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The Influence of Residual Linamarin in Dried Cassava Peel Meal on Carcass Yield and Gut Characteristics of Weaner Rabbits

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ABSTRACT

A feeding trial was conducted to assess the effects of residual linamarin on carcass yield and gut characteristics of rabbits fed diets containing sun dried cassava peel meal (CPM). The experiment was conducted using a completely randomized design involving four diets of 16% crude protein. The CPM was included at 0, 30, 35 and 40% levels. Rabbits used for the studies were fed for 42 days and were all serially slaughtered fortnightly. During each slaughter, two rabbits were randomly selected, starved overnight and slaughtered. They were skinned, eviscerated and the carcasses cut up into parts and weighed. The guts were separated into; small intestine, large intestine, caecum and appendix. Each of the visceral parts were weighed and their length recorded. The results showed that chest and back were significantly ($P<0.05$) affected by dietary treatments. Also the carcass yield obtained over time of slaughter indicated a significant ($P<0.05$) effect on the weight of the back. The time of slaughter x diet interaction effect showed no significant difference on all parameters. The results of the guts showed that, dietary influence were only obtained on the weights of the caeca ($P<0.001$) and appendix ($P<0.05$). There were significant diferences on the weights of large intestine ($P<0.05$), caeca ($P<0.01$) and appendix ($P<0.001$) over the period of slaughter. There is also a highly significant ($P<0.001$) difference in the length of the caeca. The results of the interaction effect on time of slaughter x diet for all the visceral parts (guts) measured showed a highly significant ($P<0.001$) interaction effect on the weight of the caeca and that of the small intestine ($P<0.05$). The studies indicated that despite sun drying, linamarin, a cyanogenic glucosides still has some potential toxic effects as manifested on the carcass yield, large intestine, caeca and appendix. It is thus, suggested that prolonged feeding of CPM must be investigated to safeguard against poisoning. It might also affect caecotrophy in the caeca and the absorption of nutrients in the appendix.
Keywords: Linamarin, gut characteristics, dried cassava peels, rabbits

1. Introduction

The problem of increasing feed cost in monogastric animal production is an age-long one for which cheaper alternative feedstuffs have been developed to replaced the expensive conventional ones. One of such alternatives for potential replacement of maize in animal diets is the processed cassava peel meal. Cassava peel is the outer cover of the tuber, which is usually removed manually with knife with little or no pulp in the process of turning the raw pulp into the various human foods such as gari, fufu lafun and tafioca among others in many tropical countries (IITA, 1990). It is estimated that approximately 4 million tonnes of cassava peeling are annually produced as a by-product in Nigeria alone during the processing of cassava roots. This offer tremendous potentials as a cheap source of food energy for animals, provided it is well balanced with other nutrients (Hahn, 1988). As a waste product, it especially constitutes a nuisance from the point of view of refuse disposal and environmental management. Their large-scale use, according to Obioha and Anikwe (1982), would undoubtedly recycle such waste to an utilisable feed for livestock (especially rabbits). Unlike the whole roots, the peel is not in any demand for human consumption. Its chemical composition; 5.2-6.5 % CP, 64-73 % NFE (Obioha and Anikwe, 1982., Aduku, 1993) is yet another important consideration for its recommendation as an animal feed. Apart from the lower values of crude protein and energy of the peel relative to those of maize, the greatest limitation in the use of cassava peel as a sustitute for maize is that of its hydrocyanic acid (HCN) content which is harmful to the monogastrics (Salami and Odunsi, 2003). Studies have shown that HCN concentration is greatly reduce by any one of these methods; drying, ensilage, fermentation, boiling. Esonu and Udedibie, 1993., Isaac *et al.,* 2001 and Muhammad *et al*., 2003, achieved some successes when sun dried cassava peel meal (CPM) was fed to rabbits. Adegbola and Oduozo (1997) and Agunbiade *et al.* (1999), obtained considerable successes when they fed fermented and unfermented and fortified CPM to rabbits. The later reported up to 60%CPM inclusion in the diet. Omole (1988) indicated that, inclusion of CPM could be as high as 50 % with palm oil supplementation. The influence of sun dried CPM on performance and organ weights of serially slaughtered rabbits, was studied by Muhammad *et al.,* (2003) and found no significant difference during the first slaughter (2-weeks of feeding) but the weight of the liver increased ($P<0.05$) during the second slaughter i.e. after the fourth week of feeding. It is against this background that, this study aims at evaluating the toxic potentials of residual linamarin in sun dried cassava peel meal on the carcass yield and gut characteristics of growing rabbits.

2. MATERIALS AND METHODS

2.2 Site of the experiment

The experiment was conducted at the Teaching and Research Farm of the Abubakar Tafawa Balewa University, Bauchi. Bauchi lies on10^{o}18′57″N and 09^{o}50′39″ E, its mean humidity is highest in August (66.50%) and lowest in February (16.50%). The mean annual rainfall ranges between 800 to 900mm. The climate is characterized by two seasons (wet and dry) which extends from May to June and from September to October respectively (BASDP, 1996). April is the hottest month of the year.

2.3 Processing of the experimental material

Fresh cassava peels (60506 local cassava variety) were obtained from local farmers who locally processed cassava pulp into flour. The volume reguired were collected and sun dried on concrete floor for 3 days around March. Each day, the peel was turned during the day up to five times to ensure even dryness. The dried peel was milled by use of “Piston and Mortar” to form the cassava peel meal. It was then stored in bags until when needed for the experiment.

2.4 Experimental Diets and Plan of Experiment

Apart from the cassava peels and soyabean meal which were sourced from Jannaret village in Mangu LGA and Jos Plateeu State respectively, all other feed ingredients used in the experiment were obtained from Muda Lawal Market in Bauchi. The diets used for the study were formulated to meet the 16 per cent crude protein requirement of growing rabbits. The four diets contained the same amount of bonemeal, salt and vitamin-mineral premix. The variable ingredients were maize, soyabean meal and maize offal. The cassava peel meal was included at 0, 30, 35 and 40% levels to give four experimental diets (I, II, III and IV). The components of the four diets are shown in Table 2. The design of the experiment was the completely randomised design.

2.5 Animal experiment and their Management

Twenty-four Mongrel grower rabbits of an average weight of 1.27kg were randomly assigned to the four diets with six rabbits per treatment (diet). The six rabbits were placed in three replicates of two rabbits each. The rabbits were housed in cages. One week prior to the arrival of the rabbits, the cage and the pen-house were disinfected with lzal^{R}. Also the feeders and drinkers were washed and disinfected. The rabbits after arrivals were weighed and randomly allocated to the treatments. They were vaccinated with ivomec^{R} and were fed a pre-experimental diet of grower mash for a seven day adjustment period. The rabbits were then fed the experimental diets *ad libitum* in plastic feeders and they had access to continuous water supply in plastic drinkers which were occasionally washed and dried.

All other factors apart, from diets were the same throughout the experimental period which lasted for 42 days. The rabbit were fed twice daily in the morning and afternoon. Wasted and leftover feed were recovered in the morning each day and recorded.

3. Data Collection

Rabbits were weighed at weekly interval to observe body weight changes using an Electric Digital Scale. Two rabbits from each of the four treatments were randomly selected fortnightly, starved overnight, weighed and slaughtered the following morning. The rabbits were individually weighed and killed by severing their jugular veins, bled and dressed by skinning (removal of pelt). All the rabbits were serially slaughtered at the end of the experiment. Measurements were taken of the live weight, dressing percentage and weights of the visceral organs; heart, liver, lungs, spleen and kidneys and recorded as per cent body weight.

The carcass parts (shoulder, back, chest, thigh and rest of the body) were weighed and recorded. The intestinal and caecal contents were removed by pressing in-between two fingers after which the various parts were separated into; small intestine, large intestine, caeca and appendix. The various parts were then weighed using an Electronic Digital Scale, while the lengths were measured using plastic ruler. Data so generated were subjected to analysis of variance technique, as described by Steel and Torrie (1984). Means were compared and separated using Duncan multiple Range Test.

4. RESULTS AND DISCUSSION

The dressing percentage obtained in rabbits slaughtered after 2 weeks of the study ranged from 59.5 to 66.9%. These are similar to what was obtained (60.44 - 66.5%) by Bello (1989) and a little lower than the value (74%) in skinned rabbits obtained by Aduku and Olukosi (1990). The difference, however, may be due to breed, the kind of feed fed and possibly the dressing procedures. The dressing percentage did not differ significantly among the diets and this agree with the findings of Ravidran *et al.* (1986) when they fed varying levels of cassava leaf meal to rabbits. The result (Table 2), showed no significant differences in the weight of the shoulder, thigh and rest of the body for all the treatments, but significant ($P<0.05$) dietary effects were observed on the weight of the chest and back. This might be due to the residual linamarin in the sun dried cassava peel meal, which depressed the development of these parts of the rabbits. The main time effect (Table 3) showed that, the weight of the back was significant ($P<0.05$) affected over the period of feeding. This agreed with the findings of Omole, 1988 who fed unsupplemented CPM to growing rabbits. The time of slaughter x diets interaction effects (Table 4) showed that, there were no interaction effects and this suggested that, the influence of diets on the carcass quality of rabbits was not dependent on the duration of feeding. The influence of diet (Table 5) showed no significant difference in the weights and length of the visceral parts measured. However, significant dietary influence was observed on the weight of the caeca ($P<0.001$) and appendix ($P<0.05$). This might be attributed to the enlargement (hypertrophy) of the cells of the caeca and appendix since the primary site of action of cyanide poisoning is the cell (Conn, 1969).

The dimension and weight of the guts as affected by the period (time) of slaughter (Table 6) indicated a significant difference in the weight of the large intestine ($P<0.05$), caeca ($P<0.01$) and appendix ($P<0.001$). Also the length of the caeca was highly significantly ($P<0.001$) affected. This might be attributed to the influence of the residual cyanide present in the sun dried cassava peel meal fed. The interaction effects (time of slaughter x diets) on the guts (Table 7) showed that, cassava peel meal is safe for rabbits as indicated by the non-significant interaction effect on weight of the large intestine and the appendix length. However, the weight of large intestine ($P<0.05$) and caeca ($P<0.001$) increased. This therefore, showed that, the influence of diets exerted on the large intestine and caeca depended on the period/time of feeding. The hypertrophy of the large intestine and caeca might be attributed to the residual cyanoglucoside in the diets.

5. Conclusion

It is therefore concluded that, despite adequate sun drying of the cassava peel meal used in this studies, cyanogenic glucoside still has some effect on the weights of some cut up part (back and chest). It is thus suggested that feeding CPM beyond six weeks could pose far more health risk to the other parts than were observed in this studies. The results confirmed the report of Conn (1969), that the primary site of action of cyanide poisoning is the cell. It is also concluded that the dried CPM still contained apparently high amount of cyanide which actually affected some visceral parts especially the caeca and appendix. This is likely to affect caecotrophy in the caeca and absorption in the appendix.

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Table 1: Ingredients and chemical composition (%) of cassava peel meal based diets fed to rabbits

Ingredients	Diets			
	I (0%)	II (30%)	III (35%)	IV (40%)
Maize	46.00	25.90	24.70	23.90
Soya bean meal	21.00	21.10	22.30	23.10
Cassava peel meal	0.00	30.00	35.00	40.00
Maize offal	30.00	20.00	15.00	10.00
Bone meal	2.00	2.00	2.00	2.00
Salt	0.50	0.50	0.50	0.50
Premix+	0.50	0.50	0.50	0.50
Total	100.00	100.00	100.00	100.00
Calculated analysis				
Crude protein (%)	16.60	16.00	16.10	16.00
Crude fibre (%)	11.60	11.00	11.30	11.80
Ash (%)	1.80	3.60	3.90	4.30
Metabolisable energy (MJ/kg)	8.70	8.80	8.80	9.10
HCN (PPM)	0.00	79.30	92.5	105.70

NB: + Composition of vitamin-mineral premix per kg of diet; Vitamin A 200,000IU;Vitamin E 25mg; Folic acid 25mg; Pantothenic acid 25mg; Cobalt 0.62mg; Selenium 0.25mg; Vitamin D 37500IU; Vitamin K 5mg; Nicotinic acid 50mg;Vitamin D B2 12.5mg; Vitamin B12 0.5mg; Choline 200mg; Iodine 1.38mg;
Iron 100mg; Zinc 125mg and manganese 250mg.

HCN – hydrocyanic acid and 0, 30, 35 and 40% - levels of inclusion of CPM

Table 2: Effect of diets on the carcass yield of rabbits fed CPM based diets

Parameters	Diets				
	I (0%)	II (30%)	III (35%)	IV (40%)	LSD
Shoulder (g)	126	137	128	140	NS
Chest (g)	127	153	149	193	*
Back (g)	83	84	91	110	*
Thigh (g)	207	208	201	236	NS
Rest of the body (g)	208	219	222	585	NS

Note: LSD - Least significant difference, NS - not significant and * - P<0.05

Table 3: Main time of slaughter effect on the carcass quality of rabbits

Parameter	Time of slaughter			
	1	2	3	Level of Significance
Shoulder (g)	136	138	125	NS
Chest (g)	148	166	152	NS
Back (g)	105	95	77	*
Thigh (g)	218	215	206	NS
Rest of the body (g)	219	225	482	NS

Note: NS - not significant, * - P<0.05, 1 - two weeks of feeding, 2 - four weeks of feeding, 3 - six weeks of feeding,

Table 4: Time x diet interaction effects on carcass yield of rabbits

Parameter	Diets					
	Time of slaughter	I	II	III	IV	LSD
Shoulder (g)	1	132	134	135	143	
	2	138	143	112	160	
	3	110	135	136	119	NS
Chest (g)	1	136	137	137	182	
	2	139	159	139	227	
	3	106	162	171	168	NS
Back (g)	1	99	96	106	118	
	2	94	82	81	123	
	3	53	77	84	88	NS
Thigh (g)	1	215	208	217	233	
	2	234	198	175	253	
	3	173	218	211	221	NS
Rest of the body (g)	1	199	210	246	220	
	2	222	231	202	247	
	3	202	217	219	289	NS

Note: LSD - Least significant difference, NS - Not Significant, 1, 2, 3 -Times of slaughter (two weeks Interval), I, II, III, IV - 0%, 30%, 35%, and 40% level of CPM

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Table 5: Influence of diet on the gut characteristics of rabbits

Parameter	Diets				
	I (0%)	II (30%)	III (35%)	IV (40%)	Level of Significance
Small intestine weight (g)	46.00	43.00	44.00	51.00	NS
Large intestine weight (g)	58.00	72.00	68.00	68.00	NS
Caeca weight (g)	49.00	25.00	33.00	33.00	***
Appendix weight (g)	6.60	7.00	7.10	8.40	*
Small intestine length (cm)	254	273	279	265	NS
Large intestine length (cm)	137	147	145	150	NS
Caeca length (cm)	35.50	38.70	39.70	41.50	NS
Appendix length (cm)	10.7	10.2	10.7	10.3	NS

Note: * = P <0.05, *** = P<0.01, and NS = Not Significant

Table 6: Effect of time of slaughter on the gut characteristics of rabbits

Parameter	Time of slaughter			
	1	2	3	Level of Significance
Small intestine weigth (g)	48.0	48.0	48.0	NS
Large intestine weight (g)	53.0	48.0	98.0	*
Caeca weight (g)	29.0	31.0	46.0	**
Appendix weight (g)	6.6	8.8	6.4	***
Small intestine length (cm)	267.0	284.0	253.0	NS
Large intestine length (g)	153.0	141.0	140.0	NS
Caeca length (cm)	50.0	34.0	33.0	***
Appendix length (g)	9.6	11.5	10.3	NS

Note: * = P <0.05, ** = 0.01, *** = P<0.001 and NS = Not Significant

Table 7: Time x Diet Interaction effects on gut characteristics

Parameter	Time of slaughter	Diets I	II	III	IV	LSD
Small intestine weight (g)	1 2 3	44 51 42	40 36 52	57 32 43	51 54 46	*
Large intestine weight (g)	1 2 3	54 30 100	46 44 126	56 61 90	70 59 76	NS
Caeca weight (g)	1 2 3	19 23 23	21 24 29	39 37 24	43 32 23	***
Appendix weight (g)	1 2 3	6.5 8.5 5.0	6.5 7.5 7.0	6.0 8.0 7.2	7.5 11.0 7.0	NS
Small intestine length (cm)	1 2 3	243 282 238	247 292 274	288 283 266	289 272 235	NS
Large intestine length (cm)	1 2 3	139 119 153	153 151 138	163 129 143	158 165 129	NS
Caeca length (cm)	1 2 3	45 30 32	53 32 32	49 35 35	58 35 33	NS
Appendix length (cm)	1 2 3	9.5 12.0 10.5	9.5 10.5 9.5	9.0 11.5 11.5	10.5 11.0 9.5	NS

Note: 1 = two weeks of feeding, 2 = four weeks of feeding and 3 = six weeks of feeding,
LSD = least significant difference, * = $P < 0.05$, *** = $P < 0.001$