THE EFFECTS OF GRADED LEVELS OF BREWERS' SPENT GRAINS AND KOLANUT POD MEAL ON THE PERFORMANCE CHARACTERISTICS AND CARCASS QUALITYOF RABBITS

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ABSTRACT

Thirty six New Zealand fryer rabbits (bucks) averaging 874 g in body weight were fed on three diets blended with 0. 7, 14% kolanut pod meal (KPM) and 10, 20 and 30% Brewers spent grains (BSG). Other dietary components included maize, soyabean meal, bone meal, salt and vitamin-mineral mixture. The trial lasted for 98 days.

Significant differences ($P < 0.05$) were found among the three rations with respect to daily live weight gains, feed intake and water intake.

There were significant differences among the three rations with respect to percent carcass yield, feet, blood and unemptied alimentary canal. However there were no significant ($P > 0.05$) differences among the three rations with respect to head, tail, and liver weights expressed as percentage of live weight.

There was no significant treatment effect on the wholesale cuts. The chemical composition of the meat of rabbits fed 14% KPM + 30% BSG diet was significantly lower in energy value, % moisture and % fat. The results showed that a diet fortified with 30% BSG and 14% KPM will support good growth as well as improved carcass yield of rabbits.

Key words: Rabbits, kolanut pod meal, Brewers' spent grain

INTRODUCTION

The unprecedented increase in the cost of conventional ingredients used in compounding livestock feeds has necessitated intensive investigations into the use of agricultural and agro-based industrial by-products. Nigeria produces large quantities of agricultural and agro-industrial by-products which are regarded as non-conventional feed sources.

Among such agro by-products are kolanut pod and brewers dried grains. It is estimated that Nigeria produces about 2 million tonnes of kolanut pods annually in the rain forest zone. At present, these pods are left to rot away or in some cases may be burnt. To achieve efficient utilization of this and other agricultural by-products, it is very essential to have a knowledge of their nutritive value and response of animals to thier use. Some of the limiting factors associated with using crop residues and agro-industrial by-products as animal feeds include: procurement, storage, poor feed intake, high fibre content, toxic substances, low digestibility and low nutrient contents and subsequent low animal performance (Ely et al., 1953; Forbes et al., 1992; Slyter and Kamastra, 1974; Alawa and Amadi, 1991; Adegbola and Oduozo, 1992).

Proximate analysis of kolanut and .brewers dried grains have been reported by several authors, (Eka, 1971; Ogutuga 1975; Alawa and Amadi, 1991) but little information exists on the chemical content of the kolanut pod and no information exists in the literature on the feeding value of the pod meal.

Optimum level of inclusion of these highly fibrous by-products in non-ruminant diet has always been a bone of contention among nutritionists considering the effect of crude fibre that abound in these by-products. Hence, the current investigation was undertaken to assess the value of kolanut pod meal and brewers spent grains fed at varied levels in combination with other ingredients on the performance and carcass characteristics of rabbit.

MATERIALS AND METHODS

A total of 36, eight week old New Zealand fryer rabbit bucks whose weights averaged 874g, from the Institute's rabbitry were divided into three experimental groups of 12 rabbits per treatment in a randomized block design. Animals within each treatment were housed individually in cages raised 90 cm above concrete measuring 76 x 62 x 48 cm and provided with wire screen floor which permitted faeces to drop.

Fresh kolanut pods of accuminata variety collected from Cocoa Research Institute of Nigeria, Ibadan were sun dried to about 15% moisture level and milled. The proximate composition of the milled pod and data were determined according to A.O.A.C. (1984) method (Table 1). Both kolanut pod meal and brewers dried grains were included at three levels 0. 7, 14; 10, 20 and 30% respectively with other basic ingredients to balance the ration (Table 1). The rations were provided in a mash form and offered twice daily at a level that would ensure ad-libitum intake. Water was provided ad-libitum and daily records of the feed and water intakes were kept. Record of left overs of each animal was kept throughout the 98 day trial period by the weigh-back technique. Animals were weighed at weekly intervals.

TABLE 1: PERCENTAGE COMPOSITION OF EXPERIMENTAL DIETS

Ingredients	Inclusion Levels of KPM and BSG		
	0% KPM 10% BSG	7% KPM 20% BSG	14% KPM 30% BSG
Maize	60.00	50.00	40.00
Soyabean meal	28.00	21.00	14.00
Brewers spent grains	10.00	20.00	30.00
Kolanut pod meal	0.00	7.00	14.00
Bone meal	1.00	1.00	1.00
Salt	0.50	0.50	0.50
Vitamin mineral mix	0.50	0.50	0.50

At the end of the trials, three bucks from each treatment group were randomly selected, weighed and slaughtered to evaluate the carcass and meat chemical composition. The bucks selected were slaughtered by severing their heads at the occipitoatlas articulation.

Blood of each animal was drained into a weighed container and reweighed. The tails and feet were cut off and weighed. Carcasses were skinned and each animal was cut open and alimentary canal, kidneys, liver, lungs and heart were removed and weighed individually. The weights of carcasses devoid of internal organs were recorded.

The carcasses were skinned and dissected into retail cuts of fore-legs, hind legs, ribs, loin and rump which were then weighed. The carcass yield was computed from the sum of the carcass and skin weights were expressed as a proportion of the final liveweight.

Samples of meat from each treatment group were obtained, dried, milled and analysed immediately after the experiment was completed for moisture, protein, fat and ash according to the procedures of the A.O.A.C. (1984). The gross energy content of the dried meat samples was determined with a ballistic bomb calorimeter. Data obtained were subjected to analysis of variance as described by Steel and Torrie (1980).

RESULTS

Animal Health:

Rabbits fed the control diet as well as KPM and BSG supplemented diets did not experience any digestive problems throughout the trial period.

Hemical Composition of Diets:

The diet components, their analysed proximate composition and that of the processed kolanut pod meal and BSG are shown in Table 2. Comparing the control ration with supplemented rations, the crude protein contents of the three rations were almost isonitrogenous. The crude fibre and total ash were higher in the KPM supplemented diets than the control ration.

Gross energy content was highest in the control ration and lowest in the 14% KPM + 30% BSG supplemented diet.

Performance Characteristics:

The average daily gain in weight, feed intake, feed efficiency and water intake are presented in

TABLE 2: ANALYSIS OF BREWERS SPENT GRAINS, KOLANUT POD AND DIETS

Proximate Component	BSG	KPM	Inclusion Levels of KPM and BSG (%) 0% KPM 10% BSG	7% KPM 20% BSG	14% KPM 30% BSG
Crude Protein	19.78	13.86	17.44	17.30	17.16
Crude fibre	21.65	17.25	8.54	10.88	13.02
Crude fat	7.25	1.25	1.27	1.19	1.13
Ash	3.45	5.85	5.35	7.21	8.33
Gross Energy	47.87	61.79	67.40	63.42	60.36
Gross Energy KJ/KgDM	20700	18339.06	23974.32	21417.92	20915.84

TABLE 3: PERFORMANCE OF NEW ZEALAND FRYER RABBITS FED VARIED LEVELS OF KOLANUT POD MEAL AND BREWERS SPENT GRAINS

Parameters	Inclusion Levels of KPM and BSG 0% KPM 10% BSG	7% KPM 20% BSG	14% KPM 30% BSG
Days on trial	98	98	98
Initial liveweight (g)	883± 22[a]	869±42	890±36
Final liveweight (g)	2332±84	2360±88	2462±72
Weight gain (g/d)	14.79±26	15.21± .12	16.04± .42[b]
Feed intake (g/h/d)	72.03± 1.57	75.35± 1.35	86.53± 1.36[b]
Feed efficiency (g feed/g gain)	4.87± .06	4.95± .07	4.39± .09[b]
Water intake (ml/d)	241± 5.18	248± 3.5	258± 4.5[b]

[a] Standard Error

[b] Significantly (P< 0.05) greater than other values on the smae row.

Table 3. The dietary treatments imposed influenced (P < 0.05) the growth rate of rabbits as in Table 2. Rabbits fed 14% KPM and 30% BSG supplemented diet recorded the highest body weight gain of 16.04 g/d whilst the control group recorded the lowest body weight gain of 14.72 g/d.

Feed and Water Intake:

Feed intake was very low for rabbits that received the control diet. Feed intake increased linearly as the levels of KPM and Brewers spent grains (BSG) in the diet increased. The inclusion of KPM and BSG significantly (P<0.05) influenced the intake of the diets as feed intake of both supplemented diets increased over the control group. The highest feed intake of 86.33 g/day was recorded for the group on the 14% kolanut pod meal and 30% BSG diet while the least feed intake of 71.03 g/day was recorded for the control group.

Water intake followed similar patterns as the feed intake. Increase in feed intake resulted in significant (P<0.05) increase in water intake. Average water intake for the groups were 241, 248 and 258 ml/d for the groups fed control, 7% and 14% KPM diets respectively.

Efficiency of Feed Conversion:

The efficiency of feed utilization was significantly (P 0.05) influenced by the dietary treatments imposed. The group fed 14% KPM and 30% BSG supplemented diets used least feed per gram of gain than the other two groups. The feed efficiency ratios were 4.87, 4.95 and 4.39 for groups fed 0. 7 and 14% KPM diets respectively.

Carcass yield, organs and wholesale cuts:

Table 4 shows the carcass and organ weights expressed as the percent of liveweight and wholesale cuts expressed as % of dressed carcass weight. The average carcass yield was

significantly influenced by the inclusion levels of KPM with rabbits fed 14% KPM and 30% BSG recording 62.4% as against 58.45 and 58.58% for groups fed 0 and 7% KPM respectively. The alimentary canal which was not flushed nor the rabbits starved prior to slaughter made up of 12 to 15% of the body weight and these decreased significantly (P>0.05) with increasing inclusion level of KPM. Percentage weights of head were 8.68, 8.58 and 8.35 for 0.7 and 14% KPM fortified diets respectively. Feet weights ranged from 1.82 to 2.40% of the body weight and differed significantly (P 0.05) with the inclusion levels of the KPM. The tail weights ranged from 0.46 to 0.54 of the body weight and differed non-significantly (P 0.05) among treatment groups. The relative weights of blood increased significantly with increasing inclusion level of KPM and BSG.

TABLE 4: CARCASS MEASUREMENTS OF NEW ZEALAND RABBITS FED VARIED LEVELS OF KOLANUT POD MEAL (KPM) AND BREWERS SPENT GRAINS (BSG)

Parameters	Inclusion Levels of KPM and BSG			Level of significance
	0% KPM 10% BSG	7% KPM 20% BSG	14% KPM 30% BSG	
Liveweight (g)	2190 ±95[a]	2040± 85	2235± 102	
Dressed carcass weight (g)	1280±54	1195± 48	1395± 36	P <0.05
Carcass yield (%)	58.45± 1.58	58.58± 98	62.41± 1.13	P< 0.05
Carcass components (%)				
- Head	8.68± .64	8.58± .58	8.35± .15	NS
- Tail	0.46±0.08	0.53±0.13	0.54±0.06	NS
- Feet	2.40± .56	2.31± .28	1.82± .12	P< 0.05
- Blood	1.95± .22[c]	2.45± . 31	2.91± .25	P< 0.05
- Alimentary canal	15.30± 1.21	14.46± .98	12.31± 1.18	P< 0.05
- Liver	2.40± .35	2.45± .15	2.53± .22	NS
- Kidneys	0.68±0.08	0.98±0.06	1.04±0.02	P<0.05
- Lungs	0.68±0.05	0.49±0.10	0.54±0.11	P< 0.05
- Heart	0.34±0.06	0.49±0.05	0.72±0.03	P< 0.05
Wholesale Cuts (%)				
- Rib	18.57± .52	18.58 ±.48	19.14 ±.96	NS
- Loin	24.29± 1.2	24.60 ±1.6	24.76 ±.82	NS
- Rump (Sirloin)	10.48± .65	10.36 ±.75	10.95 ±.63	NS
- Fore legs	17.62± .85	17.65 ±.68	18.57 ±.97	NS
- Hind legs	27.14± 1.21	28.34 ±1.18	27.14 ±1.31	NS

a = Standard Error
NS = Non Significant

TABLE 5: VARIATION OF BODY COMPOSITION OF RABBITS FED VARIED LEVELS OF KOLANUT POD MEAL AND BREWERS SPENT GRAINS

Parameters (%)	% INCLUSION LEVELS			Level of Sginificance
	0% KPM 10% BSG	7% KPM 20% BSG	14%KPM 30% BSG	
Moisture	75.76± .22[a]	72.28± .91	71.54± .45	P< 0.05
Crude protein	19.53± .35	19.80± .41	20.44± .13	NS
Fat	10.27± .71	10.16± .12	8.20± .54	P< 0.05
Ash	4.17 ±.38	4.17± .24	4.21± .08	NS
Energy (KJ/KgDM)	26317.36	23974 32	24894.8	P< 0.05

a = Standard Error
NS = Non-Significant

The wholesale cuts expressed as percentage of dressed carcass weight did not vary so much. Generally, percent wholesale cuts did not show any distinct differences among the treatment groups. However, slight improvements of the wholesale cuts were observed with increasing inclusion levels of KPM and BSG.

Meat Chemical Composition:

The moisture, protein, fat, ash and energy content of rabbit meat are presented in Table 5. The kolanut pod meal fed groups showed significantly lower moisture and fat in the carcass compared to the control group. Conversely, the kolanut pod meal fed groups showed higher protein content 19.80 ± 0.41% and 20.44± 0.13% respectively compared to 19.53 ±0. 35% for the control group. The differences were however not significant (P> 0.05).

The total ash showed very little variation among the three treatment groups. The gross energy values were 26317.31' 23974.32, 24894.8 kJ/kgDM of meat from control, 7 and 14% KPM diets respectively.

DISCUSSION

The proximate composition of dried kolanut pod agreed with data reported by Ogutuga (1975) except for the crude protein which was higher in our own analysis (10.22% as compared to 13.86%). This difference was probably due to varietal difference as Cola acuminata was used in this investigation as compared to Cola nitida used by Ogutuga (1975). The crude protein and fibre contents of KPM used were 13.86 and 17.25% respectively and would seem to place it in the same chemical composition groups as rice bran. The high gross energy value in KPM was probably due to the rather high protein content despite the low fat content. There was a large range in the crude fibre content of the diets which necessitated the large differences in intake. Both the crude fibre and ash contents of the diets increased with increasing levels of both KPM and BSG. In contrast, gross energy content followed a downward trend with increasing level of the non-contentional feed sources in the diets.

The improved weight gains and feed consumption observed for the groups fed KPM containing diets as compared to the control group may have been due in part to the nutrients being more readily available to support weight gains and the presence of an intrinsic factor in the meal which imparted a flavour to the diets resulting in increased feed intake. Another reason for the increased intake of KPM diets over the control diet was probably to meet their energy requirements. Lebas *et. al.*, (1986) stated that a growing rabbit is able to adjust its voluntary feed intake according to the energy concentration of the diet in order to maintain a constant daily intakes of 920 - 1000 KJ DE/Kg W0.75 per day.

Rabbits can easily take advantage of the proteins contained in cellulose rich feeds whereas chickens, the only animals having a higher performance in terms of yields, can not be fed economically on cellulose feed (Lebas, 1983). Better consumption and utilization of the supplemented diets used in this investigation which contained more fibrous components (brewers dried grains and kolanut pod meal) than the control diet, supports the findings of Cheeke and Amberg, (1972); Butcher et al. 1981; Lebas, (1983) who have shown that increased CF provided as straw resulted in increased voluntary feed intakes for growing rabbits. The range of average daily weight gains obtained in this investigation are similar to those obtained by Omole and Onwudike (1981) for rabbits fed sawdust mixed with poultry manure and Oluokun (1985) but are some how lower than values reported by Omole and Onwudike (1983) and Singh *et al* (1988) on different diets. According to Cheeke (1986), the growth rate of rabbit is usually lower in hot weather.

The feed intake reported here is higher than those reported by Omole and Onwudike (1983) and Payne *et al*;, (1983). The results of efficiency of feed utilization are in good

agreement with those reported by other workers in that the feed efficiency ratio tended to increase as the dietary quality improved but differed in the absolute ratios which are higher than ratios reported by other workers (Chen *et al*., 1978; Omole and Onwudike, 1983). The water intakes reported here which ranged from 241 - 258 ml/day were comparable to the observations of Adegbola and Oduozo (1992) which ranged from 229 - 244 ml/day for rabbits fed varying levels of fermented and unfermented cassava meal.

The organ weights for the liver, kidneys and heart expressed as the percentage of liveweight obtained in this study are lower than these reported by Rao *et al.*, (1978). However, these organs exhibited a constant increase in weight as the levels of KPM in the diets increased. The possible explanation for the observed increases is the significance of these organs, most especially the liver and the kidney, which are invovled in the metabolism of carbohydrates and proteins in the diets. The increase in heart weight was an indirect effect due to the increased metabolic activities of the liver.

Although the differences between means for retail cuts were not significant, the percent yield of the physical cuts of the KPM fed groups were slightly higher than the control group. The values obtained for ribs, loin and hind legs are slightly lower than those reported by Rao *et al.* (1978) but similar to those reported by Oluokun (1985). The lower values of the physical cuts for the control group means that the control feed was poorly utilized leading to higher wastage of energy that would have been used for fattening despite the high energy content of the diet.

In chemical composition, rabbit meat is comparable to chicken and is higher in protein content than the other meats (USDA, 1973). Rabbit meat is also lower in the fat and cholesterol contents than most of other meats (USDA, 1973). Both moisture and protein values obtained in this study are slightly higher than those reported by Fischer et al (1975); Rao *et al* (1998) and USDA (1973). The percent protein, fat, ash and energy values obtained in this study are similar to those reported by Oluokun (1985).

The results of this investigation have shown that feeding of kolanut pod meal up to 14% of inclusion plus 30% BSG in conventional rabbit diets is technically feasible.

However, further investigations are required to establish the optimum level of inclusion in order to exploit fully these sources of nutrients in livestock feeding.

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