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Full Length Research Paper

Performance, carcass analysis and sensory evaluation of cooked meat of snailets of African giant land snail (*Archachatina marginata*) fed pawpaw leaves, whole lettuce, lettuce waste and cabbage waste as sole feed ingredient

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There is paucity of information on quality feedstuffs for snail production in Nigeria. One hundred and eighty snailets (*Archachatina marginata*) of an average weight of 3.55±1.10 g were randomly distributed into four dietary treatments of pawpaw leaves (PL), whole lettuce (WL), lettuce wastes (LW) and cabbage wastes (CW). Each treatment consisted of 3 replicates of 15 snailets per replicate in a completely randomized design. The diets were fed *ad libitum* for 20 weeks. The study investigated the performance, carcass analysis and sensory evaluation of cooked meat of the snailets fed the experimental diets. The body weight gain, feed intake, dressing percentage, shell length and shell thickness gain of snailets on WL, LW and CW were similar, higher and significantly different (P < 0.05) from those of snailets fed PL. The result of the sensory evaluation revealed that the dietary treatments had no significant effect (P > 0.05) on the colour, taste, flavour, texture and overall acceptability of the snail meat. On the whole, the study established that snailets of *A. marginata* could utilize lettuce waste as well as cabbage as sole feed ingredient to increase animal protein supply in Nigeria.

Key words: Snailets, feedstuffs, performance, carcass analysis, sensory evaluation.

INTRODUCTION

In times past, snail production was given little or no attention. The main source of supply to numerous consumers is from people who gather them from nearby bushes and sell along road side or in the local market. With this trend, there is the possibility of the snails going into extinction. However, in recent times, there is growing interest in snail rearing and efforts are geared towards domestication not only to forestall the animals going into extinction but also to ensure that they are available in the market all year round.

In Nigeria, Republic of Benin and other West African countries, snail is being considered a delicacy. The meat tastes good and it is also good for the body. The conventional feed of snails are mainly of plant origin and comprise pawpaw fruits and leaves, water leaf, cocoyam tuber and leaf, mango, breadfruit, carrot, sweet potato, guava, plantain, banana, lettuce and cabbage (Awesu, 1980; Olufokunbi et al., 1989; Imevbore, 1990; Cobbinah, 1993; Ayodele and Asimalowo, 1999).

Imevbore (1990) offered a multiple choice of food items to adult snails (*Archachatina maginata*) and summarized their preference for the different items. He reported that of all his test food items, lettuce leaves, pawpaw leaves, fresh ripe pawpaw and banana fruits were very highly consumed.

There had been reports on the performance of snails fed pawpaw leaves and fruits but there is a dearth of information on the performance of snails fed lettuce leaves, whole lettuce plant and cabbage wastes. A lot of

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Table 1. Proximate composition of the snail diet (g/100 g dry matter).

Nutrients	Pawpaw leaves (PL)	Whole lettuce (WL)	Lettuce waste LW)	Cabbage waste (CW)
Dry matter	25.43	5.96	7.04	10.10
Crude protein	33.25	11.20	7.35	9.80
Crude fibre	7.26	8.96	6.32	5.48
Ether extract	0.78	0.56	0.27	0.23
Ash	10.86	11.65	9.67	6.94
Nitrogen free extract	47.85	67.63	76.39	77.55

these are generated daily as wastes in the vegetable market. This trial was therefore designed to evaluate the performance of snailets fed lettuce leaves, whole lettuce, pawpaw leaves and cabbage. This will enable one to make a recommendation for their use in formulating low cost snail feeds.

MATERIALS AND METHODS

The test ingredients used in this trial were collected fresh on a daily basis. The lettuce and cabbage wastes were collected from the early morning trimming of vegetable sellers in Sabo area of Ibadan, Oyo State, Nigeria. The experiment was carried out between June and October with heavy rainfall and cold in the month of July.

One hundred and eighty snailets (*A. maginata*) of an average weight of 3.55±1.10 g were randomly distributed into four dietary treatment groups of 45 snailets per treatment. Each treatment consisted of 3 replicates of 15 snailets per replicate in a completely randomized design. Each replicate was reared in a wooden cage of 0.5×0.5×0.5 m^3 compartments. Sandy loamy soil of 6 cm depth was used as bedding for the snails inside the cages. The test diets: pawpaw leaves (PL), whole lettuce (WL), lettuce waste (LW) and cabbage waste (CW) were offered *ad libitum* to the snailets throughout the experimental period. Water was also presented *ad libitum* in plastic troughs. 5 g of egg shell powder was added to the soil in each compartment weekly to supply calcium.

Data on feed intake was collected daily while there was weekly measurement of body weight, shell length, shell width and shell thickness. Shell length and width were measured with vernier calliper while micrometer screw gauge was used to measure the shell thickness. The trial lasted 20 weeks.

Digestibility trial

At the end of the feeding trial, nine snails per treatment (3 per replicate) were put inside cages devoid of soil but lined with foam as the bedding. They were fed with the same diet as per the feeding trial. Records were taken daily on feed intake and excreta output. Samples of the daily excreta collected were oven-dried at 60°C to constant weight using a Gallenkamp oven to determine dry matter. The digestibility trial lasted 10 days, 3 days for acclimatization and 7 days for excreta collection.

Carcass analysis

A total of 60 snails, 15 per treatment (5 per replicate) was taken at the end of the feeding trial for carcass evaluation. The snails were starved overnight and their weights taken. They were killed by a striking iron rod on the shell carefully. The fluid (haemolymph), visceral, shell and foot (flesh) were then separated and weighed. Parameters calculated were: dressing percentage which is the ratio of foot to live weight, visceral to live weight percent, shell to live weight percent and fluid to live weight percent.

Sensory evaluation of the cooked meat

The snail meat from each treatment was washed with alum and cooked separately in pots containing 3 g of salt dissolved in 300 ml of water at 100°C for 20 min. A twelve–member taste panellist was set up. They were trained prior to serving of the meat. The snail meat from each treatment was served in individual plates and given to the panellist. Drinking water was provided to rinse their mouths after tasting each sample of the meat. There was partitioning in between the panellists in such a way that there was no interaction with one another. Questionnaires were given to the panellist for rating of the samples according to the method of Larmond (1977). The ratings were based on a 9-point hedonic scale of 1(dislike extremely) and 9(like extremely). Evaluation was based on colour, taste, flavour, tenderness, and overall acceptability.

Chemical analysis

Dry matter, crude protein, crude fibre, ash and ether extract of the experimental diets as well as that of the foot of the snails were determined by the method of the Association of Official Analytical Chemists (A.O.A.C, 2005). Value for the nitrogen free extract was obtained by subtracting the sum of the values of crude protein, crude fibre, ether extract and ash from 100%.

Data analysis

All data were subjected to analysis of variance while the treatment means were separated using Duncan multiple range test (S.A.S, 1999).

RESULTS

Proximate composition of test ingredients

The proximate composition of experimental diets is as shown in Table 1. The crude protein of PL was significantly higher than that of the other test diets. Crude fibre and ash followed the pattern WL >PL >LW >CW with CW recording the highest nitrogen free extract (NFE) while PL had the lowest.

Table 2. Performance characteristics of snailets fed the experimental diets.

Parameters (mean values)	Pawpaw leaves (PL)	Whole lettuce WL)	Lettuce waste LW)	Cabbage waste (CW)	SEM
Weekly dry matter feed intake (g)	1.70[b]	2.21[a]	2.10[a]	2.22[a]	0.26
Initial weight (g)	3.53	3.53	3.55	3.57	
Final weight (g)	17.73[b]	30.03[a]	31.25[a]	31.64[a]	1.98
Weekly weight gain (g)	0.71[b]	1.32[a]	1.38[a]	1.40[a]	0.49
Total weight gain (g)	14.20[b]	26.50[a]	27.70[a]	28.10[a]	1.15
Monthly shell length gain (mm)	2.40[b]	2.60[a]	2.55[a]	2.60[a]	0.03
Monthly shell width gain (mm)	2.48[c]	2.85[a]	2.65[b]	2.84[a]	0.05
Monthly shell thickness gain (mm)	0.22[a]	0.24[a]	0.21[a]	0.24[a]	0.00
Mortality (%)	6.67	4.44	2.22	0.00	
Dry matter digestibility (%)	76.85[c]	79.38[b]	81.41[a]	81.95[a]	0.68
Feed conversion ratio	2.39[a]	1.67[b]	1.52[c]	1.58[c]	0.07

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

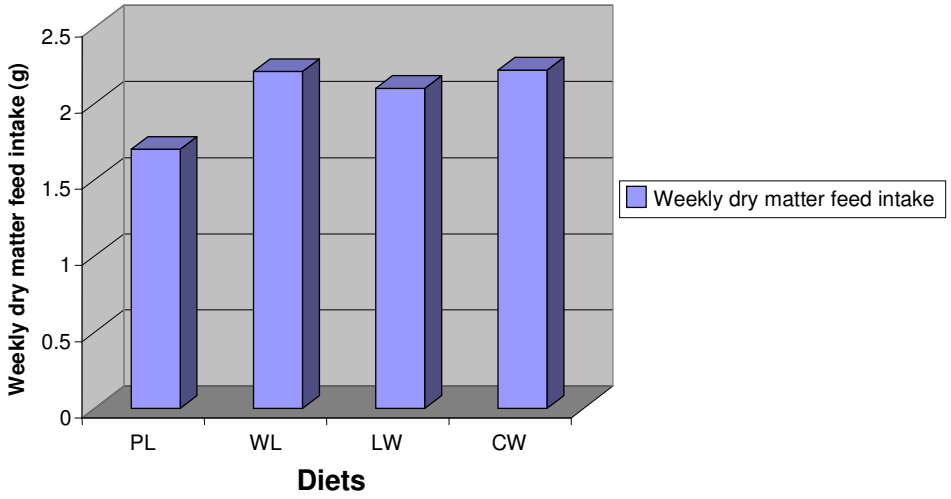

Figure 1. Mean weekly dry matter feed intake of snailets fed the experimental diets.
PL– Pawpaw leaves, WL– Whole lettuce, LW– Lettuce waste, CW– Cabbage waste.

Feeding and growth performance

The result obtained for the performance characteristics of the snailets of African giant land snail fed varieties of plant diets as sole feed ingredients is shown in Table 2. There were no significant differences in the mean weekly dry matter feed intake of snailets on WL, LW, and CW although CW was the most consumed with a weekly DM feed intake of 2.22 g. Snailets on PL had the lowest weekly dry matter feed intake of 1.70 g (Figure 1). There was a sharp decline in feed intake as from the third week which fell in the month of July when there was heavy rainfall and severe cold. Snails on PL were the most affected with several days of low feed consumption. The mean weekly weight gain also follows the same pattern as the mean weekly dry matter feed intake (Figure 2). The statistical analysis showed a significant difference in the feed conversion ratio. Snailets on PL recorded the highest value of 2.39 followed by WL (1.67) while those on LW had the lowest value of 1.52 (Figure 3).

There was an appreciable weight gain by the experimental snails. The variations observed were significant ($P < 0.05$). The respective total weight gains were 28.10, 27.70, 26.50 and 14.20 g for CW, LW, WL and PL, respectively (Table 2).

There was no appreciable difference in the mean monthly shell length increment of snails on WL, LW and CW but snails on PL recorded the least shell length increment. Snails on CW had the highest mean monthly shell width increment which was not significantly different from that of WL, followed by snails on LW while snails on PL recorded the least. There was no significant difference ($P > 0.05$) in the mean monthly shell thickness increment of the snails in all the treatment groups.

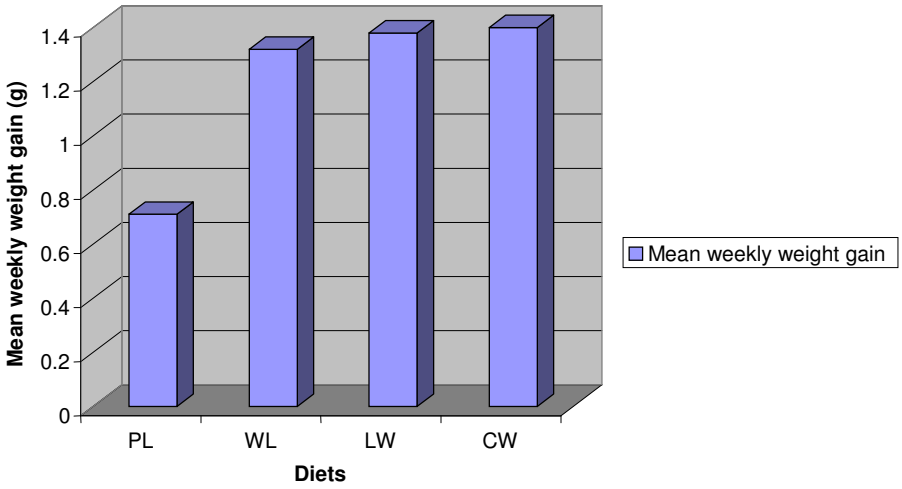

Figure 2. Mean weekly weight gain of snailets fed the experimental diets. PL – Pawpaw leaves, WL – Whole lettuce, LW – Lettuce waste, CW – Cabbage waste.

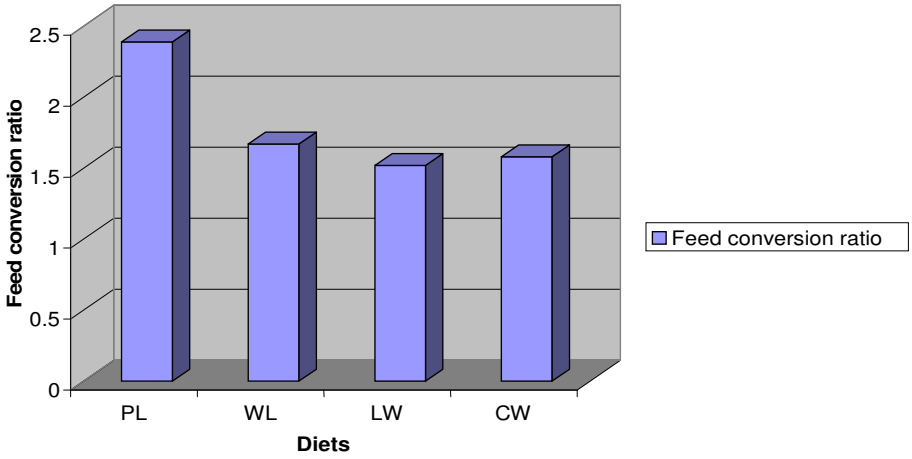

Figure 3. Feed conversion ratio (FCR) of snailets fed the experimental diets. PL– Pawpaw leaves, WL– Whole lettuce, LW– Lettuce waste, CW – Cabbage waste.

The result of the statistical analysis on the dry matter digestibility showed that the treatment effect had appreciable influence ($P < 0.05$) on the dry matter digestibility. The highest value of 81.95% was recorded in CW which was not significantly different from LW, while the least value of 76.85% was observed in PL. No mortality was recorded in snails on CW while the highest mortality of 6.67% was recorded for snails on PL.

Carcass analysis

Treatment effects on the mean weight of the feet (edible portion) were significant ($P < 0.05$) (Table 3). Snails on CW recorded the highest mean weight while the least value was recorded for those on PL. The mean weight of the visceral followed the same pattern as the mean weight of the feet. The shell weight recorded the highest value with snails on CW while the least value was recorded for snails on PL. The highest dressing percentage of 43.42% was obtained for LW although the values were similar to those on WL and CW while the least was recorded for snails on PL (Table 3).

Organoleptic properties

The result of the sensory evaluation revealed that the dietary treatments had no significant effect on all the properties studied ($P > 0.05$). The ratings of colour, taste, flavour, texture and overall acceptability were similar (Table 4).

Table 3. Carcass evaluation of snailets (*A. marginata)* fed experimental diets.

Parameter (mean value)	Pawpaw leaves (PL)	Whole lettuce (WL)	Lettuce waste (LW)	Cabbage waste (CW)	SEM
Number of snails	15	15	15	15	
Live weight (g)	17.22^{b}	28.82^{a}	30.15^{a}	31.60^{a}	2.75
Foot (edible portion) (g)	6.31^{c}	12.35^{b}	12.94^{a}	13.42^{a}	0.87
Visceral (g)	4.20^{c}	6.14^{b}	6.81^{a}	7.64^{a}	0.40
Shell (g)	2.84^{d}	5.86^{b}	5.34^{b}	6.32^{a}	0.52
Haemolymph (ml)	3.87^{c}	4.47^{b}	5.06^{a}	4.22^{b}	0.41
Dressing (%)	36.64^{b}	42.85^{a}	43.42^{a}	42.47^{a}	0.97
Shell/live weight (%)	16.49^{b}	20.33^{a}	17.71^{b}	20.00^{a}	0.78
Visceral/live weight (%)	24.39^{a}	21.30^{d}	22.59^{c}	23.44^{b}	0.53
Haemolymph/live weight (%)	22.47^{a}	15.51^{b}	16.78^{b}	12.94^{c}	1.28

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

Table 4. Organoleptic properties of snail meat from snails fed experimental diets.

Properties	Pawpaw leaves (PL)	Whole lettuce (WL)	Lettuce waste (LW)	Cabbage waste (CW)	SEM
Colour	6.79^{a}	6.81^{a}	6.82^{a}	6.81^{a}	0.23
Taste	7.20^{a}	7.15^{a}	7.11^{a}	7.14^{a}	0.31
Flavour	7.24^{a}	7.35^{a}	7.41^{a}	7.28^{a}	0.28
Texture	6.85^{a}	6.84^{a}	6.59^{a}	6.70^{a}	0.43
Overall acceptability	7.12^{a}	7.09^{a}	7.24^{a}	7.15^{a}	0.26

Means along the same row with the same superscripts are not significantly different ($p < 0.05$).

DISCUSSION

The findings of the study showed that snails feed mostly at night and during the day when there is rainfall and the weather is cool. This observation agreed with the findings of (Amusan and Omidiji, 1999; Akinnusi, 2002). A sharp decline in feed intake was noticed when there was heavy rainfall and severe cold was also reported elsewhere (Ademolu et al., 2004; Hodasi, 1986).

The low weight gained by snails on PL is a reflection of the low feed intake. The generally low weight gained in all the treatments confirms that snails are slow growing animals when compared with other conventional livestock like sheep, goat, broiler and rabbit and this could be attributed to low feed intake, small size and genetic factor (Odukoya, 1998; Akegbejo and Akinnusi, 2000). The low shell length and width increment can also be attributed to poor feed intake in snails on PL.

The highest dry matter digestibility reported in snails fed CW and LW could be as a result of the highest dry matter feed intake and the low fibre content of the feed. Ifut et al. *(*1987) reported that the level of feed intake, method of feed preparation and ration composition are the major factors affecting digestibility. The low dry matter digestibility of snails on PL could be as a result of the higher crude fibre when compared with snails on CW and LW. Adu et al. (2002) attributed the low feed intake of snails fed pawpaw leaves to the high fibre content of pawpaw leaves (7.8%).

The highest mortality observed in snails on PL could be as a result of the explanations given above. However this is still very low when compared with other conventional livestock such as broiler, turkey, sheep, goat, etc (Stievnart, 1992; Akegbejo and Akinnusi, 2000; Amusan et al., 1998).

The highest volume of haemolymph was observed for snails on LW. It can be deduced that LW favoured production of haemolymph more than the other tested ingredients. The sensory evaluation was similar for all the treatments showing that feed had no appreciable effect on the meat quality of snails.

It could be concluded that *A. marginata* could utilize lettuce waste as well as cabbage waste as sole feed ingredient to increase animal protein supply in Nigeria.

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