Journal of American Science

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MARSLAND PRESS
Multidisciplinary Academic Journal Publisher

Nutritional Potential Of Yam Peel (*Discorea rotundata*) As Feed Resource For Growing Snails (*Archachatina marginata*)

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Abstract: Yam peel is a by-product during processing of yam to pounded yam or yam flour and could be used as alternative source energy in the diet of livestock. This study was conducted to determine the effect of inclusion of dry yam peel meal (YP) as partial replacement for maize in the diet of growing Giant African land snail (*Archachatina marginata*) on feed intake, weight gain, meat qualities and cost benefits. Yam peel was included at 0% (YP_1) Control, 25% (YP_2), 50% (YP_3) and 75% (YP_4) as replacement for maize fraction of diet of growing snails. Each dietary treatment was replicated thrice with 10 snails per replicate in a completely randomized design. Parameters measured or calculated were feed intake, weight gain, shell length and width, feed conversion ratio and cost per weight gain among others. Significant differences were observed in the mean total feed intake of the snails fed inclusion levels of yam peel meal in the diets ($P<0.05$) The highest total feed intake of 544.32 g was recorded in YP_1 which was relatively similar to YP_3 while the mean lowest feed intake of 516.46g intake was recorded in YP_4. The result of feed efficiency shows that snails fed 0% YP as replacement for maize fraction of the diet had the best feed efficiency ($P<0.05$) which was not significantly different from YP_3 The morbidity and mortality percent were very low in all the treatments. The highest dressing percentage of 43.57% was recorded in YP_1 ($P<0.05$) which was not significantly different from 43.45 % and 43.13 % in YP_2 and YP_3 respectively. The mean total no of egg laid was significantly influenced by different inclusion levels ($p<0.05$). It could be concluded that weight gain, feed efficiency and dressing percentage were relatively similar in the snails fed control diet and 50% YP. The mean total number of egg laid and the size were not significantly different in the control and 50% inclusion, also the lowest cost per weight gain was recorded in YP_3 containing 50% YP, hence maize fraction of the diet of snails could be replaced up to 50% of yam peel without any adverse effect.
[Popoola, Y.A., Kehinde, A.S., Oladele-Bukola, M.O., Banjoko, O.J. **Nutritional Potential Of Yam Peel (*Discorea rotundata*) As Feed Resource For Growing Snails (*Archachatina marginata*).** *J Am Sci* 2021;17(1):1-5]. ISSN 1545-1003 (print); ISSN 2375-7264 (online). http://www.jofamericanscience.org. 1. doi:10.7537/marsjas170121.01.

Keywords: Dressing percentage, feed efficiency, mortality, snails, reproductive indices, Yam peel

Introduction

Micro-livestock are small-bodied livestock reared mainly for meat and other by-products such as the shell of snails, fur from rabbits. The management practices are simple and they are good ventures for the women, youths and retirees that are looking for other source of income with less stress (Omole *et. al,*2012*)*. Micro-livestock include rabbits, bush rodents, bees, snails, guinea pigs, reptiles, tortoise. Snail meat is tasty and a delicacy with low fat and cholesterol level (Kehinde, 2009; Odeyinka, 2014). The high protein content of snail meat make it an alternative source of animal protein which is important for growth, reproduction and other metabolism activities in the body (Odeyinka, 2014). One of the limiting factors for the increased production of snails is the high cost of feed. Feed constitutes about 50-70% of total cost of production (Hamzat and Longe 2014). Conventional feed ingredients such as maize, sorghum and maize bran are expensive hence there is need to look for alternative feed resources that are readily available at affordable price (Uchegbu *et. al,* 2008; Hamzat and Longe 2014). A lot of works have been done on the use of agro-industrial by products (AIBs) such as cassava peel, brewer dry grains, rice bran and maize cobs in the diet of livestock with encouraging results, resulting in to reduction in the cost of feed (Kehinde, 2009; Hamzat and Longe, 2014). Yam peel is another feed resource that can be used as an alternative ingredient. Yam peel is consumed fresh by sheep and goats without any adverse effect. Yam peel can be sun-dried in order to enhance its utilization. The peel contains 2-6% of crude protein depending on the varieties, the crude fibre ranges between 9-15% (Akinmutimi *et. al.,*2006; Uchegbu *et. al.,*2008).

Yam peel is readily available in all parts of Nigeria with little or no cost. It constitutes environmental hazard where it is not properly utilized. There is paucity of information on the utilization of yam peel in the diet of snails hence the feeding trial was conducted to determine the effect of varying inclusion of dry yam peel in the diet of growing snails on feed intake, weight gain, feed efficiency, carcass analysis and cost per weight gain.

Materials and Method

A total of one hundred and twenty snails of mean weight 78.46± 4.4g were used for the feeding trial. The snails were acclimatized for one week before the commencement of the feeding trial. Yam peel was collected from a restaurant in Ibadan, Oyo state, Nigeria and sun-dried. Dry yam peel was later incorporated with other feedstuffs at 0% (YP_1) Control, 25% (YP_2), 50% (YP_3) and 75% (YP_4) as replacement for maize fraction of diet of growing snails. Each dietary treatment was replicated thrice with 10 snails per replicate in a completely randomized design. The diets were formulated to contain about 24% crude protein and energy of about 2400 kcal/kgME (Table 1).

Table 1: Gross Composition of Experimental Diet.

Ingredient (%)	YP_1 (0% YP)	YP_2 (25% YP)	YP_3 (50% YP)	YP_4 (75%YP)
Maize	22.00	16.5	11	5.5
Soya bean meal	10.5	10.5	10.5	10.5
Yam peel	0.0	5.5	11	16.5
*Others fixed ingredients	67.5	67.5	67.5	67.5
Total	**100.0**	**100.0**	**100.0**	**100.0**
Calculated analysis				
Crude protein (%)	24.53	24.18	23.72	23.19
Metabolizable energy (kcal/KgME)	2429.1	2419.11	2400.23	2384.44

*Other fixed ingredients: G.N.C. – 19.0; rice-bran -17.5; Fish meal -3; Bone meal -2.15; Oyster shell-9.5, Brewer dry grain-15.8; Methionine - 0.1; Lysine - 0.1; Premix 0.25; Salt-0.1

Feed intake and weight gain were measured on daily and weekly basis with the use of digital weighing balance. Feed intake was calculated by subtracting the left-over feed from the feed given while the weight gain was calculated by deducting the initial weight from the final weight. Shell length and width were measured on weekly basis with vernier caliper. Micrometer screw gauge was used to measured the shell thickness on weekly basis. Feed conversion ratio were calculated as the ratio of feed intake to weight gain. Feed cost and cost per weight gain were also calculated. Total number of egg s laid and hatched were calculated. Feed conversion ratio were calculated as the ratio of feed intake to weight gain. Carcass analysis was carried out at the end of the feeding trial by randomly selecting eight snails from each treatment and weighed separately. Each snail was killed by striking the shell with a club. The shell, foot and viscerals were separated and weighed separately. The meat samples (feet) were cooked separately for 18 minutes without salt and 120ml of water was added to the meat before cooking. The meat samples (which were coded) were served to ten panelists to assess for organoleptic properties of the snail meat according to the methods of (Kehinde, 2009) in which case the rating were 1, 2, 3, 4, 5, 6, 7, 8 and 9 correspond to Like extremely, Like very much, Like moderately, Like slightly, Neither like nor dislike, Dislike slightly, Dislike moderately, Dislike very much, and Dislike extremely, respectively. The meat organoleptic properties were rated for colour, appearance, flavor, texture, taste and overall acceptability. The chemical composition of the experimental diets was done according to the method of A.O.A.C. (1990). All data were subjected to statistical analysis using analysis of variance and the means were separated if they are significantly different using Duncan Multiple Range Test (SAS, 1999).

Results and Discussion

The proximate composition of the test ingredient and experimental diets are shown in table 1. The crude protein content of the yam was 4.87 as shown in table 2. The protein reported is relative similar to the report of Uchewa, *et. al.,* (2014). The crude protein of the experimental diets are in line with the recommended values as observed by Omole, (2003).

Table 2: Determined Proximate Composition of the yam peel and the Experimental diets

Parameters	YP	YP_1 (0% YP)	YP_2 (25% YP)	YP_3 (50% YP)	YP_4 (75%YP)
Dry Matter	95.34	94.24	93.98	94.49	93.90
Crude Protein	4.89	24.09	23.98	23.51	23.42
Crude Fibre	12.24	10.67	10.89	10.99	11.07
Ether Extract	3.34	4.24	4.18	4.12	4.02
Ash	9.78	9.55	9.49	9.27	9.14
Nitrogen Free Extract	69.75	51.45	51.56	52.11	52.35

YP- Yam peel

There was significant difference in the mean total feed intake of the snails fed experimental diets ($P<0.05$). The highest total feed intake of 723.72 g was recorded in YP_1 which was not significantly different from YP_2 while the mean lowest feed intake of 710.57 g intake was recorded in YP_4 as shown in Table 3. The significant difference was observed in the mean total weight gain ($P<0.05$). The highest mean weight gain of 166.76 g was recorded in YP_1 which was not significant ($P>0.05$) difference from YP_3. The lowest mean weight gain of 138.78 g was recorded in snail fed highest level of YP in the diet (YP_4). The result of feed efficiency shows that snails fed 0% YP as replacement for maize fraction of the diet had the best feed efficiency ($P<0.05$) which was not significantly different from YP_3 which implies that yam peel could be used to replace 50% of the maize fraction of the diet of snail without any appreciable loss in growth rate. No mortality was recorded in the course of the feeding trial which signifies that yam peel could be used as alternative feed resource.

Table 3 Growth performance of snails fed different inclusion levels of yam peel in the diet

Parameters (Means)	YP_1 (0% YP)	YP_2 (25% YP)	YP_3 (50% YP)	YP_4 (75%YP)	±SEM
Initial weight (g)	76.45	75.87	74.67	75.49	3.78
Final weight (g)	243.21^{a}	242.34^{a}	238.93^{a}	214.27^{b}	8.98
Total weight gain (g)	166.76^{a}	166.47^{a}	164.26^{a}	138.78^{b}	6.71
Total feed intake (g)	723.72^{a}	724.12^{a}	719.45^{b}	710.57^{c}	4.13
Feed conversion ratio	4.34^{b}	4.35^{b}	4.38^{b}	5.12^{a}	0.25
Shell length increment (mm)	11.93	11.90	11.09	10.76	1.45
Shell width increment (mm)	9.75	9.76	9.72	9.70	0.72
Shell thickness increment (mm)	0.12	0.12	0.11	0.11	0.03
Mortality (Number)	0	0	0	0	
Dressing percent (%)	44.89^{a}	43.98^{a}	42.99^{ab}	40.57^{b}	1.94
Cost/weight gain (N/kg)	398.45^{a}	392.56^{b}	387.78^{c}	389.95^{bc}	3.68
Shell/live weight (%)	24.47	24.57	24.43	24.01	1.39

Means along rows with different superscript are significantly different from each other ($P<0.05$)

No significant differences were observed in the shell length, width and thickness of the snails fed diet containing varying levels of yam peel as replacement for maize ($P>0.05$). The results of feed intake and weight gain recorded in snails fed 0% and 50% YP as replacement for maize were similar to the observation of Omole (2003) and Kehinde (2009). The lowest weight gain recorded at highest inclusion level of YP could be due to lowest feed intake recorded in YP_4 as it has been established Esonu, (2000) that feed intake has positive correlation with growth rate of an animal also the protein level and energy levels reduced as the level of yam peel increased in the diets. The lowest feed intake and weight gain recorded in YP_4 was in accordance with report of Kehinde (2009) and Hamzat and Longe (2014) who reported low feed and weight at highest inclusion level of Kolanut pod and dry cassava peel meal respectively in the diet of snails. Strict adherence to management practices could be responsible for zero mortality recorded, also it has been reported that snails are hardy animal (Omole *et. al,*2012*)*. As shown in Table 3, the dressing percentage was influenced by dietary treatments. The highest dressing percentage of 44.89% was recorded in YP_1 ($P<0.05$) which was not significantly different from 43.98 % and 42.99 % in YP_2 and YP_3 respectively. The dressing percentage observed in YP_1 and YP_3 were in agreement with the report of Kehinde (2009) and Hamzat and Longe (2014). The lowest dressing percentage of 38.56% was recorded in YP_4. The results of cost analysis shows that the cost per kg feed (CPW) reduced as the level of YP in the diet

increased from YP_1 to YP_3 as shown in YP_3 (Table 3). The highest cost per weight gain was observed in the control while the lowest cost per weight gain was recorded in YP_3. The lowest CPW observed in YP_3 implies that the appropriate level of inclusion of yam peel is at 50% replacement.

Table 4 Reproductive performance of Snail fed diets containing snail shell

Parameters (Mean values)	YP_1 (0% YP)	YP_2 (25% YP)	YP_3 (50% YP)	YP_4 (75%YP)	±S.E.M.
Total egg laid (Number)	16.12 [a]	16.03a	15.45ab	13.34b	1.24
Weight of the eggs (g)	5.89a	5.76a	5.23a	4.23b	0.56
Egg shell length (mm)	4.59	4.42	4.40	4.10	0.34
Egg shell width (mm)	3.71	3.70	3.64	3.34	0.21
Incubation period (day)	31.23	31.22	31.21	31.20	1.32
Weight of hatchling at day old (g)	5.79	5.83	5.74	5.34	0.12
Shell length hatchling (mm)	3.60	3.62	3.63	3.61	0.03
Shell width hatchling (mm)	2.85	2.84	2.84	2.82	0.02

Means along rows with different superscript are significantly different from each other (P<0,05)

The mean total no of egg laid was significantly influenced by different inclusion levels of yam peel (p<0.05), YP1,YP2 and YP3 were not significantly affected by the dietary treatments (p>0,05) (Table 4). The mean weight of the eggs also was not significantly different from one another across the treatments (p>0,05), the lowest value was observed in YP4. The value reported in the control diet and 50 % inclusion was relatively similar to that of Ajasin, *et. al.,* (2010). The weight of the eggs was also affected by dietary treatments. The highest weight was observed in YP1 which was relatively the same with that of YP3 while the lowest weight of the egg laid was observed 4 in YP4 as shown in table. The mean egg shell length and width were relatively similar across the treatments (p>0,05). The mean incubation period of the snails in all the treatments was not affected by dietary treatments (p>0,05). The incubation period reported was similar to the observation of several authors who reported incubation period of 30 to 32 days (Omole *et. al.,*2012; Popoola, *et. al.,* 2019). The mean weight of the hatchlings at day old was significantly different from one another across the treatments (p>0,05). The results of the weight follow the same patter with the size of the eggs laid as shown in the table and this in agreement with the reports of Kehinde, (2009) who concluded that there is positive correlation between the size of the egg laid and the size of the hatchlings. The mean egg shell length and width of the hatchlings were relatively the same across the treatments.

Table 5: Organoleptic properties of the meat of snails fed different inclusion levels of yam peel in the diet

Mean Score Values	YP_1 (0% YP)	YP_2 (25% YP)	YP_3 (50% YP)	YP_4 (75%YP)	±S.E.M.
Color	6.74	6.78	6.76	6.77	0.44
Taste	7.24	7.23	7.24	7.27	0.46
Flavour	6.76	6.74	6.76	6.78	0.47
Texture	6.69	6.68	6.69	6.68	0.45
General Acceptability	7.60	7.62	7.63	7.64	0.6

Means with the same superscripts are not significantly different (P > 0.05).

The results of the organoleptic properties of the meat shows that the there was no significant difference in the taste of the meat (P>0.05) as shown in table 5, the values ranged between 7.23 and 7.27. The color, flavor and texture of the meat were not influenced by (P>0.05) the varying inclusion of YP in the diets (Table 5) The generally acceptability of the meat as observed by the panelists was not significant different form one another. The results of organoleptic property of the meat also buttressed the fact that yam peel could be used to replace maize without effect on meat qualities.

Conclusion

It could be concluded that weight gain, feed efficiency and dressing percentage were relatively similar in the snails fed control diet and 50% YP. The mean total number of egg laid and the size were not significantly different in the control and 50% and 50% inclusion, also the lowest cost per weight gain was recorded in YP_3 containing 50% YP hence maize fraction of the diet of snails could be replaced up to 50% of yam peel without any adverse effect. It is recommended that breeding snails can tolerate up to 50% yam peel as partial replacement for maize.

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1/21/2021