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Performance of growing rabbits fed graded levels of sugarcane peel diets

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Target Audience: Animal Nutritionists, Rabbit farmers, Feed millers

Abstract

Twenty five growing rabbits of mixed breeds and average weight of 894g were used in a seven week feeding trial. Five experimental diets were formulated in which sugarcane peels (SCP) was included at 0, 10, 20, 30 and 40% levels to replace maize offal. The rabbits were balanced for weight and allotted to the treatments (n=5 rabbits/treatment) in a completely randomized design. Water was supplied ad libitum. Results obtained showed that final live weight was not significantly affected by sugarcane peel level. Feed intake decreased as the level of sugarcane peels increased in the diets. Dry matter intake per body weight or metabolic weight was similar for all the sugarcane peel levels. At 30% inclusion, sugarcane peels gave weight gain that was comparable to the control, 10% and 20% SCP. Weight gain decreased (P<0.05) on 40% diets compared to 10% SCP. There was no significant effect of sugarcane peels on metabolic body weight and feed efficiency. The trend showed that the cost of feed per kilogram live weight gain was linearly reduced as the level of sugarcane peel increased. Percent savings of 29.67 to 46.30 was obtained with sugarcane peel inclusion in the diet. Inclusion of sugarcane peels at 30% level improved (P<0.05) thigh and head percentage, while the meat composition (crude protein, ether extract, moisture and ash) were not significantly affected by the inclusion level. Based on savings per kilogram gain of ₦125.9 (33.06%) with comparable weight gain on 30% SCP diet compared with the control, it was concluded that sugarcane peels inclusion at 30% of the diet was adequate for growing rabbits without compromising performance, carcass characteristics and composition.

Keywords: Performance, sugarcane peels, carcass characteristics, meat composition, rabbits

Description of Problem

Feed accounts for about 60 to 70% of the production costs and therefore the demand for inexpensive feedstuffs have led to an increasing interest in novel sources of dietary proteins, fats and carbohydrates (1). Consequently, Aletor (2) suggested that rapid expansion and success of livestock industry in Nigeria would depend mainly on the availability of good quality and

relatively inexpensive feed ingredients for the formulation of livestock feeds. Agro-industrial by-products and crop residues represent a vast animal feed resource, which are still largely unexploited (3). Considerable research has been, and is being, carried out on the potential utilization of these by-products and crop residues, however many more are wasted and constituting environmental hazard.

Sugarcane is highly productive and low cost resource useful for food, feed and fuel purposes (4). Some of the main by-products that are available from sugarcane industry are: sugarcane tops, bagasse, molasses, and press mud (5). Other locally available sugarcane by-products are sugarcane scrapping and sugarcane peels. Sugarcane tops is a major by-product of sugarcane industry (6). Sugarcane peels is a waste product obtained when sugarcane stem is processed for consumption. The peels are obtained from peeling of sugarcane stem with a sharp knife. The peels consist of soil particles, wax pigments, fibrous materials and some of the underlying parenchyma cells. Sugarcane peels contain nutrients such as fibre, energy and minerals required for animals' growth and performance (7). The scrapings contained a 87.6% dry matter, 3.2% crude protein, 12.7% crude fibre, 2.8% ether extract, 12.8% ash and 77.1% (8) NFE.

There is much availability of sugarcane peels in the Northern part of Nigeria which is polluting the environment (9). Information on the utilization of sugarcane peels for feeding animals such as rabbits at the moment is scarce. Having known that sugarcane peels is very rich in crude fibre, this study was therefore designed to determine the growth performance, carcass characteristics and meat composition of growing rabbits fed graded levels of sugarcane peel meal diets. If this can be achieved, then considerable increase in rabbit production will follow, helping to reduce the acknowledged animal protein deficit and environmental pollution.

Materials and Methods

Experimental Location

The study was conducted at the University Farm, Faculty of Agriculture, Bayero University, Kano. The farm is located at the New Site of the University, about 5km west of Kano city in Ungogo Local Government Area. Kano is located within the general area demarcated by longitude 8^{o}E and 9^{o}E and latitude 12^{o}N and 13^{o}N in the Northern Guinea Savannah zone of Nigeria. The area has two seasons, a wet season (May-September) and dry season (October-April). Annual temperature ranges between 21^{o}C and 39^{o}C. In the wet season, the temperature range is 25-33^{o}C, while in the dry season the range is 28-39^{o}C. Annual rainfall ranges between 787mm and 960mm (10).

Source and Processing of Sugarcane Peels

The sugarcane peels was collected from sugarcane selling points within the metropolitan areas of Kano State. The peels were sun dried on a cemented floor for a period of 4 days and finally milled with a hammer mill to produce sugarcane peel meal.

Experimental animals and their management

Twenty five (25) growing rabbits of mixed breeds with an average initial weight of 894g were purchased from Kano metropolitan market for the experiment. On arrival, the animals were dewormed with Banmith, given terramycin and vitalyte as anti-stress and antibiotics for the first five days. The experimental diets were gradually

used to replace the feed the animals were used to in the first week at the experimental station to acclimatize them. In the second week, the animals continued with the experimental diet, and record taking commenced.

Growth study

Five complete experimental diets were formulated to contain varying levels of sugarcane peels (SCP) to replace maize offal at 0 (control), 10, 20, 30, 40% inclusion level (Table 1). Five rabbits were allocated to each treatment to serve as replications in a completely randomized design. The weight of rabbits in each treatment was balanced before the commencement of the experiment. One hundred and fifty grams of experimental diet was served to each animal per day to give room for ad-libitum feeding in earthen feeders. Clean drinking water was provided daily in earthen drinkers. Feed intake was recorded by subtracting the left over from the amount of feed offered the animals. This was done on daily basis. Growth performance, expressed by weight gain was recorded by weighing the rabbits weekly. Data collection for growth performance was carried out for seven weeks.

Table 1: Experimental Diets fed to rabbits

	Sugarcane peel level (SCP %)				
Ingredient	0	10	20	30	40
Maize offal	40	30	20	10	0
Sugarcane peels	0	10	20	30	40
Maize	25	25	25	25	25
Soya Bean Meal	15	15	15	15	15
Groundnut Cake	15	15	15	15	15
Bone Meal	3	3	3	3	3
Palm Oil	1	1	1	1	1
Premix	0.5	0.5	0.5	0.5	0.5
Salt	0.5	0.5	0.5	0.5	0.5
Total	100	100	100	100	100
Nutrient Composition:					
CF (%)	8.96	10.51	12.31	13.95	15.57
CP (%)	16.41	15.48	15.51	14.96	14.65
Energy (Kcal ME/kg)	2426	2361	2338	2304	2262
Cost of feed/kg diet (₦)*	51.19	42.96	35.32	28.25	21.91

*Calculated

Carcass and meat composition evaluation

The carcass evaluation was conducted at the end of the experiment. Two rabbits were randomly selected from each treatment for carcass analysis. The rabbits were fasted for twenty four hours to clear the gut before slaughter. The rabbits were sacrificed by cutting the jugular vein with a sharp knife. The live weight before fasting and live weight at slaughter were recorded for each animal. Carcass weight was taken and recorded before and after skinning. The carcasses were eviscerated. The dressed carcass were weighed and expressed as percentage of the live weight to obtain dressing percentage. Weights of the cut parts

such as hind legs (tarsus, metatarsus and phalanges), fore legs (carpus and metacarpus), thigh (femur, fibula, tibia and calcaneus), shoulder (scapula, ulna and radius), loin, chest, head were obtained and expressed as a percentage of carcass weight and the weight of organs such as: kidney, heart, liver and lung were expressed as percentage of the live weight. The weights were obtained with the aid of a ADG 3000L sensitive weighing balance. A muscle portion weighing 50g from the thigh of each skinned carcass was analyzed for nutrient composition (water, crude protein, ether extract and ash).

Chemical Analytical

Thoroughly mixed representative samples of the experimental diets and sugarcane peels were analyzed for proximate composition as outlined by the AOAC (11) and Van Soest *et al*. (12). Dry matter was determined by drying the samples at 70^0C for 24h using a Memmert convection oven. Total nitrogen content was determined by the macro-kjeldahl method. The nitrogen content was converted to crude protein by multiplying by the factor 6.25. Crude fibre was determined as the fraction remaining after digestion with standard solution of sulphuric acid and sodium hydroxide under controlled conditions. Ash was determined by ashing at 550^0C. Ether extract was determined using Soxhlet extraction procedure. For the energy content determination, an adiabatic bomb calorimeter was used.

Statistical analysis

Data collected from the experiment were subjected to analysis of variance in a Completely Randomized Design using the General Linear Model Procedure and pair-wise difference was used to separate significant means (13).

Results and Discussion

Growth performance

The growth performance of rabbits is shown in Table 2. Final live weight of the rabbits were not significantly affected by sugarcane peel level. Feed intake decreased quadratically as level of sugarcane peel increased. Feed intake was significantly ($P<0.05$) higher on 0, 10, and 20% SCP than 40% SCP which had similar intake with 30% SCP. The decrease in feed intake above 20% SCP may be due to the chaffy nature of the diets and/or increase in the level of fibre in the diet. Amata and Bratte (14) observed similar decrease in daily feed intake with increase in crude fibre content from 10.48 to 14.25% in rabbits fed Gliricidia leaf meal. Dry matter intake per body weight or metabolic weight was similar for all the sugarcane peel levels. It is possible that grinding might have reduced the fibre length of the peels therefore making it ineffective in reducing transit time of food through the gastrointestinal system of the rabbits.

Table 2: Performance of Growing Rabbits fed graded levels of Sugarcane Peels

	Sugarcane peel level (SCP %)					SEM	P	Trend		
Parameter	0	10	20	30	40			L	Q	C
Initial wt (g)	884	902	930	891	864	147.17	0.96			
Final wt (g)	1198.00	1283.00	1279.00	1153.00	1082.50	162.45	0.28			
Feed intake (g/day)	44.61^{ab}	47.30^{a}	46.23^{a}	43.31^{bc}	40.59^{c}	4.55	0.001	**	**	
Average daily Gain (g/day)	6.41^{ab}	7.78^{a}	7.12^{ab}	5.35^{ab}	4.70^{b}	1.57	0.05	*		
Dry matter intake/kg bwt (g/day)	50.53	48.74	47.19	47.60	50.64	5.91	0.83			
Dry matter intake/LW$^{0.75}$ (g/day)	52.69	51.76	49.94	49.02	51.50	4.73	0.73			
Feed conversion ratio	7.44	6.23	7.41	9.02	9.33	5.75	0.39			
Feed cost (₦/day)	2.28^{a}	2.03^{b}	1.63^{c}	1.22^{d}	0.89^{e}	0.17	<0.0001	**		*
Feed cost /kg gain (₦)	380.80	267.80	261.70	254.90	204.50	60.12	0.08			
Savings (₦/kg gain)	-	113.0	119.1	125.9	176.3					

Means in the same row with different superscripts are significantly different. SEM= Standard Error of Mean. P = probability. L= Linear, Q = Quadratic and C = Cubic. ₦ = Naira (Nigerian currency).

Cheeke (15) showed that the large digestible fibre in hay was more effective in moving food through the digestive tracts of herbivores than small, pulverized fibre. The mean ambient temperature during the period of the study was 36^{o}C. This might also have contributed to the general reduction in feed intake observed in the animals as high ambient temperatures are reported to exert a negative effect on feed intake (16, 17). Inclusion of oil to reduce dustiness and increase energy value of the diets did not appear to improve feed intake likely because the same level was used in all the diets.

Daily weight gain decreased linearly as sugarcane peels increased in the diets. Rabbits on 10% SCP had 39.6% more weight gain ($P<0.05$) than rabbits on 40% SCP, whose value did not differ ($P>0.05$) significantly with the other treatments. The low crude protein and high crude fibre content of the diet, coupled with low feed intake of rabbits on this diet might have made for insufficient nutrient availability in terms of protein and energy to meet the rabbits requirement for growth. Similar decrease in daily weight gain of rabbits fed a mixture of leaf meals and concentrates (18) and graded levels of *Pueraria phaseoloide* leaf meal (19) was reported. Adeyemi *et al.* (20) also reported decrease in daily weight gain of rabbits when the level of dietary inclusion of pineapple peel meal increased from 0 to 25% resulting in increase in crude

fibre level from 6 to 10% in rabbit diet. Weight gain by the rabbits followed a trend closely similar to that of feed intake, suggesting that the reduction in feed intake played an important role in the reduction in weight gain. This might suggest a likely effect of low energy intake and influence of the type of fibre on intake and weight gain.

Weight gain values obtained are similar to that reported by (21) for New Zealand White, Californian and Chinchilla rabbits and for rabbits fed groundnut haulms, sweet potato vines and soybean forage obtained after harvest of the tuber and seed (22). The average daily gain (4.70 – 7.78g) obtained was higher than 3.0 – 4.3g/day reported by (23) for rabbits fed morning glory forage as a replacement for groundnut hay. Nworgu *et al*. (24) obtained gains of 6.51-19.22g/day for rabbits fed *Centrosema pubescence* and *Cynodon dactylon* leaf meals.

Feed conversion ratio, was non-significantly ($P>0.05$) affected by sugarcane peel level. Similar non-significant effect of feeding rabbits with Gliricidia leaf meal (14) and groundnut haulms, sweet potato vines and soybean forage (22) have been reported. Cost of feed consumed had a cubic decrease ($P<0.05$) as level of sugarcane peels increased in the diet. Cost of feed per kg live weight gain was similar ($P>0.05$) for all the treatments but decreased linearly as level of sugarcane peels increased. Savings in cost per kilogram gain and percent savings increased with increase in level of sugarcane peels in the diet. Percent savings of 29.67 to 46.30 was obtained with sugarcane peel inclusion in the diet. This is expected since sugarcane peel which is a waste replaced the more expensive maize offal. Similar reduction in the cost of feed per kg live weight gain by including cassava leaf meal (25) and cassava peels (26) in the diets of weaner rabbits. Savings per kilogram gain obtained could likely result in a general reduction in cost of production of rabbits and increase profit margin of farmers.

Carcass Characteristics

Dressing percentage and carcass parts were similar for all the sugarcane peel levels (Table 3). Dressing percentage was 12.5% higher on 30% SCP than the control. The thigh increased ($P<0.05$) as level of sugarcane peel increased up to 30% and was 8% higher on 30% SCP compared to the control. The chest region was similar for all the treatments. Head was 14.4% higher ($P<0.05$) on 30% SCP than 10% SCP whose value was the same with the other treatments. Loin and forelegs weights were similar ($P>0.05$) for all the treatments. Bawa *et al*. (27) reported no significant difference in head and thigh, but significant improvement in dressing percentage, intestine, skin, loin with increase in crude fibre content of the diets of weaner rabbits fed varying levels of groundnut haulms and cowpea shells.

Table 3: Carcass Characteristics of growing rabbits fed sugarcane peels

	Sugarcane peel level (SCP %)					SEM	P
Parameter	0	10	20	30	40		
Live weight (g)	1122.50	1192.50	1147.50	1002.50	1150.00	89.45	0.37
Carcass weight (g)	1084.06	1139.28	1121.44	942.04	1102.31	67.71	0.15
Dressing Percentage	49.40	50.57	51.86	56.43	54.28	2.28	0.15
Meat parts (% Carcass weight):							
Thigh	19.91[b]	20.14[b]	20.53[b]	21.83[a]	20.43[b]	0.38	0.05
Chest	12.70	12.81	11.65	12.85	11.30	0.79	0.44
Head	9.63[b]	9.17[b]	9.66[b]	10.71[a]	9.27[b]	0.29	0.04
Loin	8.34	8.72	8.53	9.10	8.19	0.94	0.94
Shoulder	8.04	7.57	8.56	8.80	8.14	0.51	0.18
Skin	11.20	9.38	10.61	10.67	9.48	0.73	0.12
Hind legs	1.61	1.45	1.54	1.67	1.51	0.08	0.08
Fore legs	0.67	0.61	0.65	0.69	0.61	0.04	0.55
Organs (% Live weight):							
Liver	2.79	2.59	2.82	2.86	2.56	0.13	0.36
Lung	0.63	0.77	0.71	0.81	0.67	0.08	0.50
Kidney	0.99	1..7	1.01	1.08	0.94	0.09	0.70
Heart	0.30	0.29	0.21	0.24	0.20	0.03	0.19

Means in the same row with different superscripts are significantly different.

The shoulders were higher on 30% SCP by 1.4% than 10% SCP. Skin was 16.3% and 15.4% higher on the control than 10% and 40% SCP respectively. Hind leg was 13.2% higher on 30% SCP than 10% SCP. Fanimo *et al*. (28) observed increase in the weights of carcass cut parts with increase in the level of cashew apple waste in rabbit diets. These differences could be attributed to the nature of the fibre source, age differences of the rabbits and length of the adaptation period of their digestive system to the fibre source (29).

All the organs (liver, lung, kidney and heart) were similar for all the treatments. Similar results were obtained for rabbits fed dried plantain peels (30) and fermented cocoa bean shell diets (31). This indicates that sugarcane peels is relatively devoid of anti-nutritional factors that could possibly affect these organs particularly liver and kidney. According to (32) the weights of some internal organs like the liver and kidney are commonly used in animal feeding experiments as evidence of feed toxicity

Meat Composition

Meat composition was not affected (P>0.05) by sugarcane level in the diet (Table 4). The non significant difference in crude protein, ether extract, moisture and ash of the meat of all the treatments indicate that the inclusion level of sugarcane peels had very little effect on the meat composition. Martinez *et al*. (33) reported no significant difference in the protein component and significant differences in ether extract and moisture content of the meat of rabbits fed lucerne hay substituted with mulberry leaves in diets. The possible explanation for this variation could be the differences in the type of fibre fed to the rabbits.

Table 4: Meat composition of growing rabbits fed sugarcane peel diets

	Sugarcane peel level (SCP %)						
Nutrient (%)	0	10	20	30	40	SEM	P
Crude Protein	21.08	20.37	20.89	20.52	20.22	0.48	0.61
Ether Extract	15.43	15.38	15.19	15.00	15.59	0.31	0.62
Moisture	71.46	71.85	71.13	71.02	71.74	0.38	0.41
Ash	2.88	2.92	2.91	2.82	2.89	0.11	0.73

The values obtained by (34) for moisture (71.54 – 75.76%) and crude protein (19.33 - 20.44%) for rabbits fed graded levels of brewer's spent grains and kolanut pod meal are comparable to the results of this study. Ash obtained in this study was lower than the range 4.17 – 4.21 obtained by the authors. At the same time, ether extract observed in this study is higher than the range (8.20 – 10.27%) reported by the same authors. The possible explanation for this could be the inclusion of palm oil in all the diets in this study as opposed to theirs that did not include such. Xiccato (35) reported that fat addition to diet, both as inclusion level and source, significantly improved carcass fatness and meat fatty acid composition. Iyeghe-Erakpotobor, et al (36) observed that palm oil supplementation increased organ fatty acid composition when rabbits were fed diets with different levels of palm oil supplementation. Addition of fat to rabbit diet increased fat concentration in rabbit meat (37, 38, 39).

Conclusion and Application

This study indicates that

1. Sugarcane peels is a good source of fibre in rabbits diets.
2. Dietary inclusion of sugarcane peels up to 10% replacement level supported better feed conversion ratio however inclusion at 30% level gave feed efficiency and average daily gain that were comparable to 10% inclusion level and ₦125.9 savings per kilogram gain with comparable weight gain to the rabbits on 0% SCP.
3. These coupled with the cost of feed per kilogram live weight gain that is a little bit lower in value for 30% SCP make it a practical feed for feeding rabbits. Results of such experiments could therefore be used to formulate cheaper feed packages for rabbits.
4. Furthermore, sugarcane peels is a waste obtainable from sugarcane peeling centres free of charge. Therefore, its inclusion in the diets of rabbits will reduce the cost of rabbit production, urban solid waste, air pollution and blockage of waterways (drainages).

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