

**Effect of cassava peel based diets on performance and Meat quantity of snail
(*Archachatina marginata* Swainson).**

Abstract

The effect of cassava peel (CPL) incorporation (0,5,10 and 15%) in the diets of growing snails (average initial weight $66.0 \pm 0.15g$) on the growth performance, shell morphological changes, digestibility of nutrients, carcass yield and mineral element composition of the meat. The nutritional trial adopted four T₁ (0%), T₂ (5%), T₃ (10%) and T₄ (15%) almost isocaloric and isonitrogenous diets. Two hundred and forty growing snails were randomly allotted at 60 snails/treatment, while each treatment was replicated three times. The digestibility of nutrients was evaluated at the 12th of the fourteen week trial. Data collected were analyzed in a complete randomized design using (ANOVA), significant difference among the means was separated using Duncan's multiple range test. Cassava peel is rich in NFE (70.0%), low in crude protein (3.94%), while the four diets held almost equal proximate composition. Feed intake increased (P<0.05) from T₁ to T₄ and T₁ (control) had the best (P<0.05) carcass yield. Survivability of snails at all levels was 100%. Highest dry matter digestibility (70.01%) was obtained in T₁; the digestibility of other nutrients also reduced (P< 0.05) with CPL incorporation. Meat mineral composition was not compromised by the treatments. Cassava peel based diet was favorably utilized at 15% CPL incorporation without any adverse effect on feed intake, growth, meat quality and carcass yield, farmers should adopt it.

Keywords: Growth performance, Nutrients digestibility, snail meat, cassava peel, growing snail

Introduction

Snail farming has become a promising job creation and empowerment venture that is engaging many farmers as a means of promoting good health and job creation policy of the Federal Government of Nigeria (Kingsley, 2019). It is very common in peri-urban settlements to find backyard micro-livestock rearing and Snail domestication inclusive (Omole, 2002) .

There are various reasons for the increasing acceptability of snail farming such as no noise or air pollution, low capital outlay and facility unlike poultry and other livestock, that are capital intensive (Kehinde, 2009).

Snail meat is very beneficial to its consumers, due to its low level of fat (1.35%), cholesterol (0.5 mg /100mg), low density lipid (3.08 mg/ 100g), High density lipid (1.86 mg/ 100mg) and free fatty Acid (3.50mg/100mg) Ebenso et al (2019) . It was further buttressed by Babalola and Akinsoyinu (2009). That snail meat is leaner, juicy and delicious.

The full benefits of the good attributes of snails cannot be explored, if snail supply is left to the gatherers, this has prompted the Forestry Research Institute of Nigeria to lead in the captive rearing of snail, formulation of least cost snail ration and reduction of maturity period. It is also active in the supply of foundation stock, in order to salvage snail from imminent extinction (Kehinde, 2019).

43 Feeding has been a big threat to the livestock industry, because it has been variously computed
44 that feeding constitute about 70% of the cost of animal production (Oluyemi, and Robert, 2000).
45 Then many alternative feedstuffs that are cheaper and available throughout the year have been
46 used to promote production and sustain the chemical content of snail meat (Bobadoye et al.,
47 2010), due to the feeding habit of snail as a monogastric herbivore, trials have been conducted on
48 the adoption of mulberry leaf, cassava peel, leaf, sieviate, chaff, gliricidia and leuceana leaf in
49 the feeding of snail. This was done to screen the plants and assess their safety in snail feeding.

50 It is an established fact that snail cannot subsist only on forages, they perform better on
51 compounded ration. A trial by (Omole, 2002) on the use of plant materials to feed snail showed a
52 ridiculous low dressing percentage of less than 40%. In order to optimize forages in snail
53 feeding, they are incorporated at different levels which must be determined (Akinnusi et al.,
54 2019). In this study cassava peel was systematically included in the feed of snail at 0, 5, 10 and
55 15% to assess its effect on performance, nutrient digestibility and quality of meat. The meat
56 quality is important because the consumer cherishes it as a source of protein and treatment of
57 ailments.

58 **Materials and method**

59 **Experimental site**

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

62

63 **Experimental animals**

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

67

68 **Management of experimental snails**

69 The snails were housed in concrete pens of dimension $0.25 \times 0.25 \times 1$ m³ for growing snails. The
70 pen was provided with concrete drinkers and feeders. Water was offered throughout the trial,
71 while known quantity of feed was offered, they were fed in the evening, due to their nocturnal
72 nature. The trial lasted for fourteen weeks.

73

74 **Growth performance evaluation**

75 Known quantity of feed was offered to the snails everyday and the left over was measured to
76 determine feed intake, weight change in the treatment was determined on a weekly basis, by
77 using well calibrated electric weighing balance. FCR was the evaluated by dividing the feed
78 intake by the weight gain.

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

81

82 **Nutrient digestibility determination.**

83 This was carried out at the end of the 12th week of a 14 week trial. Four snails from each
84 replicate were moved to the constructed wooden metabolic cage of dimension $0.2 \times 0.2 \times 0.5$ m³,
85 which was lined with a thin foam, for easy collection of voided excreta, the excreta voided were

86 accurately measured on a daily basis, dried in hot air oven at 105bc until the moisture content
87 was constant, then allowed to cool, ground and stored for subsequent proximate analysis
88 determination, by the methods of A.O.A.C (2005)

89 Proximate and macronutrient analysis of Snail meat

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

94 The level of calcium, potassium and sodium was determined by the method of A.C, Arc (995.11)
95 by the use of the Jen way digital flame photo meter (PF86 model), Phosphorus content of the
96 meat sample was determined by the use of spectro photometric method (A.O.A.C 975.11) and
97 Magnesium by A.O.A.C (975.23)

98 Statistical analysis

99 Data collected were subjected to Analysis of variance (ANOVA), using Complete Randomized
100 Design while significant means were separated using Duncan’s Multiple Range Test of (1995) as
101 explained by Sam *et al.*, (2019).

102 Results

103 **Table 1**; shows the gross composition of cassava peel based diets, with cassava peel inclusion at
104 (0, 5, 10, and 15%) in the diet of snails. The diets were compounded to meet the nutritional need
105 of growers snail. The diets had almost the same levels of crude protein (23.34- 23.98%) and
106 Metabolizable energy (2390- 2401kcal /kg)

107 **Table 1:** Gross composition of cassava peel based diets fed to snail.

Ingredients %	Treatments			
	T ₁	T ₂	T ₃	T ₄
Maize	22.50	21.60	21.10	21.10
Maize Offal	10.00	9.00	9.00	7.00
Wheal Offal	10.85	7.35	4.35	1.35
Palm Kernel Cake	5.00	5.00	3.50	1.10
Soya bean cake	25.70	22.10	22.10	22.00
Groundnut cake	10.00	14.00	14.00	16.50
Fish meal	4.00	4.00	4.00	4.00
Oyster shell	9.70	9.70	9.70	9.70
Bone meal	2.15	2.15	2.15	2.15
Grower premix	0.10	0.10	0.10	0.10
Cassava peel	0.00	5.00	10.00	15.0
Estimated Nutrients Composition crude protein	23.98	23.45	23.34	23.38

Metabolizable Energy (Kcal/kg) 2400 2399 2401 2390

108

109 Table 2: Shows the proximate composition of cassava peel (CPL) and cassava peel based diets. It
 110 revealed the crude protein, crude fiber, ether extract, Ash and Nitrogen free extract. The diet had
 111 the following proximate constituents, crude protein (23.34 – 23.98%) crude fiber (6.45-6.91%)
 112 ether extract (20.18- 3.48%), Ash (8,71- 8,96%) and NFE (57.15-57.897). Cassava peel was
 113 high in fiber (18.21%) and low in crude protein (3.94%).

114 **Table 2:** Proximate composition of cassava of cassava peel (CPC) and cassava peel based diets
 115 fed to growing snails.

	Treatments				
	CPL	T ₁	T ₂	T ₃	T ₄
Proximate Parameters %					
Dry matter	92.00	92.15	92.83	92.45	93.01
Crude protein	3.94	23.98	23.45	22.34	23.38
Crude fibre	13.21	6.45	6.62	6.91	6.97
Ether Extract	1.03	3.48	3.31	3.26	3.18
Ash %	3.82	8.94	8.96	8.71	8.65
NFE	70.00	57.15	57.86	57.78	57.84

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117 Growth performance indices were shown on table 3, this revealed, the feed intake, weight gain,
 118 shell morphological changes and cost per gram weight gain. Initial weight of the snail (66.50 –
 119 66.75g), final weight gain (141.74 – 150.31g), shell thickness increment (0.05mm), shell length
 120 increment were not significantly varied. Highest daily feed intake was recorded for T₄ (42.00g)
 121 and least in the control treatment (35.95g), however, better (P<0.05) and comparable feed
 122 conversion value were recorded in T₁, T₂, and T₃.

123 Carcass yield was significantly varied in all the treatments, with the best (P<0.05) performance
 124 obtained in T₃ with 10% of cassava peel inclusion.

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130 **Table 3:** Growth performance indices of snail fed cassava peel based diets.

	T ₁	T ₂	T ₃	T ₄	SEM±
Initial body weight (g)	66.75	66.75	66.500	66.60	3.20
Final body weight (g)	144.50	150.39	149.04	141.74	2.50

Daily weight gain (g)	6.50 ^{ab}	6.97 ^a	6.92 ^a	6.27 ^b	0.05
Daily feed intake	35.95 ^c	38.21 ^a	38.05 ^a	42.00 ^a	0.70
Feed conversion ratio	5.43 ^b	5.41 ^b	5.43 ^a	6.01 ^a	0.60
Dressing percentage (%)	44.32 ^b	44.09 ^b	44.77 ^a	42.50 ^c	0.40
Offal weight (g)	22.67 ^b	22.83 ^b	22.88 ^b	25.13 ^b	0.30
Shell weight (g)	33.01 ^a	33.09 ^b	32.47 ^b	31.39 ^c	0.50
Shell thickness increment (mm)	0.05	0.05	0.05	0.05	-
Shell length increment (mm)	0.07	0.25	0.24	0.25	0.06
Shell width increment (mm)	6.21	6.25	6.28	6.29	0.29
Mortality					

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132 Table 4- Shows the digestibility of nutrients, such as crude protein, crude fiber, ether extract and
 133 nitrogen free extract, which were all significantly ($P < 0.05$) Varied – best performance in terms of
 134 nutrients digestibility was recorded in the control treatment (T_1).

135 Table 4: Nutrients digestibility of snails feed cassava peel based diets.

	T_1 (0%)	T_2 (5%)	T_3 (10%)	T_4 (15%)	SEM \pm
Nutrient					
Dry matter	70.01 ^a	69.05 ^a	64.05 ^c	64.00 ^b	1.1
Crude protein	69.00 ^b	69.05 ^a	65.00 ^a	64.99 ^b	1.0
Crude fibre	62.00 ^c	58.69 ^b	58.67 ^b	58.00 ^b	1.2
Ether Extract	62.00 ^a	61.00 ^b	59.00 ^c	56.66 ^b	0.75
Nitrogen Free extract	62.33 ^a	61.00 ^b	60.00 ^b	60.00 ^b	2.0

136

137 Table 5, shows the mineral profile and pH values of snail meat fed CPL based diets. The level of
 138 calcium (105.00 -105.7mg/100g), potassium (0.049 – 0.06mg/100g), Iron (1.88 – 1.99mg/100g)
 139 Phosphorus (22.40 – 22.65mg/100g), Copper (0.66 – 0.71mg/100g), Sodium (1.20 –
 140 1.29mg/100g) and pH (9.40) were not significantly ($P < 0.05$) influenced by the treatments.

141 Table 5: Mineral profile of meat of snails fed cassava peel based diets.

Parameters mineral Element	T_1 (0%)	T_2 (5%)	T_3 (10%)	T_4 (15%)	SEM \pm
Calcium (mg/100g)	103.35	105.70	105.45	105.00	0.5
Potassium (mg/100g)	49.00	50.00	60.00	54.00	2.0
Iron (mg/100g)	1.99	1.98	1.99	1.88	0.3
Phosphorus (mg/100g)	22.50	22.60	22.65	22.40	0.10
Copper (mg/100g)	0.69	0.70	0.91	0.66	0.10
Sodium (mg/100g)	1.27	1.28	1.29	1.20	0.10
PH	9.40	9.40	9.40	9.40	

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143 Discussions

144 The gross composition of cassava peel based diets fed to growing snail showed the inclusion of
 145 cassava peel into four almost isocaloric and isonitrogenous diets, the diets were formulated to

146 meet the nutritional needs of growing snails, based on the recommendation of Omole (2002), that
147 snails require diets that are high in crude protein, for proper metabolism and growth
148 performance, it also impacted on the carcass yield. It was evident from the findings of Kehinde
149 (2019), that snail cannot subsist on forage alone. This agreed with the observation of Ayoola and
150 Adeyeye (2010) and Mogbo et al (2014), when they stated that snail feed must be high in protein
151 to promote growth and shell thickness.

152 Snail shell formation and integrity are important survivability index, hence appropriate inclusion
153 of Oyster shell, bone meal and mineral premix are important. It is common experience for snail
154 to leak each others shell or for nutrients to irrigate from the foot and haemolymph, which
155 resulted to weigh loss confirmation of the importance of snail shell to survival.

156 The diets and CPL were analyzed for their proximate composition, so as to ascertain their levels
157 of dry matter and constituent crude protein, crude fiber, ether extract, ash and NFE. The diets had
158 (23.34 – 23.98%) crude protein, this range agreed with the recommended adequate level
159 suggested by Sam et al (2014). The adoption of cassava peel as energy source was limited by its
160 low level of crude protein (3.94%) and thus requires supplementation from protein concentrates
161 (Akintola and Tewe 2001 and Akinfela et al 2013). Cassava peel is also high in crude fiber
162 (13.21%), this has been implicated in nutrient digestibility.

163 Daily weight gain was best in T₂ and T₃, while values in T₁ and T₄ compared (P<0.05). Highest
164 feed intake (P<0.05) was recorded in T₄, because of the compensatory feed intake by the snails,
165 due to low bulk density of the diets fed to snail in T₄ and since animals feed to meet their need
166 for growth, cell formation and survival (Kehinde 2009). Feed conversion was least and
167 comparable (P<0.05) in T₁ to T₃, while diet T₄ was least utilized, a confirmation of the view of
168 Akinfala and Tewe (2001) that cassava products are high in fiber and causes a lot of nutrient
169 dilution thus rendering such diet poorly utilized.

170 Dressing percentage for the treatments (42.50 – 44.77%) were significantly varied, best (P<0.05)
171 carcass yield was obtained in T₃, however, all the values obtained were above the threshold of
172 below 40% dressing percentage obtained for growing snails fed forages (Omole, 2002), due to
173 their inadequacy of nutrients to meet snail metabolism.

174 Offals weight increased as the level of cassava peel in the diet increased, highest (P<0.05) was
175 obtained in T₄, which could be attributed to the muscular activities of the intestine, to digest
176 fiber. Shell integrity was sustained at all levels, this reflected in the comparable (P<0.05) shell
177 thickness increment, shell length increment and shell width increment and guaranteed
178 survivability (100%) recorded in all the treatments, since shell in protects all the internal body
179 parts of snail, in practice, snail with broken shell rarely survive (Akinnusi, 2019).

180 The digestibility of dry matter reduced from T₁ to T₄, which is directly related to the reduced
181 bulk density of cassava peel based diets (Okon et al 2016), which can be enhanced by the
182 fermentation of cassava peel, to break the cell wall, improve its digestibility and throughout
183 protein enrichment (Kehinde et al 2019).

184 This trial revealed that snail meat is rich in evaluated nutrients, such as Ca (105–
185 105.700mg/100g), K (49.00 – 60.00mg/100g), Fe (1.88 – 199mg/100g), P(22.40–22.65mg/100g)
186 Cu (0.66 – 0.71mg/100g) and Na (1.20 – 129mg/100g): these values agreed with the findings of

187 Eruvbetine (2012), Akinnusi et al (2019). It could be implied that the benefit of eating snail meat
188 were not lost, due to the adequacy of these nutrients in snail raised on cassava peel based diets.

189 **Conclusion**

190 It could be stated that cassava peel is low in crude protein, high in crude fiber and Nitrogen Free
191 Extract. Growing Snail utilized cassava peel based diet without any deleterious effect on the
192 shell, carcass yield, survival and nutrients content of the snail meat. Cassava peel can be properly
193 utilized by snail at inclusion level of 15%.

194 **Recommendation**

195 Snail farmers should adopt the use of cassava peel in the diets of snail, because it is available all
196 year round, its use will keep the environment clean and promote snail production.

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