Growth Performance and Economic Benefit of Snails (*Archachatina marginata*) Fed Diets Containing Graded Levels of *Moringa oleifera* Leaf Meal as Replacement for Soybean Meal

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Abstract

The study evaluated the effects of replacing soybean meal with *Moringa oleifera* leaf meal (MOLM) on the growth performance and economic efficiency of growing snails (*Archachatina marginata*). Five diets were formulated: T1 (control: 24% soybean, 0% MOLM), T2 (50% soybean replaced with MOLM), T3 (75% soybean replaced with MOLM), T4 (100% soybean replaced with MOLM), and T5 (pawpaw leaf only). A total of 150 snails were randomly allocated to five dietary treatments in a completely randomized design with three replicates. The feed intake and weight gain were measured while feed conversion ratio and feed costs per kg diets were calculated. Results revealed that weight gain and feed conversion ratio (FCR) were significantly ($p<0.05$) influenced by dietary treatments. Snails fed T3 diet had the highest weight gain (23.36 g) and best FCR (4.63), comparable to the control, while T5 (pawpaw leaf only) performed poorest (11.34 g weight gain, FCR 9.29). Feed cost/kg reduced with increasing MOLM inclusion, lowest in T4. However, cost per kg weight gain was most favorable in T3 (₦2531.70). It is concluded that MOLM can replace soybean meal up to 75% in snail diets for optimal biological and economic performance.

Keywords: Moringa oleifera, snail nutrition, soybean replacement, feed cost, growth performance.

Description of problem

Feed constitutes the greatest cost in snail production, often accounting for more than 60% of total expenses [7]. Protein sources such as soybean meal, though widely used, remain expensive and scarce for smallholder farmers. There is, therefore, a need to explore cheaper and readily available alternatives that can support sustainable snail production. *Moringa oleifera*, commonly referred to as the "miracle tree," is widely cultivated in tropical regions. Its leaves are rich in protein (25–30%), vitamins, and minerals, making it a promising feed ingredient [3, 5]. However, the presence of anti-nutritional factors such as tannins and phytates limits its full utilization, requiring careful inclusion levels [6]. Although studies have documented the use of MOLM in poultry and rabbit diets, limited research has explored its potential in snail feeding systems. This study, therefore, investigated the growth performance and economic implications of replacing soybean meal with graded levels of MOLM in diets of growing *Archachatina marginata*.

Materials and methods

The experiment was conducted at the snailery unit of the Animal Production Technology Department farm, Federal College of Agriculture, Moor Plantation, Ibadan located at longitude 3’540E and latitude 7’230N in the humid zone of south western Nigeria (Oyo State) annual rainfall of 1564 mm and annual average temperature of 28.7^{0}C. A total of 150 healthy growing snails (*Archachatina marginata*), with an average initial weight of 128.5 g, were randomly assigned to five dietary treatments with three replicates of 10 snails each, arranged in a completely randomized design (CRD). The snail were housed in wooden cages that were raised from the floor. The feeding trial lasted for 12 weeks. Feed and water was provided ad-libitum throughout the experiment. Moringa leaf used was obtained from a farm within Ibadan metropolis of Oyo state. *Moringa oleifera* leaves were air-dried under shade for 5days until it was crispy to touch while retaining its greenish color. The leaves was milled and incorporated into the diet formulated. Five experimental diets were prepared such that T1–T4 had graded MOLM replacing SBM at 0, 50, 75, and 100% respectively while T5 was

pawpaw leaf only (Table 1). All diets were isonitrogenous and iso-caloric except T5.

Data collection

Upon arrival, the snails were weighed to determine the initial body weight; then on weekly basis, the snails were weighed. The weight gain was calculated by subtracting the initial body weight from the final body weight. The record of feed consumed was taken. It was obtained by finding the difference between the amount of feed given to the snails and the remnants gotten each day. The average weekly feed intake was computed from the amount of the feed consumed on daily basis. The feed conversion ratio was calculated from the weight gained and the feed intake of the snail at the different treatments. Feed intake divided by weight gain. The prevailing market prices of ingredients used during the period of the study were used for the economic appraisal of the feeds. Economics of production was based on the feed cost per kg diet (Table 2).

Experimental design and statistics Analysis

A Complete Randomized Design (CRD) was used for the trial. The experiment consists of five treatments which were replicated three times. All data were subjected to analysis of variance (ANOVA) using [4]. Differences between means were separated by the Tukey's procedure of the same package at 99.95% confidence limit.

Table 1: Gross Composition of the Experimental Diets

Ingredients	T1	T2	T3	T4	T5
Maize	59.80	59.80	59.80	59.80	0.00
Soybean	24.00	12.00	6.00	0.00	0.00
MOLM	0.00	12.00	18.00	24.00	0.00
Fish meal (65%)	4.00	4.00	4.00	4.00	0.00
Bone meal	2.15	2.15	2.15	2.15	0.00
Oyster shell	9.80	9.80	9.80	9.80	0.00
Pawpaw leaf	0.00	0.00	0.00	0.00	100.00
Premix	0.25	0.25	0.25	0.25	0.00
Total	100.00	100.00	100.00	100.00	100.00
Calculated analysis					
Crude protein (%)	16.96	15.56	14.86	14.15	-------
ME (Kcal/kg)	2596.50	2296.50	2146.50	1996.50	-------
Calcium (%)	4.59	4.57	4.55	4.54	--------
Av. Phosphorus (%)	0.72	0.64	0.61	0.57	--------
Crude fibre (%)	3.39	3.98	4.28	4.57	-------

MOLM: Moringa leaf meal; ME: Metabolizable energy

Result and Discussion

Table 2 shows the Growth performance and cost analysis of snail fed varying inclusion levels of moringa leaf meal (MOLM) as a replacement for soybean in their diet**.** Results indicated significant differences ($p<0.05$) in growth performance and feed economics among treatments. T3 recorded the best weight gain (23.36 g), daily weight gain (0.42 g), and FCR (4.63), while T5 (pawpaw leaf) recorded the poorest values. Feed cost decreased with higher MOLM inclusion, with the lowest cost in T4. However, cost per kg weight gain was most favorable in T3**.** The present study demonstrated that partial replacement of soybean meal with MOLM significantly influenced the growth performance and economic returns of snails. Initial weights were similar across treatments, confirming uniformity of the experimental stock. However, growth responses varied significantly, highlighting the role of dietary protein quality.

Snails on T3 (75% soybean replaced with MOLM) performed best, suggesting that MOLM provides adequate nutrients when optimally included. This agrees with findings in poultry and rabbits, where moderate MOLM inclusion improved growth [6, 1]. The poor performance at 100% replacement (T4) could be linked to anti-nutritional compounds that reduce digestibility [3, 5]. Feed intake was

highest in T2, indicating good palatability at moderate replacement. The poor performance of T5 confirms that snails require a balanced protein–energy diet, and cannot thrive on pawpaw leaf alone [7]. Economically, MOLM reduced feed cost, but optimal efficiency was achieved at 75% replacement (T3). This suggests that both biological and economic efficiency converge at this inclusion level, consistent with earlier reports of MOLM as a cost-effective protein source [2, 1].

Table 2: Growth performance and cost analysis of snail fed varying inclusion levels of moringa leaf meal (MOLM) as a replacement for soybean in their diet

Parameters	T1	T2	T3	T4	T5	±SEM	P-value
Initial weight (g)	128.51	128.48	128.88	128.69	128.29	140.00	1.000
Final weight (g)	150.40	150.84	152.25	147.51	139.63	164.00	0.654
Weight gain (g)	21.88^{a}	22.35^{a}	23.36^{a}	18.82^{b}	11.34^{c}	1.26	0.000
Daily weight gain (g)	0.39^{a}	0.40^{a}	0.42^{a}	0.34^{b}	0.20^{c}	0.00	0.000
Feed intake (g)	107.00^{b}	117.00^{a}	108.00^{b}	108.00^{b}	105.00^{b}	5.07	0.000
Daily feed intake (g)	1.91^{b}	2.09^{a}	1.93^{b}	1.93^{b}	1.88^{b}	0.00	0.000
FCR	4.90^{bc}	5.24^{bc}	4.63^{c}	5.77^{b}	9.29^{a}	0.18	0.000
Feed cost/kg (₦)	672.76^{a}	588.76^{b}	546.76^{c}	504.76^{d}	0.00^{e}	0.00	-------
TCFC (₦)	71.99^{a}	68.89^{b}	59.05^{c}	54.51^{d}	0.00^{e}	1.17	0.000
Cost/weight gain (₦)	3296.70^{a}	3083.20^{ab}	2531.70^{c}	2914.70^{b}	0.00^{d}	25156.00	0.000

Means with different superscript in a row are significantly different at ($p<0.05$)
FCR: feed conversion ratio; TCFC: total cost of feed consumed
T1: basal diet (24% SBM 0% MOLM) T2: diet containing 12% SBM, 12% MOLM (50%)
T3: diet containing 6% SBM, 18% MOLM (75%) T4: diet containing 0% SBM 24% MOLM (100%)
T5: Pawpaw leaf only

Conclusion and Application

Moringa leaf meal can effectively replace soybean meal up to 75% in snail diets without negative effects on growth or feed efficiency. Hence:

1. Snail farmers should adopt MOLM at up to 75% replacement of soybean to reduce feed costs while maintaining performance.
2. Extension services should promote MOLM use as a low-cost protein alternative in snail farming systems.

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