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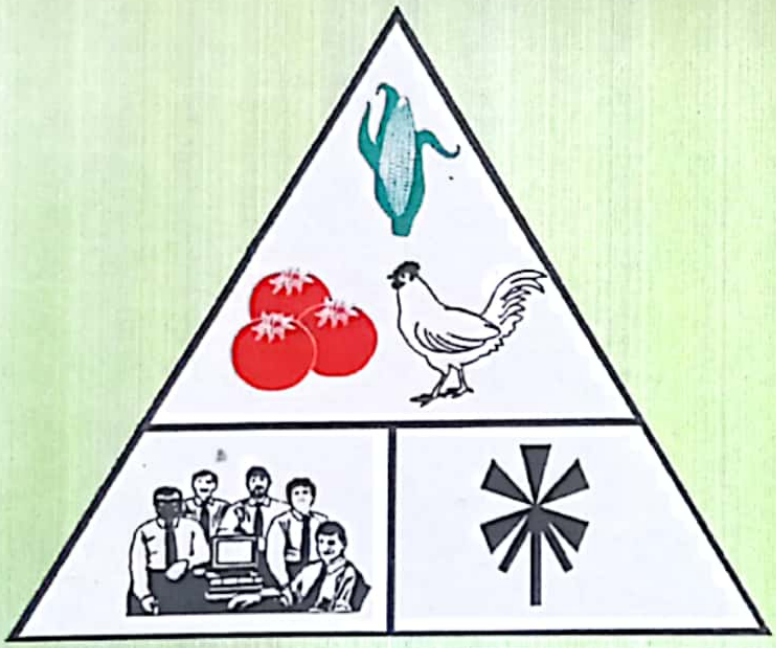

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Dietary Effect of Varying Levels of Bambara Groundnut (*Vigna subterranea* (L.) Verdcourt) Meal on the Performance, Nutrient Digestibility and Carcass Characteristics of Rabbits

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Abstract

A study on the dietary effect of varying levels of roasted bambara groundnut meal (BGM) on the performance, nutrient digestibility and carcass characteristics of rabbits was conducted in a five-week feeding trial. Forty New Zealand White x California rabbits of both sexes, between 5 and 7 weeks old, with an average initial weight of 700g were allocated to four dietary treatments. BGM was incorporated in the experimental diets at graded levels of 0, 10, 20 and 30% BGM. Each treatment had ten rabbits and five replicate per treatment in a completely randomized design (CRD). There were no significant difference in the daily feed intake (45.44 - 52.47g), daily weight gain (11.04 - 13.18g), feed conversion ratio (3.44 - 4.14), finial live weight (1103.00 - 1335.00g), carcass weight (548.50 - 688.50g), dressing percentage (49.14 - 51.42%) and relative organ weights. Intakes of dry matter (DM), organic matter (OM), crude protein (CP), acid detergent fibre (ADF), and neutral detergent fibre (NDF) as well as nutrient digestibilities (DMD, OMD, CPD, ADFD and NDFD) were all not significantly influenced by dietary treatments. Study showed that BGM could be included in the diet of rabbits up to 30% level without negatively affecting the performance, nutirent digestibility and carcass characteristics of rabbits.

KEY WORDS: Dietary, bambara groundnut, performance, nutrient digestibility, carcass characteristics, rabbits

Introduction

It is evident in Nigeria that the conventional sources of feed can no longer adequately supply the needs of the fast growing livestock industry. There is the need for the exploitation of the full potential of the relatively neglected and under-exploited non-conventional legumes like bambara groundnut for livestock feeding.

Bambara groundnut originated from the African continent as reported by several workers (Dalziel, 1937; Jacques-Felix, 1946; Rassel, 1960; Hepper, 1963; Begemann, 1988). A total of 150,000 - 160,000t or 45 - 50% of world production of the crop, came from West Africa (Kiwallo, 1991). Bambara groundnut is reported to have been carried from Africa to as far as India, Sri Lanka, Indonesia, the Philippines, Malaysia, New Caledonia and South America, particularly Brazil (Rassel, 1960).

Bambara groundnut seeds have been reported by Temple and Aliyu (1994) to contain 16 - 24% crude protein and about 6% ether extract with high proportions of lysine (6.6%) and methionine (1.3%). Leucine has been stated to be the most concentrated essential amino acid found in bambara groundnut (Olomu, 1995; Aremu *et al.*, 2006). Bambara groundnut is a well balanced food with a calorific value comparable with that of a high quality cereal grain (Barimila *et al.*, 1994).

However, like most tropical legumes, bambara groundnut seeds contain some antinutrients mainly trypsin inhibitors which is heat-labile.

Bambara groundnut belongs to the family *Leguminosae*, sub-family *Papillonoideae* (Goli, 1995). Bambara groundnut is an herbaceous, intermediate, annual plant with creeping stems at ground level. The fruit of bambara groundnut develops on or below the soil surface (Swanevelder, 1998). The pods usually develop underground and may reach up to 3.7cm, depending on the number of seeds they contain. Most varieties have single-seeded pods, but pods with three seeds were frequently found in ecotypes collected in Congo (Goli and Ng, 1988). In many dry, hostile environments, bambara groundnut is able to produce some yield, where groundnut and other drought-tolerant legumes may fail completely (Nyamudedza, 1989; Lewitt, 1990).

The aim of the study was to examine the dietary effect of roasted bambara groundnut seed meal (BGM) on

the performance, nutrient digestibility and carcass characteristics of rabbits.

Materials and Methods

Experimental Animals and their Management

The experiment was conducted at the Rabbit Research House of the Abubakar Tafawa Balewa University, Bauchi. Forty weaner rabbits, of both sexes, mainly crosses between New Zealand White and California, obtained from the National Veterinary Research Institute (NVRI) Vom, Plateau State, Nigeria. They had an initial mean weight of 700g and between 5 and 7 weeks old were allocated to four dietary treatments. Each treatment had ten rabbits and five replicate per treatment in a completely randomized design (CRD).

The bambara groundnut seeds were roasted and milled to produce the bambara groundnut meal (BGM) which was incorporated into the experimental diets at graded levels of 0, 10, 20 and 30% BGM (Table 1 depicts the composition of experimental diets). Before the commencement of the experiment, the rabbits were weighed and allocated to metabolic cages. Animals were provided with feed and water *ad libitum*. Left-over feed was collected and weighed before the next morning feeding. Animals were weighed on weekly basis and feed intake was measured daily. Feed conversion ratio was calculated from the data obtained. In the fourth week of the feeding trial, faeces were collected for a period of seven days; they were dried, bulked and weighed for nutrient digestibility determination. At the end of the five-week feeding trial, four out of ten rabbits (40 percent) were randomly selected for carcass and organ measurements. Data obtained from performance parameters, nutrient digestibility, carcass and organ measurements were subjected to the analysis of variance (Steel and Torrie, 1980).

Chemical analysis:

Proximate analyses of bambara groundnut (both raw and roasted seeds), experimental diets and faecal samples were

carried out using the methods outlined by the Association of Official Analytical Chemists (AOAC, 1990). The acid detergent fibre (ADF) and neutral detergent fibre (NDF) of the samples were determined by the method of Goering and Van Soest (1970). The proximate composition of bambara groundnut seeds are presented in Table 2

Table I: Ingredient and chemical composition (%) of roasted bambara groundnut meal based diets

Ingredients	BGM 0%	BGM 10%	BGM 20%	BGM 30%
Maize	32	26	20	14
Soyabean (full-fat)	19	15	11	7
Bambara groundnut meal	0	10	20	30
Groundnut haulms	15	15	15	15
Maize offal	30	30	30	30
Bone meal	3	3	3	3
Salt	0.5	0.5	0.5	0.5
Min/vit/premix*	0.5	0.5	0.5	0.5
Total	100	100	100	100
Calculated analyses				
Crude protein	16	16	16	16
Energy (Kcal/kg)	2689	2713	2737	2761
Lysine (%)	0.66	0.68	0.70	0.73
Methionine+cystine (%)	0.50	0.53	0.56	0.60
Calcium (%)	1.20	1.20	1.20	1.20
Phosphorus (%)	0.77	0.73	0.69	0.65
Chemical analyses				
Dry matter	95.32	95.40	95.24	95.43
Crude protein	17.34	17.64	17.62	16.81
Crude fibre	7.28	8.31	8.75	8.86
Crude fat	4.67	4.42	4.91	4.29
Ash	7.92	8.40	7.42	8.49

*Premix (Agricare-mix®) supplied per kg of diet; Vitamin A 20,000IU; Vitamin D 4,000IU; Vitamin E 39.96 IU; Vitamin K 5.99mg; Riboflavin 12mg; Vitamin B_{12} 0.1mg; Pyridoxine Hcl 7mg; Cal-D-Panthothenate 30mg Nicotinic acid 70mg; Folic acid 2mg; Biotin 0.2mg; Potassium 0.41%; Sodium 0.30%; Copper 24mg; Manganese 110mg; Zinc 100mg; Iron 110mg; Selenium 0.3mg; Calcium 0.22mg; Iodine 3mg; Choline 1000mg; Butylated hydroxytoluene (BHT) 140mg and Zeolex 50mg.

Table 2: Proximate composition (%) of raw and roasted bambara groundnut seeds

Content	Raw seed	Roasted seed
Dry matter	95.24	96.36
Crude protein	20.05	22.54
Crude fat	7.15	8.31
Crude fibre	5.48	4.88
Ash	3.40	3.48
Nitrogen free extract	59.16	57.15

Results

The performance parameters of rabbits fed graded dietary levels of roasted bambara groundnut meal are shown in Table 3. Daily feed intake of rabbits fed graded levels of bambara groundnut meal (BGM) were not significantly different from each other. The daily feed intake values ranged from 45.44g for rabbits on 0% BGM based diet to 52.47g for those on 10% BGM based diet. Results showed that dietary treatments did not significantly influence daily weight gain (11.04 - 13.18g) of rabbits fed graded dietary levels of BGM. Feed conversion ratios (FCR) were also not significantly affected by dietary treatments although it tended to decrease with increasing dietary levels of BGM.

Table 3: Effect of graded dietary levels of roasted bambara groundnut meal on performance parameters of rabbits

Parameters	Dietary levels of bambara groundnut (%)				
	0	10	20	30	SEM
Initial live weight (g)	720.00	745.00	655.00	620.00	44.86^{NS}
Final live weight (g)	1208.33	1335.00	1317.00	1103.00	73.68^{NS}
Daily feed intake (g)	45.44	52.47	51.10	45.71	1.44^{NS}
Daily weight gain (g)	11.04	13.18	12.65	12.40	0.90^{NS}
Feed conversion ratio	4.14	4.12	3.97	3.44	0.36^{NS}

SEM = Standard error of mean
NS = Not significant

The FCR values were 4.14, 4.12, 3.97 and 3.44 for rabbits on 0, 10, 20 and 30% dietary levels of BGM respectively. Rabbits on 10% BGM based diet had the highest final live weight of 1335.00g while rabbits on 30% BGM based diet had the lowest final live weight of 1103.00g although the difference was not significant.

Carcass characteristics of rabbits are shown in Table 4. There was no significant variation among dietary treatments. Carcass weights ranged from 548.50 to 688.50g for rabbits on the 30 and 10% BGM based diets respectively. The dressing percentage ranged from 49.14% for rabbits on 20% dietary level of BGM to 51.42% for those on 10% dietary level of BGM. Percent live weights for small intestine values were 4.19, 4.41, 5.02 and 5.38% and values for of the liver were 2.42, 2.45, 2.65 and 2.68% for rabbits on 0, 10, 20 and 30% dietary levels of BGM respectively. The values for the small intestine and for the liver showed slight increases with increase in dietary levels of BGM although the

effects were not significant. For the other organs however, no consistent trend was observed. The following range of values were observed: large intestine, 1.31 - 1.51%; caecum, 5.20 - 5.96%; stomach, 3.38 - 5.52%; kidney, 0.59 - 0.72%; heart, 0.19 - 0.26%; head, 8.54 - 9.04% and pelt, 7.02 - 7.97%.

Table 4: Effect of graded dietary levels of roasted bambara groundnut meal on carcass characteristics of rabbits

Parameters	Dietary levels of bambara groundnut meal (%)				SEM
	0	10	20	30	
Carcass weight (g)	602.67	688.50	646.33	548.50	44.65^{NS}
Dressing %	49.79	51.42	49.14	49.76	1.06^{NS}
Organ weights (% LW)					
Small intestine	4.19	4.41	5.02	5.38	0.25^{NS}
Large intestine	1.50	1.31	1.38	1.51	0.12^{NS}
Caecum	5.96	5.52	5.82	5.20	0.47^{NS}
Stomach	5.15	3.38	4.25	5.52	0.52^{NS}
Liver	2.42	2.45	2.65	2.68	0.18^{NS}
Kidney	0.69	0.59	0.63	0.72	0.04^{NS}
Heart	0.25	0.26	0.19	0.21	0.02^{NS}
Head	9.04	9.01	8.54	8.70	0.11^{NS}
Pelt	7.79	7.07	7.50	7.02	0.27^{NS}

SEM = Standard error of mean
NS = Not significant
LW = Live weight

Table 5: Nutrient intake and digestibility of rabbits fed diets containing graded levels of roasted bambara groundnut meal

Parameters	Dietary levels of bambara groundnut meal (%)				SEM
	0	10	20	30	
DMI (g)	44.12	48.71	46.84	44.06	1.44 NS
OMI (g)	40.62	44.62	43.37	40.32	1.32 NS
CPI (g)	7.65	8.59	8.26	7.32	0.24 NS
ADFI (g)	5.86	6.51	6.25	5.89	0.19 NS
NDFI (g)	9.72	10.73	9.7	9.21	0.30 NS
DMD	71.13	69.45	70.62	70.7	2.00 NS
OMD	79.06	81.85	79.37	80.14	1.57 NS
CPD	85.86	86.37	86.77	85.89	0.94 NS
ADFD	29.43	28.33	29.40	27.08	1.34 NS
NDFD	43.20	44.42	46.53	46.33	1.48 NS

DMI = Dry matter intake
OMI = Organic matter intake
CPI = Crude protein intake
ADFI = Acid detergepnt fibre intake
NDFI = Neutral detergent fibre intake
SEM = Standard error of mean
DMD = Dry matter digestibility
OMD = Organic matter digestibility
CPD = Crude protein digestibility
ADFD = Acid detergent fibre digestibility
NDFD = Neutral detergent fibre digestibility
NS = Not significant

The nutrient intake and digestibility values of rabbits fed roasted bambara groundnut based diets are shown in Table 5. Results of the nutrient intakes (DMI, OMI, CPI, ADFI and NDFI) showed that rabbits in the control group that received 0% BGM based diet were not significantly different in their nutrient intakes when compared with those that received 10, 20 and 30% dietary levels of BGM. The following range of values were obtained for: DMI (44.06 - 48.71g); OMI (40.32 - 44.62g) and CPI (7.32 - 8.59g). The lowest values were obtained for rabbits on 30% BGM based diet and

the highest values for rabbits fed 10% BGM based diet respectively. They all followed the same trend. The acid detergent fibre intake (ADFI) ranged from 5.86g for rabbits on 0% BGM based diet to 6.51g for those on 10% BGM based diet. The NDFI values fell in the range of 9.21g for rabbits fed 30% BGM based diet to 10.73g for those fed 10% BGM based diet. Results obtained from the digestibility of nutrients revealed the following range of values: DMD (69.45 - 71.13%), OMD (79.06 - 81.85%), CPD (85.86 - 86.77%), ADFD (27.08 - 29.43%) and NDFD (43.20 - 46.53%)

Discussion

Daily feed intake of rabbits were not significantly affected by varying dietary levels of bambara groundnut meal (BGM). The daily feed intake values ranged from 45.44g for rabbits on 0% BGM based diet to 52.47g for those on 10% BGM based diet. These values are within the range of 51.4 - 55.6g reported by Joseph *et al.* (2000), who also obtained a non-significant dietary effect of roasted bambara groundnut on daily feed intake of rabbits. This result contradicts the findings of Arijeniwa and Igene (2002), who reported a significant difference in DFI and DWG of rabbits fed graded dietary levels of bambara groundnut meal. This may be attributed to the fact that these workers fed raw bambara groundnut as opposed to roasted bambara groundut fed in this study. The presence of antinutritional factors in the raw bambara groundnut such as trypsin inhibitors might have resulted in reduction in feed intake and poor protein digestion and nutrient utilization. The results obtained for final live weight of rabbits in this study is in agreement with that of Joseph *et al.* (2000), who observed no significant difference in the final live weights of rabbits fed graded levels of toasted bambara groundnut. Carcass weights obtained in this study also did not show any significant effect of dietary treatments. Carcass weights fell within the range of 548.50 - 688.50g and dressing percent ranged from 49.14 to

51.42%. These values were higher than the values reported by Joseph *et al.* (2000) who obtained carcass weights in the range of 288.70 - 501.60g and dressing percentage in the range of 35.30 - 48.20%. Organ weights (expressed as percentage of live weight) were also not significantly influenced by dietary treatments. These results agree with the findings of Ehebha *et al.* (2008).

The results on DMI revealed that the rabbits that received the 10% BGM based diet had the highest DMI of 48.71g and those fed 30% BGM based diet had the lowest value of 44.06g. Differences between means of DMI were not significant. The OMI and CPI values were in the range of 40.32 - 44.66g and 7.32 - 8.59g respectively. The OMI and CPI values followed a similar trend as observed in the DMI. The values of CPI obtained in this study fell within the range of 7.58 - 11.78g reported by Adegbola (1991) for rabbits under humid tropical conditions. The ADFI and NDFI showed range of values of 5.86 - 6.51g and 9.21 - 10.73g respectively. Digestibility of nutrients (DMD, OMD, CPD, ADFD and NDFD) did not exhibit significant variation among dietary treatments. The values of 69.45 - 71.13% for DMD agree with the findings of Egbo (2001) who reported a mean value of 70.88%. The values of CPD varied from 85.86 to 86.77% for rabbits fed 0 and 20% BGM based diets respectively. The digestibilities of the detergent fibres (ADFD and NDFD) revealed that the control diet (0% BGM based diet) was not significantly different from other dietary treatments. The ADFD and NDFD values varied from 27.08 to 29.43% and from 43.20 to 46.53% respectively. The digestibilities of these detergent fibres did not show any particular pattern or trend as a result of dietary treatments.

Conclusion

It was concluded that BGM, a non-conventional protein source has great nutritional potentials in the diets of rabbits and could be included up to 30% in the diets of rabbits without adverse

effect on the performance, nutrient digestibility and carcass characteristics of rabbits.

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