained from cassava and soya bean milk processing respectively. Their abundance, cheapness and availability all year round qualify them as good non-conventional ingredient [13].

This study is aimed at evaluating the effect of feeding diets containing graded levels of Soya Bean Milk Residue (SBMR)/Cassava Sievate (CS) meal mixture on the performance of growing snail.

MATERIALS AND METHODS

Location

The experiment was conducted at the Snailery Annex of Teaching and Research Farm of Ladoke Akintola University of Technology, Ogbomoso within the derived Savannah Zone of Nigeria. The agro-ecological description of the study area has been documented by Oguntoyinbo [14].

Preparation of Test Ingredients

Fresh cassava sievates were procured from the local Gari Processing Outlets within Ogbomoso and sundried for 5 days (Figure 1). Fresh Soya bean milk residues (SBMR) were procured from Soya milk processing outlets within Ogbomoso North Local Government Area. The residues were immediately spread on clean slatted floor and sundried for 5 days under atmospheric temperature of 31 ± 2 ^{0}C (Figure 2).

The sundried SBMR and cassava sievate were hammer milled, bagged and stored until needed.

Preparation of Rearing Medium

Sandy loam soil collected from plots under cultivation within the Teaching and Research farm was sterilized and used as the rearing medium. Sterilization was done using hot water treatment. Water was heated to 100 ^{0}C and then poured into the medium (soil) to its level in plastic bowls used for the experiment. The water was later drained after cooling.

Formulation of the Experimental Diets

Two experimental diets were prepared. Diet_1 was the control without inclusion of CS-SBMR while Diet_2 had 30% of SBMR-CS mixtures in ratio 3:2. The diets were formulated to be isonitrogenous and isocaloric (Table 1).

Experimental Animal and Management

Thirty-six giant African land snail (*A. marginata*) growers were used for the experiment. The snails were fed with the control diet and acclimatized for one week before the commencement of the feeding trial. They were of average initial weight of 73.40 ± 5.58 - 76.02 ± 3.34. Perforated plastic bowls of 20 cm depth and 40 cm diameter were used for housing the snails. They were filled with moist sterilized sandy loam soil to a depth of 15 cm, the basin were covered individually with mosquito net reinforced with chicken wire netting for proper aeration and to prevent escape of snails. They were kept under cool environmental condition.

After acclimatization, the snails were randomly allotted to two dietary treatments of eighteen snails per treatment. Each dietary treatment was replicated thrice at the rate of six snails per replicate in a completely randomized design experiment. The experiment lasted for 10 weeks, throughout which the snails were fed *ad-libitum* and were provided clean water in the evening (between 17-18 hour). While the experiment lasted, feed offered and orts were weighed to determine feed intake. Weekly weights were also taken after the initial weight and the records kept were used to determine the response criteria in term of mean weight gain, and feed intake to weight gain ratio. The shell length and shell width were also measured weekly using vener calipers.

Laboratory analysis

The proximate composition of the SBMR, CS and that of experimental diets were determined using the procedure of AOAC [15]. HCN determination was done using the procedure described by Bradbury et al. [16] and Egan et al. [17].

Statistical Analysis

All data generated were analyzed using Student T-test statistical analysis [18].

RESULTS AND DISCUSSION

The proximate composition of the test ingredients is presented in Table 2 while the proximate composition of the experimental diets is presented in Table 3. The proximate composition of the CS is higher than the value reported by Nwokoro et al. [19] but the crude fibre is lower. The experimental diets were similar in composition and the protein and energy values are similar to the values of Omole [20]. The protein is lower than that of Iman *et al*, Uberu et al. [21, 22].

The effect of soya bean milk residue (SBMR)/Cassava Sievate (CS) meal mixture on performance characteristics of snail is presented in Table 4. The terminal weight, daily weight gain, daily feed intake were similar ($p > 0.05$) for snails on control diet and 30% inclusion of SBMR/CS mixtures respectively. There was no mortality in any treatment. The feed to gain ratio ,feed cost per kg weight gain \$0.003±0.00 vs \$0.02±0.00 for snails on control diet and 30% inclusion of SBMR/CS mixtures respectively were affected ($p < 0.05$) by the dietary treatments.

The similarity in the terminal weights, daily feed intake, daily weight gain, and the zero mortality in both the treatment and control groups attest to the safety of the tested ingredients, as well as its potential usefulness in replacing maize. The final weights and daily weight gain obtained in this study were similar to the values reported by Oredein [23]. The zero mortality recorded in the snails fed control diet and 30% SBMR/CS mixture indicates that the inclusion of the test ingredients has no detrimental effect on the snails and confirms the report of Akinnusi [24] that, under proper management, the mortality rate in snails is lower than that of other conventional livestock.

The lower feed: gain ratio of diet 2 may be attributed to a better utilization of the diet. The shell morphological changes as presented in Table 4 shows that the terminal shell length, shell length increment, shell width and shell width increment were not affected ($p > 0.05$) by dietary treatments. This agrees with the findings of Amao et al. and Omole [12, 20]. This could be due to the relatively similar ash content of the experimental diets.

The results of the carcass analysis are presented in Table 5. Although the visceral/live weight (%) as well as the shell/live weight (%) of the snails on the control diet did not differ ($p > 0.05$) from those of the snails on SBMR/CS-based diets, the values were lower than those reported by

Figure 1: This figure shows a flow chart of production of cassava sievate

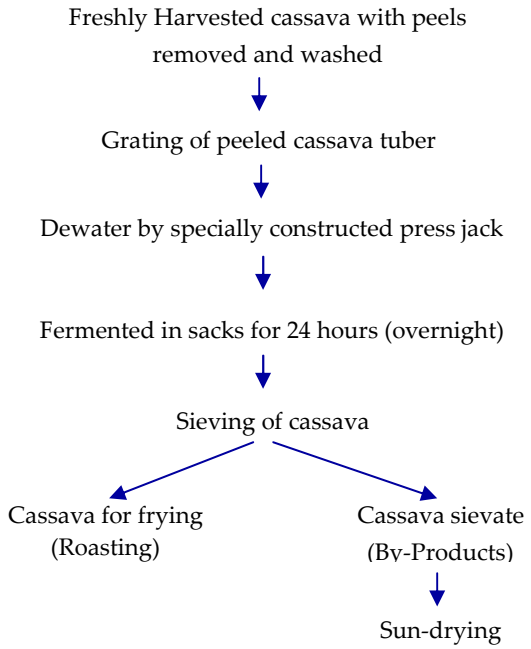
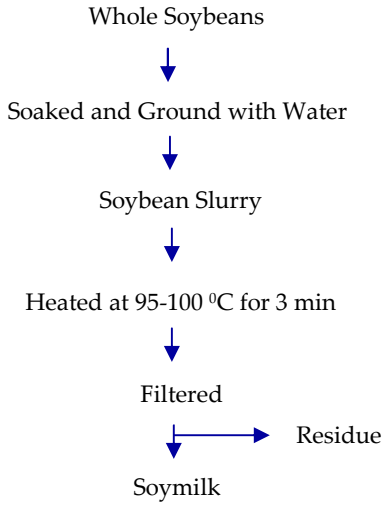


Figure 2: This figure shows flow chart of production of Soy bean milk Residue



Odunaiya [25]. The results indicated that the foot weight which is otherwise referred to as edible portion was not affected ($p > 0.05$) by dietary treatment. The dressing

percentages of the snails in this study are similar for the control and the diet containing SBMR/CS, but are higher

Table 1: This table shows gross composition of experimental diets

Ingredients	% Composition	
	$T_{1\ (Control)}$	$T_{2(SBMR/CS)}$
Maize	20	2.35
Groundnut cake	14	14
SBMR/CS	0	30
Corn bran	14	1.65
Rice husk	16	16
Brewery dry grain	16	16
Palm kernel cake	14.25	14.25
Fish meal	1.0	1.0
Bone meal	2.0	2.0
Oyster shell	2.5	2.5
Vitamin premix	0.25	0.25
Total	100	100
Calculated analysis		
ME (Kcal/kg)	2499.5	2492.1
CP%	17.68	18.28
Fat	5.41	4.4
Fibre	9.82	8.65
Cost/kg of feed (N)	42.41	38.42

Premix Composition per kg of diet: Vitamin A – 3, 200, 000IU, Vitamin D_3- 1,200IU, Vitamin E_3- 200IU, Vitamin K_3- 800 mg, Vitamine B_1- 400mg, Vitamin B_2- 1000mg, Vitamin B_{12}- 2000 mg, Niacin- 400mg, Selenite (Se)- 40mg, Manganese (Mn)- 32,000 mg, Pantothetic Acid- 2,000 mg, Folic Acid-200mg, Choline Chloride- 60,000 mg, Iron (Fe)- 8,000 mg, Copper (Cu)-3,200mg, Zinc (Zn)-2,000 mg, Cobalt (Co)-90 mg, Iodine (I)-800mg; SBMR/CS – Soybean Milk Residue– Cassava Sievate mixtures; ME – Metabolizable Energy; CP – Crude Protein

Table 2: This table shows proximate composition of the test ingredients and experimental diets

Nutrients (%)	D1	D2	CS	SBMR	CSBM
Dry matter	89.94	89.54	88.25	90.35	89.65
Crude protein	17.40	17.39	2.34	29.94	1.81
Crude fibre	9.65	9.89	1.21	3.79	2.41
Ash	7.03	6.95	1.86	3.16	1.97
Ether extract	3.58	3.69	0.26	2.49	0.57
Nitrogen free extract	51.94	51.62	82.58	50.97	82.89
Gross energy (kcal/kg)	3.206	3.489	2.853	3.192	3.159
Cyanide content (mg/kg)	0.00	2.11	6.28	0.00	3.24

Cyanide content was determined using spectrophotometer method. SBMR – Soya bean milk residue; D1 – Control diet; D2 – Diet with 30% inclusion level of SBMR/CS meal mixtures; CS – Cassava sievate; SBMR – Soybean milk residue; CSBM – Cassava sievate + soybean milk residue (3:2).

Table 3: This table shows growth performance of snails fed diets containing graded levels of soya bean milk residue (SBMR) cassava sievate (CS) mixtures

Parameters	Treatments	
	1	2
Initial live weight (g)	73.40±5.58	75.94±4.70
Terminal live weight (g)	110.44±4.47	111.11±4.93
Average daily weight gain (g)	0.53±0.32	0.50±0.75
Total weight gain (g)	37.04±2.20	35.17±5.24
Feed/Gain ratio (FGR)	1.01±0.07[a]	0.85±0.22[b]
Mortality (%)	0.00	0.00
Feed cost (N/g)	0.042±0.00	0.038±0.00
[1]Feed cost/g weight gain(N)	0.42±0.00	0.0.32±0.22

[ab]Means along the row with different superscript are significantly different (P<0.05); 1 – Control; 2 – 10% inclusion level of SBMR/CS meal mixtures; [1]One American dollar=One hundred and sixty Nigerian Naira

Table 4: This table shows carcass analysis and shell characteristics of snails fed diets containing graded levels of soya bean milk residue (SBMR)/cassava sievate (CS) mixtures

Parameters	Treatments	
	1	2
Carcass Characteristics		
Mean live weight (g)	110.44±4.47	111.11±4.93
Foot weight (g)	48.69±2.75	46.61±2.31
Dressing (%)	44.09±1.79	42.00±1.69
Visceral weight	17.28±0.78	16.00±0.99
Shell weight (g)	18.18±1.68	22.19±1.30
Shell/live weight (%)	17.03±1.22	20.21±1.08
Visceral/live weight (%)	15.79±0.84	14.40±0.57
Foot/live weight (%)	40.17±1.07	38.73±0.76
Shell Characteristics		
Initial shell length (mm)	79.01±2.10	79.69±1.32
Terminal shell length (mm)	89.47±0.94	87.61±1.97
Shell length increment (mm)	10.46±1.43	8.83±1.90
Initial shell width (mm)	45.11±0.69	47.00±0.81
Terminal shell width (mm)	50.82±0.53	51.04±0.79
Shell width increment (mm)	5.71±0.50	4.49±0.77

SBMR – Soya bean milk residue; CS – Cassava sievate; 1 – Control diet; 2 – 10% inclusion level of SBMR/CS meal mixtures

than the values reported by Odunaiya, Omole [25, 26]. This may be an indication that the test ingredients used in this study has potential of producing more edible portion.

CONCLUSION

The study revealed that SBMR/CS mixtures are potential feed resource for replacing maize in snail feed. This will lower production cost, increase the farmers' profit margin,

and stimulate more snail production, hopefully, making more animal protein available for consumption.

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CONFLICT OF INTEREST

No conflict of interests was declared by authors.