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EFFECTS OF CASSAVA WASTE SUBSTITUTION FOR MAIZE IN WEANER RABBIT DIETS

O.A. ABU* and A.A. ONIFADE

Department of Animal Science, University of Ibadan, Ibadan, Nigeria

LES CONSEQUENCES DE LA SUBSTITUTION DU MAIS A DES DECHETS DE MANIOC DANS LES REGIMES ALIMENTAIRES DES LAPINS SEVRES

Résumé

Le maïs dans le régime alimentaire des lapins sevrés était substitué aux déchets de farine de manioc (DFM) à 0; 25; 50; 75; et 100%. Les conséquences de ces traitements sur la performance, la digestibilité et l'hématologie des lapins étaient évaluées au cours d'un essai d'alimentation de 70 jours. Vingt cinq lapins de la Nouvelle Zélande de la même portée âgés de 6 – 7 semaines, ayant un poids moyen de 750 + 25,23 g, étaient utilisés. Les lapins étaient répartis au hasard en 5 lots de traitement et chaque lapin était logé individuellement dans des cages métalliques. L'aliment et l'eau étaient servis *ad libitum*.

La moyenne de la consommation alimentaire volontaire a augmenté ($P < 0,05$) avec l'accroissement des taux d'incorporation de déchets de farine de manioc dans les régimes alimentaires. Le gain de poids corporel a diminué ($P < 0,05$) tout au long des traitements au régime. La moyenne la plus faible de gain de poids quotidien était enregistrée ches les lapins nourris avec 100% d'incorporation de déchets de farine de manioc, tandis que l'efficience alimentaire a baissé ($P < 0,05$) proportionnellement avec l'accroissement des taux de DFM dans les régimes alimentaires. A l'exception des taux de cendre brute qui étaient similaires ($P > 0,05$), la digestibilité apparente pour les autres éléments du régime était différente ($P < 0,05$) pour tous les traitements. Les valeurs hématologiques n'étaient pas affectées ($P > 0,05$). Cette étude indique que DFM peut remplacer jusqu'à 75% le maïs dans l'alimentation des lapins sans affecter la croissance et la digestibilité.

Summary

The maize in a weaner rabbit diet was substituted with cassava waste meal (CWM) at 0, 25, 50, 75 and 100%. The effects of these treatments on the performance, nutrient digestibility and haematology of the rabbits were evaluated in a 70-day feeding trail period. Twenty-five littermate New Zealand white rabbits between 6 – 7 weeks old averaging 750 ± 25.23g were used. The rabbits were randomly alloted to five treatments and each animal was individually accommodated in metal cages. Feed and water were provided *ad libitum*.

The mean voluntary feed intake increased ($P < 0.05$) with increasing levels of cassava waste meal inclusion in the diets. The body weight gain decreased ($P < 0.05$) along the dietary treatments. The lowest average daily weight gain was recorded in rabbits fed 100% cassava waste meal inclusion, while the feed efficiency decreased ($P < 0.05$) correspondingly with increasing levels of CWM in the diets. Except for crude ash which were similar ($P > 0.05$), apparent digestibility for the other dietary components were different ($P < 0.05$) among treatments. The haematological values were unaffected ($P > 0.05$). This study indicates that CWM can replace up to 75% of maize in rabbit diets without compromising growth and digestibility.

Introduction

Cassava (*Manihot esculenta crantz*) is a major energy food source in the tropics and subtropics. One major by-product derivable from the processing of cassava roots for human food is the cassava waste. Cassava waste is a low-energy product which comprises the peel, a little portion of the pulp and discarded small tubers. This waste can be obtained in large quantities in cassava-producing areas.

Between 13 – 26 million metric tonnes of cassava waste is generated yearly in the tropics[1] and the production is on the increase[2]. The availability of this waste in large quantities

*To whom correspondence should be addressed.

and because man does not utilize it, makes the waste a potential feed resource for livestock in tropical and sub-tropical agricultural systems.

Many researchers have reported utilization of cassava peel in rabbit diets. However, there appears to be conflicting opinions as to the best level of inclusion of cassava peel in rabbit nutrition. Omole and Sonaiya[3], and Omole and Onwudike[4] reported that cassava peel meal could be fed as much as 40%, while Esonu and Udedibie[5] reported 25% maximum inclusion and Onifade and Tewe[6] reported 100% replacement for maize. The present study was designed to provide information on the substitutional value of cassava waste for maize in a maize-groundnut cake diet for growing rabbits.

Materials and Methods

The cassava waste was collected from a cassava processing centre at Ojoo, Ibadan, Nigeria. This was sun-dried for five days, after which it was milled and later incorporated into the diets. Five experimental diets in which maize was replaced weight for weight (w/w) with CWM at 0, 25, 50, 75 and 100% levels were formulated as shown in Table 1. Twenty-five 6 – 7 weeks old littermates of New Zealand White rabbits with a initial average weight of 750 + 25.23g were randomly alloted to the five dietary treatments in groups of five each. Each rabbit served as a replicate. The rabbits were individually accommodated in metal cages. Feed and water were provided *ad libitum* for a period of 70 days.

Voluntary daily feed intake was calculated as the difference between the feed offered at 0700 hours and the oats the following day prior to feeding.

Apparent nutrient digestibility was evaluated between Day 42 – and 46 with three[3] rabbits per treatment. Feed allocation continued *ad libitum* while total collection of daily faecal output for each rabbit was carried out. Faeces were oven-dried at 60° for 24 hours, milled and stored for chemical analysis. The computation of apparent digestibility coefficients were as carried out by Onifade and Tewe[6].

Table 1: Composition of experimental diets

Ingredients	Levels of substitution of CWM				
	0%	25%	50%	75%	100%
	1	2	3	4	5
Maize	50.00	37.50	25.00	12.50	0.0
Cassava waste meal (CWM)	0.00	12.50	25.00	37.50	50.00
Brewer's dried grains	37.47	37.47	36.47	34.97	34.47
Groundnut cake	8.78	8.78	8.78	8.78	8.78
Palm oil	1.00	1.00	2.00	3.50	4.00
Bone meal	1.50	1.50	1.50	1.50	1.50
Oyster shells	0.50	0.50	0.50	0.50	0.50
Salt	0.50	0.50	0.50	0.50	0.50
	100.0	100.0	100.0	100.0	100.0

*Vitamin-mineral mix per kg contained; Vit. A, 4,000,000 I.U.; Vit D_3, 1,200,000 I.U; Vit E, 3,200 I.U; Vit K, 800mg; Vit B_1, 800mg; Vit B_2, 2,200mg; Vit B_6, 480mg; Vit B_{12}, 4.8mg; Biotin, 12mg; Pantothenic acid, 2,800mg; Folic acid, 240mg; Choline chloride, 200,000mg; Vit C, 4,000mg; Fe, 2,400mg; Mn, 32,000mg; Copper, 3,200mg; Zn, 20,000mg; Co, 160mg; Iodine, 800mg; Selenium, 40mg; Anti-oxidant, 2,400mg; Calcium carbonate, 1,000mg.

Haematological analyses

Blood sample (5 ml per rabbit) was collected using sterile syringes and needles (21 gauge) through the prominent ear vein of the rabbit. The blood was immediately dispelled into specimen bottles containing ethylene diamine tetra acetic acid salt (EDTA) as anticoagulant.

Parked cell volume (Haematocrit), red blood cell (RBC), white blood cell (WBC) and haemoglobin concentrations were determined using Wintrobes microhaematocrit, improved Neubauer haemocytometer and cyanomethhaemoglobin methods respectively[7]. The erythrocytic indices: mean corpuscular volume (MCV); mean corpuscular haemoglobin (MCH) and mean corpuscular haemoglobin concentration (MCHC) were computed according to Jain[7].

Analyses

Duplicate samples of maize, cassava waste meal, experimental diets and faeces per rabbit were analyzed for proximate composition according to AOAC[8].

All the data collected in this study were subjected to analysis of variance as outlined by Steel and Torrie[9], and means were separated according to Duncan[10].

Results

The proximate composition of CWM, maize and experimental diets are shown in Table 2. Maize contained higher crude protein, ether extract and nitrogen free extract than CWM while CWM had more fibre. The crude protein and ME (Kcal/kg) energy of the diets decreased with increasing substitution of maize with CWM.

Table 3 shows the performance characteristics of the rabbits. Voluntary feed intake increased ($P < 0.05$) correspondingly with levels of CWM in the diet, being significantly highest ($P < 0.05$) in rabbits fed the diet in which maize was completely replaced by CWM. A similar trend was observed for water consumption ($P < 0.05$). Rabbits fed no CWM attained the highest ($P < 0.05$) average daily gain while rabbits fed maximum level of CWM had the lowest ($P < 0.05$) gain. Feed efficiency decreased ($P < 0.05$) with increasing levels of CWM.

Table 2: Proximate composition of maize, cassava waste meal and experimental diets (% dry matter)

Proximate components	maize	CWM	Experimental dietslevel of substitution of CWM				
			0%	25%	50%	75%	100%
			1	2	3	4	5
Dry matter	87.33	87.33	88.21	86.50	87.32	88.25	
Ash	1.50	4.63	8.25	8.70	9.54	10.2	11.13
Crude fibre	2.10	13.20	7.01	8.02	9.12	10.00	12.35
Crude protein	9.82	5.21	19.03	18.40	17.75	16.80	13.95
Ether extract	4.30	0.65	2.02	1.81	1.92	2.23	2.07
ME Kcal/kg*	3,470	N.A.	2,6000	2,570	2,540	2,510	2,370

* Calculated metabolisable energy values

N.A Not available

Table 3: Performance characteristics of rabbits fed cassava waste meal (CWM) in substitution for maize

Characteristics	Levels of substitution of CWM					Pooled
	0%	25%	50%	75%	100%	S.E.
	1	2	3	4	5	
Initial body weight (g)	752.25	755.10	765.50	754.20	750.21	25.23
Final body weight (g)	1681.76^{a}	1540.25^{b}	1534.76^{b}	1476.0^{b}	1294.60^{c}	102.11
Live weight gain (g)	929.51^{a}	785.16^{b}	769.26^{b}	721.80^{b}	544.39^{c}	72.55
Average daily weight gain (g)	13.28^{a}	11.22^{b}	10.99^{b}	10.31^{b}	8.90^{c}	17.6
Average daily feed intake (g)	62.66^{a}	70.50^{b}	69.32^{b}	70.20^{b}	80.60^{c}	5.26
Feed efficiency	4.72^{a}	6.28^{b}	6.31b	6.78b^{c}	9.06^{c}	0.65
Water intake (ml/rabbit/day)	270.16^{a}	280.0^{ab}	287.21^{b}	300.45^{c}	320.10^{c}	30.50

a, b, c: Treatment means in the same row without a common superscript are different ($P < 0.05$)

Table 4: Nutrients digestibility by rabbits fed cassava waste meal (CWM) in substitution for maize

Proximate nutrients	Level of substitution of CWM					Pooled
	0%	25%	50%	75%	100%	S.E.
	1	2	3	4	5	
Dry matter	70.12^{d}	64.52^{ab}	60.15^{b}	56.19^{c}	55.11	10.25
Crude protein	75.16^{a}	74.18^{a}	69.22^{b}	68.25^{b}	66.12^{b}	4.32
Crude fibre	32.13^{b}	28.52^{bc}	22.31^{c}	20.25^{a}	15.23^{d}	5.62
Ether extract	80.62^{a}	79.15^{a}	81.22^{a}	89.53^{b}	87.0^{b}	13.24

a, b, c, d: Treatment means in the same row without a common superscript are different ($P < 0.05$)

Table 4 shows the apparent digestibility of nutrients in the diets fed. Dry matter, crude protein, and crude fibre digestibilities decreased ($P < 0.05$) with incremental substitution of CWM, while digestibility of ether extract was higher in rabbits fed 0, 25 and 50% substitutional levels of CWM.

The haematological values in the rabbits fed the experimental diets is shown in Table 5. The values of parked cell volume, haemoglobin, red blood cell and white blood cell in the rabbits on the five dietary treatments were similar ($P < 0.05$). Mean corpuscular volume were higher ($P < 0.05$) in rabbits fed. CWM at 50 – 100% than their counterparts fed on 0 and 25% substitutional levels. Mean corpuscular haemoglobin was unaffected ($P < 0.05$) but for the significantly ($P < 0.05$) low value determined in rabbits fed 25% CWM as replacement for maize. Rabbits fed diets containing CWM (25 – 100%) had uniformly lower ($P < 0.05$) mean corpuscular haemoglobin concentration than those fed the control diet.

Table 5: Haematological indices in rabbits fed cassava waste meal (CWM) in substitution for maize

	Level of substitution of CWM					
Pooled Indices	0% 1	25% 2	50% 3	75% 4	75% 5	100% S.E.
Packed cell volume (%)	32.52	33.25	33.80	32.60	32.60	2.75
Haemoglobin (%)	12.90	10.98	10.96	10.12	10.40	1.23
RBC ($10^6/_l$)	6.65	6.42	5.70	5.32	5.38	0.61
WBC ($10^3/_l$)	5.00	4.92	4.88	4.76	4.36	0.43
MCV (fl)	48.90a	51.79a	59.29b	57.19b	60.59b	6.77
MCH (pg)	19.40a	17.10b	19.23a	19.02a	19.33a	0.32
MCHC (%)	39.67a	33.02b	32.43b	31.04b	31.90b	0.92

a, b: Treatment means in the same raw without a common superscript are different ($P < 0.05$).

Discussion

Cassava waste meal (CWM) is nutritionally inferior to maize both in energy and protein contents (Table 2). Therefore, a direct substitution of cassava waste meal for maize in the diets led to a reduction in the protein and energy values of the diets. It is these calorie and protein dilutions that necessitated the significantly high voluntary feed intake of rabbits fed cassava waste meal substituted diets, and more apparently on treatment five which was without maize (100% CWM). This observation indicates the ability of rabbits to regulate their feed intake to satisfy their digestible energy requirements as previously reported[6,11]. The increasing water consumption along the increasingly fibrous treatments (Diets 2 – 5) is consistent with those of Adegbola and Osuji[12].

Rabbits fed without CWM attained the highest ($P < 0.05$) average daily gain (ADG). This reflects the superior nutrient density of the diet. The converse holds for rabbits fed the maximum level of CWM. However, the variation in the ADG obtained in this study were similar to those reported by[3,4,6,12], but higher than values reported by Onifade et al[6]. The decreasing trend in the values for digestibility of DM, CP and CF by rabbits could be attributed to the increasing levels of CWM. Cassava waste meal is more fibrous than maize and dietary fibre has a depressing influence on nutrient digestibility[6,11,12] in rabbits. Haematological indices in rabbits depicted gross similarities; this more probably suggests nutritional adequacy and safety of the dietary treatments according to Onifade and Tewe[6]. Understandably, differences in erythrocytic indices: MCV, MCH and MCHC are composite of the differences in PCV, Hb and RBC values. Therefore, the increasing corpuscular volume ostensibly predicate the decreasing haemoglobinisation, i.e. haemoglobin per cent (MCHC) and this may be nutritionally interpreted as microcytic normocytic anaemia, a most probable result of incipient and/or chronic iron deficiency[14]. The significantly low MCHC in rabbits fed Diet 2 cannot be explained.

According to Onifade and Tewe[6], the lower MCHC in rabbits fed CWM substituted diets[2-5] could not be attributed to restricted or lower energy intake as suggested by Edozien and Switzer[15] since the rabbits significantly adjusted their feed intake incrementally, with the substitutional levels of CWM. Above all, the magnitude and ranges of haematological indices obtained in this study were comparable to normal values reported[6,13].

This study suggests that CWM can replace up to 75% of dietary maize (i.e. as much as 37.5% of the diet) for rabbits without compromising performance, nutrient utilization, and without having any adverse health and/or haematological implications. However, adequate dietary protein and iron provisions are strongly recommended.

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