Effect of graded levels of raw bambaranut (*Voandzeia subterranea* L) waste on nutrient intake, digestibility and utilization by rabbits

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Abstract

The effect of graded levels of raw bambara nut (*Voandzeia subterranea* L) waste on nutrient intake, digestibility and utilization by weaner rabbits was investigated. Four diets were formulated to contain 0, 10, 20 and 30% raw bambara nut waste (RBW). Twenty-four hybrid (Chinchilla x New Zealand white) weaner rabbits weighing 790 – 880g at six weeks were randomly divided into four groups of 6 rabbits each. The groups were randomly assigned to the four diets in a completely randomized design (CRD) for 56 days. Each treatment was replicated 3 times with two rabbits per replicate. Results showed that significant differences ($P < 0.05$) existed among treatments in final body weight (FBW), average daily weight gain (ADWG) and intake of dry matter (DM), crude protein (CP), gross energy (GE) and digestible energy (DE). There were also significant differences ($P < 0.05$) among treatments in digestibility coefficients of DM, CP, crude fibre (CF), ether extract (EE) and nitrogen free extract (NFE). Rabbits fed 20 and 30% RBW diets had significantly ($P < 0.05$) lower FBW and ADGW, and lower ($P < 0.05$) intake of DM, CP, GE and DE than rabbits fed the control diet. Rabbits fed 20 and 30% RBW diets also had significantly ($P < 0.05$) lower digestibility coefficients of DM, CP, CF, EE and NFE. Results showed that nutrient intake, weight gain and digestibility coefficients were depressed. Mortality was observed at 20 and 30% RBW levels. Although there were no significant differences ($P > 0.05$) among treatments in relative organ weights and in carcass dressing percentage, the kidney of rabbits fed 30% RBW diets had mild degeneration necrosis and dilatation of the tubules. Bile duct dilatation, hyperplasia of the bile duct epithelia cells, fibrosis and thickening of the interlobular septa were observed in the liver of rabbits fed 30% RBW diets. The depression in nutrient intake, and weight gain, and the observed histopathological changes at 20 and 30% RBW levels could be due to ant nutritional factors present in the raw bambara nut waste or done to high fibre levels of RBW. The results indicate that up to 10% RBW can be included in the diets of weaner rabbits without serious deleterious effects on rabbits.

Key words: Nutrient intake, digestibility, utilization, bambara nut waste, rabbits

Introduction

The increasing cost of livestock feed with the concomitant increase in the cost of livestock products has necessitated the search for cheaper and readily available alternative feed ingredients for livestock feeding. One of such alternative feed ingredients is bambara nut (*Voandzeia subterranea* L) waste. Bambara nut is an indigenous African legume which is extensively cultivated for its edible grain (Rachie and Roberts, 1974) in Nigeria, bambara nut is widely grown in a number of Southern and Northern states, and in most of these states, the dried reeds are converted into paste, steamed and eaten in the form of moi-moi (Enwere, 1998). Dry bambara nut seed contains 12.13 – 22.9% crude protein (Ndiokwere, 1982. Apata and Ologhobo 1994;). Okeke (2000) showed that raw bambara nut waste contains 16.19% crude protein. Bambara nut waste has been identified as a potential protein and carbohydrate source for livestock feeding (Ani and Okafor (2004; Ani 2006). However the

use of bambara nut and its waste in livestock feeding is limited because of the presence of such ant nutritional factors as cyanogens, flatulence factors, tannins, trypsin inhibitors and hemagglutinins in raw bambara nut (Doku and Kari Kari, 1981; Ensminger *et al.*, 1996; Onwudike and Eguakun; 1992). Due to paucity of information on the effects of dietary RBW on nutrient intake, digestibility and utilization by weaver rabbits, this study was conducted to investigate the possible adverse effects of graded levels of RBW on pathology, growth and survivals of weaner rabbits. The study also aimed at determining characteristics and organ weights of weaver rabbits

Material and methods

The raw bambara nut waste and other ingredients used in the study were purchased from Orba and Nsukka markets in Enugu State. Four experimental

Table 1: Percentage Composition of experimental diets

Ingredients	Dietary level of raw bambara groundnut waste (%)			
	0	10	20	30
Maize	41.4	34.80	28.10	21.00
Palm kernel meal	7.90	13.90	14.30	18.30
Wheat offal	27.6	23.20	19.35	14.00
Fish meal	5.30	5.50	5.70	6.10
Soyabean meal	13.30	8.30	7.95	6.10
Raw bambara nut waste	0	10.00	20.00	30.00
Bone meal	4.00	4.00	4.00	4.00
Iodized salt	0.25	0.25	0.25	0.25
Vit-mineral mix*	0.25	0.25	0.25	0.25
Total	100	100	100	100
Calculated composition				
Crude protein (%)	16.75	16.82	16.90	17.01
Metabolizable energy (MJ/kg)	12.68	12.64	12.76	12.84

*Vit A – 10,000.00 iu, D₃-2,000 iu, B₁-0.75g, B₂-5g, Nicotinic acid – 25g, Calcium pantothenate 12.5g, B₁₂ – 0.015g, K₁-2.5g, E-25g, Biotin – 0.050g, Folic acid – 1g, Manganese 64g, Choline chloride 250g, Cobalt – 0.8g, Copper 8g, Manganese 64g, Iron – 32g, Zn-40g, Iodine-0.8g, Flavomycin-100g, Spiramycin 5g, Dl-methionine-50g, Selenium 0.6g, Lysine 120g, BAT-5g.

diets were formulated with the raw bambara nut waste (RBW) and other feed ingredients. The composition of the diets is given in Table 1. Twenty-four hybrid (Chinchilla x New Zealand white) weaner rabbits weighing 790-880g at 6 weeks were randomly divided into four groups of 6 rabbits each. The groups were randomly assigned to the four diets, containing 0, 10, 20 and 30% RBW in a completely randomized design (CRD) for 56 days. Each treatment was replicated 3 times with 2 rabbits per replicate placed in a four tier rabbit cages which had a total of 12 hutches per tier. Each hutch which measures 0.6mx0.5mx0.4m was partitioned with metallic sheets and wire mesh fitted with metallic trays (for collection of faecal droppings) and with stainless feeders and drinkers. The cages were located inside a rabbit building equipped with vents and windows for proper ventilation. The rabbits were provided with feed and water ad libitum twice daily at 8.00a.m and 3.00 p.m for 56days. The rabbits were also fed equal quantity of fresh forage (*Centrosema pubescens*) as a supplement to the experimental diets. The rabbits were weighed at the beginning of the experiment and subsequently on weekly basis. Live weights were recorded weekly while feed intake was determined by the weight back technique.

Digestibility of the diets was carried out at the seventh week of the experiment and lasted for eight days; the first three days were for the adaptation of the animals to the new environment. One rabbits was selected from each replicate and fasted for 24hrs and there after fed 90% of their ad libitum intake for 5 days. Faeces arising from

the 5-day feeding plus that from another 24-hr fasting period were collected. This was to ensure total collection of faecal droppings associated with the feed consumed. Faecal droppings collected each day were oven-dried at 60°C put in a plastic bag and stored in a refrigerator. At the end, all droppings collected from each replicate were pooled together and samples taken for the determination of proximate composition. Three rabbits from each treatment were selected, weighed and starved over night to clear the gut. Each rabbit was stunned and slaughter by cutting the jugular vein with a sharp knife. During the evisceration, the internal organs were carefully removed and weighed the each organ. The dressed carcass and organ were weighed. Dressed carcass weight and the organ weights were expressed as percentages of the live weight. The internal organs were also subjected to gross pathological examination. Experimental diets and faecal droppings were analyzed for proximate composition using the method of A.O.A.C (1990). All data collected were subjected to analysis of variance (ANOVA) for a CRD (Steel and Torrie, 1980). Significant differences between treatment means were separated using Duncan's New Multiple Range Test (Duncan, 1955).

Results and Discussion

The proximate composition of the experimental diets is presented in Table 2 while Table 3 shows the effects of graded levels of RBW on nutrient intake, weight gain, final body weight and mortality of rabbits. There were significant differences ($P<0.05$) among treatments in the

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Table 2: Proximate composition of experimental diets (% of dry matter)

Components	Dietary raw bambara nut waste levels (%)			
	0	10	20	30
Dry matter	95.00	94.00	92.00	95.50
Crude protein	16.47	15.59	17.01	17.43
Crude fibre	8.95	12.77	13.59	17.28
Ether extract	4.21	3.19	3.80	4.71
Ash	12.11	13.30	14.13	14.14
Nitrogen-free extract	58.26	55.15	51.47	46.44
Gross energy (MJ/KG)	12.03	11.79	11.55	11.37

Table 3: Nutrient intake, weight gain and mortality of rabbits fed graded levels of raw bambara nut waste

Parameters	Dietary raw bambara nut waste levels (%)				SEM
	0	10	20	30	
Dry matter intake (g%)as	87.00 ^a	82.88 ^a	69.43 ^b	59.69 ^b	4.66
% body weight	5.21	5.26	4.68	4.15	0.48
Crude protein intake (g)	15.08 ^a	13.75 ^{ab}	12.84 ^b	10.88 ^c	0.84
Gross energy intake (MJ)	1.10 ^a	1.05 ^{ab}	0.87 ^b	0.71 ^c	0.06
Digestible energy intake (MJ)	0.83 ^a	0.72 ^a	0.59 ^b	0.36 ^b	0.06
Average weight gain (g)	14.28 ^a	13.93 ^a	12.17 ^{ab}	10.68 ^b	1.07
Mortality %	0.00 ^b	0.00 ^b	16.67 ^a	16.67	11.79

a, bc = means on the same row with different superscripts are significantly ($P < 0.05$) different SEM = standard error of mean

intake of dry matter (DM), crude protein (CP), gross energy (GE) and digestible energy (DE). There were also significant differences ($P < 0.05$) among treatments in final body weight (RBW), average daily weight gain (ADWG) and percentage mortality of rabbits. Rabbits on control diet (0% RBW) had significantly ($P < 0.05$) higher intake of DM, CP, GE and DE than rabbits fed 20 and 30% RBW diets. Rabbits fed the

control diet had similar weight gain with those fed the 20% RBW diet, and this was significantly ($P < 0.05$) higher than that of rabbits fed 30% RBW diet.

Percentage mortality was highly significant ($P < 0.05$) 20 and 30% levels of dietary RBW. It could be observed (Table 3) that there was depression in nutrient intake as the level of RBW increased beyond 10% in the diets. Similar

observations have been reported (Ani and Okafor, 2004). The depression in nutrient intake could be attributed to the presence of anti-nutritive factors such as tannin, cyanogens and trypsin inhibitors in RBW (Liener, 1975). Tannins in particular have been shown to decrease voluntary feed intake and digestibility (Ensminger *et al.*, 1996). Besides, the high fibre content of dietary RBW may have contributed to the depression in nutrient intake. High dietary fibre level has been shown to depress nutrient intake in animals (Kass *et al.*, 1980). The dietary fibre may have exerted its depressive effect on nutrient intake by causing early gut-fill. According to MacDonald *et al.* (1995), fibrous feeds tend to spend a long time in the digestive tract there by resulting in reduced feed and nutrient intake. The result in Table 3 also shows that weight gain and final body weight declined at 30% level of dietary RBW. The result agrees with the reported finding of Sklan *et al.* (1975) that ingestion of raw oil bean caused growth inhibition. The reduction in weight gain could be due to the presence of such anti-nutritive factors as tannins in RBW which have been shown implicated in the reduced feed intake (Jaffe, 1980; Ensminger *et al.*, 1996). The depression in weight gain at 30% level of RBW inclusion could also be attributed to decline in nutrient intake which could have resulted to the inability of the rabbits to meet their production and metabolic requirements. The high incident of mortality observed at 20 and 30% levels of RBW could be due probably to the antinutritional factors, especially hydrogen cyanide

(HCN) from cyanogenic glycosides in the raw bambara nut waste. This would have increased in concentration and toxicity with increase in RBW levels. Liener (1986) reported that ingestion of raw soybean, field bean and kidney bean elicit certain physio-pathological changes which could result in death. Ensminger (1996) also reported that HCN is very toxic at low concentrations to human and animals.

Table 4 shows the percentage digestibility of diets containing grade levels of raw Bambara nut waste. These were significant differences ($P < 0.05$) among treatments in dry matter (DM), crude protein (CP), crude fibre (CF), ether extract (EE) and nitrogen-free extract (NFE) digestibility. Rabbits fed the control diet had significantly ($P < 0.05$) higher digestibility coefficients of all nutrients than those fed 20 and 30% RBW diets. The digestibility coefficients of DM, CP, CF, EE and NFE significantly decreased ($P < 0.05$) with increasing RBW levels. The observed decrease could be either due to presence of dietary CF (Table, 2), or due to antinutritional factors in the RBW diets. The higher the fibre level in the food the more quickly it passes through the rabbit's digestive system and the lower the digestibility (Fielding, 1991). Moreover, fibre contains lignins, celluloses and hemicelluloses. Lignin is not only largely indigestible itself, but it also lowers the digestibility of cellulose, other complex carbohydrates and other nutrients (Jokthan *et al.*, 2006). Besides fibre, the antinutritional factors (ANFS) in the RBW diets may have contributed to the decrease in nutrient digestibility at the 20 and 30% RBW levels. Jaffe (1980) reported that

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ANFS have depressive effects on digestion and utilization of nutrients.

Table 5 shows the effect of graded levels of raw bambara nut waste on carcass yield and relative organ weights of rabbits. There were no significant differences ($P>0.05$) in dressed carcass weight, dressing percentage and relative

organ weights. The result contradicts that of Ani (2006) which showed that the carcass dressing percentage of rabbits fed 20 and 30% toasted bambara nut waste was significantly ($P<0.05$) higher than that of rabbits fed the control diet. The dressing percentage values (53.57-63.40%) obtained in this study are comparable with the

Table 4: Percentage digestibility of diets containing graded levels of raw bambara nut waste

Parameters	Dietary raw bambara nut waste levels (%)				
	0	10	20	30	SEM
Dry matter (%)	75.62 ^a	71.68 ^a	63.67 ^b	62.8 ^b	2.50
Crude protein (%)	78.45 ^a	70.15 ^a	67.32 ^b	56.80 ^c	2.80
Crude fibre (%)	82.17 ^a	77.15 ^b	73.38 ^{bc}	69.71 ^c	2.03
Ether extract (%)	90.66 ^a	84.09 ^a	67.13 ^b	50.15 ^c	3.14
Nitrogen- free extract (%)	73.73 ^a	68.87 ^a	58.58 ^b	58.63 ^b	2.78

a, b, c = means on the same row with different superscripts are significantly ($P<0.05$) different

SEM = standard error of mean

Table 5: Effect of graded levels of raw bambara nut waste on carcass yield and relative organ weights of rabbits

Parameters	Dietary raw bambara nut waste levels (%)				
	0	10	20	30	SEM
Dressed carcass weight (kg)	0.95	0.85	0.83	0.75	0.08
Dressing %	58.73	53.57	63.40	58.81	6.21
Liver (% of live weight)	3.38	3.57	6.07	5.48	1.14
Kidney (% of live weight)	0.37	0.41	0.41	0.46	0.06
Spleen (% of live weight)	0.07	0.13	0.06	0.07	0.06
Length of small intestine (Cm)	321.00	332.00	303.50	322.50	36.32
Length of large intestine (cm)	51.50 ^a	50.50 ^a	57.00 ^a	44.50 ^b	4.23
Length of stomach (cm)	12.50 ^a	10.25 ^b	11.50 ^{ab}	10.70 ^{ab}	0.75

a, b = Means on the same row with different superscripts are significantly ($p<0.05$) different SEM = standard error of mean

values, (51.61-59.00% and 52.00-59.00%) reported by Dairo *et al.* (2005) and Ani (2006) respectively. The dressing percentage value (58.81%) recorded at 30% RBW level is higher than the value (54.2%) reported by Arijeniwa and Igene (2002) for rabbits fed 30% raw bambara nut. There were significant differences ($P>0.05$) among treatments in large intestine and stomach lengths. Rabbits fed the control diet and those fed the 20 and 30% RBW diets had similar ($P>0.05$) length of stomach.

The pathological changes observed in the kidney of rabbits fed 30% RBW diet were mild degeneration, necrosis, and dilatation of the tubules. Bile duct dilatation, hyperplasia of the bile duct, epithelial cells, fibrosis and thickening of the interlobular septa were also observed in the liver of rabbits fed 30% RBW diet. However, no lesions were observed in the organs of rabbits, fed the control diet. The results obtained tend to suggest that the inclusion of high level (30%) of RBW in the diets of growing rabbits may have adverse effects on the rabbits. Although the inclusion of RBW in the diets did not have any significant effects on the relative organ weights of rabbits, the pathological changes observed in the liver and kidneys of rabbits fed 30% RBW diets tend to suggest that inclusion of 30% RBW in weaner rabbits' diets may have some adverse effects on the rabbits.

Conclusion

It is evident from this study that raw bambara nut waste is a potential feed ingredient for rabbit feeding. However, the inclusion of more than 10%

RBW in the diets of weaner rabbits may have adverse effects on nutrient intake, digestibility and utilization by rabbits.

Acknowledgement

The author wishes to acknowledge the assistance of Ms. I.C Okafor of Animal Science Department and Dr. W. Ezema of the Department of Veterinary Pathology and Microbiology, University of Nigeria, Nsukka.

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Received: 20th March, 2007; Accepted 4th Dec., 2008.