

Growth, Nutrient Digestibility and Carcass Indices of Rabbits fed Varying Levels of Sugarcane Rind Meal

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Abstract

The potential of sugarcane peels as a substitute for maize offal in rabbit diets and its effect on growth, nutrient digestibility, and carcass characteristics were studied. Twenty five growing rabbits of mixed breeds and average body weight of 894±26.14g were used in a 7-week feeding trial. Five experimental diets were formulated in which sugarcane rind (SCR) was included at 0, 10, 20, 30 and 40% level to replace maize offal (weight for weight). The rabbits were balanced for weight and allotted to the treatments (n=5 rabbits/treatment) in a completely randomized design. Results obtained indicated that dry matter, crude protein, ether extract, nitrogen free extract, hemicellulose, acid and neutral detergent fibre intake and digestibility decreased with increasing level of sugarcane rind inclusion. Crude fibre intake (5.59-8.67 g/day) and digestibility (20.60-40.80%) however increased ($P<0.05$) as level of sugarcane rind increased in the diet. The 30% inclusion of sugarcane rind gave body weight gain (5.35 g/d) comparable to the control (6.41 g/d), 10 (7.78 g/d) and 20% (7.12 g/d) inclusion of sugarcane peels. Feed intake (44.61-40.59 g/d) decreased as the level of sugarcane rind increased in the diets. There was no significant ($P>0.05$) effect of sugarcane rind on metabolic body weight and feed efficiency. Inclusion of sugarcane rind at 30% level increased ($P<0.05$) thigh and head percentage but without any adverse effect on chest, loin, shoulder and skin. Based on the results, it is concluded that sugarcane rind is a good fibre source that can be used to replace maize offal up to 30% in rabbit diets.

Keywords: Nutrient intake, digestibility, sugarcane rind and rabbit

Introduction

Rabbit production has gained considerable interest recently in Nigeria because of the exorbitant prices of conventional sources of beef, chevon, mutton, pork and poultry (Adeyemi and Akanji, 2012). Rabbit meat is high quality meat that is often considered a delicacy. It is high in protein and low in fat, cholesterol, sodium and calories (Damron, 2006). Rabbit meat contains all essential amino acids, minerals and all required vitamins except vitamin C needed by humans (Partridge *et al.*, 1989).

Chewing of sugar cane is a way of life especially in northern Nigeria. The

sugarcane is derinded and cut into small sections for chewing. This has resulted in accumulation of sugarcane rinds in towns and villages causing a nuisance by clogging water ways and drains and thus polluting the environment (Saleh, 2008). Sugar cane rind is very available and can be used as a feed resource especially as a source of crude fibre.

Today, in the Nigerian feed industry, maize offal has been found to be widely and successfully used as a good source of crude fibre in the diets of so many species of livestock, rabbits inclusive. This, however, has made its price to skyrocket in the

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market. Hence, there is need to develop more alternative feed resources that can yield same output at cheaper cost when compared to the use of maize offal. One possible way out of this problem is the use of sugarcane rind as possible replacement for maize or wheat offal. In the work of Garba and Abubakar (2016), the authors replaced wheat offal with sugarcane peels meal in Kano Brown goat diets up to 75% and observed no significant difference in weight gain and feed conversion. Maize offal (12.07% CF) and sugarcane rind (12.7% CF) have similar crude fibre content as sugar cane rind (Exieshi *et al.*, 2011; Adeosun and Iyeghe-Erakpotobor, 2012) and can therefore be used as fibre source in rabbit diets. Rabbits utilize fibrous feed by courtesy of their feeding and digestive strategies (Leng, 2006) based on this, they can utilize the fibre in sugarcane rind. This study was therefore conducted to evaluate the effect of replacing maize offal with sugarcane peels as a source of crude fibre on nutrient intake, digestibility, growth and carcass characteristics of rabbits.

Materials and Methods

Location of Experiment

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 the lines of longitude 8°E and 9°E and latitude 12°N and 13°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 and 39°C. In the wet season, the temperature range is 25-33°C, while in the dry season the range is 28-39°C. Annual rainfall ranges between 787 and

960mm (KNARDA, 2001).

Animals and their management

Twenty five growing rabbits of mixed breeds with average initial weight of 894±26.14g were used for the experiment. The rabbits were treated with an antibiotic to clear any pending infections, anti-stress and deworming medications were also provided, for the first five days of the study. The experimental diets were gradually used to replace the feed the animals were used to in the first week as an adjustment period.

Diets Formulation and Feeding Procedure

Sugarcane rinds were collected from sugarcane selling points within the metropolitan areas of Kano State. The rinds were sun dried on a cemented floor for 4 days and finally milled with a hammer mill to produce sugarcane rind meal. Five experimental diets were formulated to contain varying levels of sugarcane rind to replace maize offal at 0, 10, 20, 30, and 40% inclusion levels (Table 1).

One hundred and fifty grams of experimental diet was served to each animal per day in earthen feeders. Feed intake was recorded by subtracting the left over from the amount of feed offered the animals. Growth performance, expressed by weight gain was recorded by weighing the rabbits weekly. Data collection for feed intake and weight changes was carried out for seven weeks.

Digestibility Study

This study was carried out on the seventh week of the feeding trial. Feed intake and faecal output from each animal was recorded daily at 9:00am for seven days. At the end of faecal collection period, the samples were bulked for each animal for proximate analysis according to AOAC (1990) and thoroughly mixed and representative samples of the experimental diets, faecal samples and sugarcane rind

Table 1: Experimental Diets fed to rabbits

Ingredient	Sugarcane peel level (SCP %)				
	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
Feed cost (₦/kg)	51.19	42.96	35.32	28.25	21.91

were analysed for proximate composition as outlined by AOAC (1990) and Van Soest *et al.* (1991). Dry matter was determined by drying the samples at 105°C 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°C. Ether extract was determined using Soxhlet extraction procedure. For the energy content determination, an adiabatic bomb calorimeter was used.

Carcass evaluation

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 stunned, bled, skinned and eviscerated. Carcass weight was taken and recorded before and after

skinning. 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, fore legs, thigh (femur, fibula, tibia and calcaneus), shoulder (scapula, ulna and radius), loin, chest, head were obtained and expressed as a percentage of carcass weight.

Statistical Analysis

The values obtained for nutrients intake, digestibility, daily weight gain, feed efficiency, feed intake, metabolic body weight and meat parts 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 (SAS, 1987).

Results and Discussion

Nutrient Intake

Dry matter and crude protein intake decreased with increasing level of crude fibre in the diet (Table 2). This agrees with the work of Adegbola and Okonkwo (2002), who reported decreased dry matter intake from 66.85 to 44.24% and crude protein intake of 11.32 to 7.51% for rabbits fed a

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cassava leaf meal diet with increase in crude fibre content. The decrease in feed intake as the percentage of sugarcane peel inclusion increased above 20% SCP in this study is linked to increase in the level of fibre in the diet, and this agrees with the findings of Amata and Bratte (2008) who observed decrease in daily feed intake with increase in crude fibre content from 10.48 to 14.25% in rabbits fed *Gliricidia* leaf meal. Also, Jegede *et al.* (2008) reported decrease in daily protein intake with increasing crude fibre in malted sorghum sprout diets for growing rabbits.

Crude fibre intake (Table 2) increased as the level of sugarcane peels increased in the diets, indicating that crude fibre intake was lower in the control, and higher in 40% SCP.

This agrees with increased intake with increasing level of crude fibre in the diet observed by Iyeghe-Erakpotobor and Esievo (2010) who fed a mixture of soybean cheese waste meal and lablab hay to rabbits. The report of Maigandi and Ngang (2002) was similar to these when rabbits were fed calabash seed cake diet with increasing level of crude fibre. Ether extract, ash and nitrogen free extract intake decreased with increase in level of sugarcane peel. This supports the work of Iyeghe-Erakpotobor *et al.* (2006a) who observed decrease in nutrients intake with increase in crude fibre level when varying levels of soybean cheese waste/maize offal diet and *Brachiaria* grass hay were fed to weaner rabbits.

Table 2: Nutrient Intake of Growing Rabbits fed graded levels of Sugarcane Peel

Nutrient (g/d)	Sugarcane Peel Level (%)					SEM	Prob.
	0	10	20	30	40		
Dry Matter	59.99 ^a	62.15 ^a	59.51 ^a	54.01 ^b	54.30 ^b	6.24	0.0007
Crude Protein	10.24 ^a	10.05 ^{ab}	9.45 ^b	8.41 ^c	8.16 ^c	1.01	<0.0001
Crude Fibre	5.59 ^d	6.85 ^c	7.50 ^b	7.84 ^b	8.67 ^a	1.05	<0.0001
Ether Extract	8.98 ^a	9.30 ^a	7.86 ^b	6.85 ^c	6.14 ^d	0.85	<0.0001
Ash	6.92 ^b	7.62 ^a	6.91 ^b	6.86 ^b	6.81 ^b	0.76	0.0101
NFE	30.69 ^a	31.13 ^a	29.22 ^a	26.23 ^b	25.74 ^b	3.16	<0.0001

^{abc}Means in the same row with different superscripts are significantly different. SEM= Standard error of mean. Prob.= probability.

Nutrient Digestibility of Rabbits

Digestibility of dry matter, crude protein, ether extract, ash, and nitrogen free extract decreased with increasing level of sugarcane peels inclusion (Table 3) in the diets. This agrees with the findings of Adegbola and Okonkwo (2002) who fed cassava leaf meal to rabbits and reported decreased nutrient digestibility as crude fibre increased in the diet. Doma *et al.* (1999) and Gidenne (1996) also observed that as fibre level in rabbit diets increased, the dry matter and other nutrient digestibility decreased. The level at which crude fibre determines increase or decrease in digestibility of a feed is a function of the

type of fibre that is present in the feed (Doma *et al.*, 1999). They discovered significant decrease in dry matter and crude protein intake with increasing dietary fibre level of maize cob diets, and significant increase in dry matter and crude protein intake with increasing dietary fibre level of cowpea shell diets fed to rabbits. Dry matter digestibility values obtained in this study fall within the range of 67–81% and 61.16–87.03% reported by Adegbola and Okonkwo (2002) and Bawa *et al.* (2008a) who fed cassava leaf meal and varying levels of groundnut haulms and cowpea shells to rabbits respectively.

Crude protein digestibility decreased as the

level of sugarcane peel increased in the diets. This is in line with the report of Bawa *et al.* (2008b) who reported decreased crude protein digestibility as the level of maize cob increased in the diet fed to rabbits. Crude protein digestibility obtained in this study are higher than that reported by Bawa *et al.* (2008a) who obtained a range of 76.28 – 81.18%, for rabbits fed with varying levels of groundnut haulms and cowpea shells, but is in agreement with the range of 60.45 – 93.54% reported by Taiwo *et al.* (2005) who fed rabbits with forages supplemented with concentrate.

Ether extract digestibility obtained in this study were comparable with the range of 88.10 – 93.92% reported by Bawa *et al.* (2008a), while ash digestibility were higher than that reported by the same authors, but fell within the range of 85.29 – 96.84 observed by Taiwo *et al.* (2005). Nitrogen free extract digestibility obtained was within the ranges of 69 – 82% and 73.70 – 89.01% reported by Iyeghe-Erakpotobor *et al.* (2006b) and Bawa *et al.* (2008a) respectively.

Digestibility of crude fibre increased with increasing level of sugarcane rind in the diet, this could be attributed to lower feed intake recorded with increasing level of sugarcane rind in the diet, this agrees with

the findings of Martinez *et al.* (2007) who reported increase in crude fibre digestibility with decrease in feed intake for rabbits fed a diet in which lucerne hay was substituted by mulberry leaves. Nworgu *et al.* (2001) also reported increase in crude fibre digestibility with increasing level of crude fibre in the diets of rabbits when a mixture of leaf meals and concentrates were fed to growing rabbits. Crude fibre digestibility obtained in this study is within the range of 24.96 – 44.43% reported by Adegbola and Okonkwo (2002), but lower than 43 – 55% and 85.86 – 97.24% observed by Iyeghe-Erakpotobor *et al.* (2006b) and Taiwo *et al.* (2005).

The digestibility values obtained for crude fibre in this study are lower than those of the other nutrients. This may be due to the fact that rabbits are less efficient at digesting fibre than ruminants as reported by Joyce *et al.* (1971). Likewise, Cheeke *et al.* (1986) stated that dietary fibre has a low digestibility in rabbits, because the digestive strategy of the rabbit is to separate the larger fibre particles from smaller non-fibre substances in the hindgut thereby excreting the fibre in the faeces. The lower values recorded in crude fibre digestibility were in line with the observation of Nworgu *et al.* (2001).

Table 3: Nutrient Digestibility of Growing Rabbits fed graded level of Sugarcane Peel

Nutrient (%)	Sugarcane Peel Level (%)					SEM	Prob.
	0	10	20	30	40		
Dry Matter	78.37 ^a	78.32 ^a	76.24 ^b	73.75 ^c	72.52 ^c	2.08	<0.0001
Crude Protein	92.63 ^{ab}	93.21 ^a	91.83 ^{bc}	92.49 ^{ab}	90.77 ^c	1.54	0.0023
Crude Fibre	20.60 ^e	32.11 ^d	34.54 ^c	39.51 ^b	40.80 ^a	1.81	<0.0001
Ether Extract	90.23 ^a	90.97 ^a	89.85 ^a	88.31 ^b	87.95 ^b	1.63	0.0002
Ash	92.92 ^a	92.18 ^{ab}	91.17 ^b	87.74 ^c	87.73 ^c	1.59	<0.0001
NFE	77.47 ^a	76.46 ^a	74.86 ^b	73.15 ^c	72.73 ^c	2.04	<0.0001

^{abc}Means in the same row with different superscripts are significantly different. SEM= Standard error of mean. Prob.= Probability.

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Growth Performance

The inclusion of sugarcane rind at 40% dietary level significantly reduced weight gain when compared to rabbits on 10% SCR (Table 4). The decrease in daily weight gain with increase in crude fibre level is in support of the findings of Nworgu *et al.* (2001) and Babatunde *et al.* (1999) who fed a mixture of leaf meals and concentrates, and graded levels of *Pueraria phaseoloide* leaf meal to rabbits respectively. 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. Feed efficiency, though numerically increasing with increase in sugarcane peel level was not significantly ($P < 0.05$) affected by dietary treatments and this agrees with the no significant difference in the feed efficiency of rabbits fed *Gliricidia* leaf meal by Amata and Bratte (2008).

Table 4: Growth and Carcass Characteristics of Rabbits fed graded level of Sugarcane Peels

Parameter	Sugarcane Peel Level (%)					SEM	Prob.
	0	10	20	30	40		
Metabolic Body Weight (kg)	1.15	1.21	1.20	1.11	1.06	0.11	0.25
Average Daily Gain (g/day)	6.41 ^{ab}	7.78 ^a	7.12 ^{ab}	5.35 ^{ab}	4.70 ^b	1.57	0.05
Feed Efficiency	7.44	6.23	7.41	9.02	9.33	5.75	0.39
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

^{ab}Means in the same row with different superscripts are significantly different. SEM= Standard error of mean. Prob.= probability.

Carcass Characteristics

Thigh and head proportions increased significantly as sugarcane rind meal level increased in the diet up to 30% SCR. However, chest, loin, shoulder, skin, fore and hind legs were not affected by sugarcane rind meal level. This probably shows that the inclusion of sugarcane rind in the diet of growing rabbits had positive influence on these parts. Bawa *et al.* (2008a) fed varying levels of groundnut haulms and cowpea shells to weaner rabbits and 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. This is at variance with results obtained in this study. 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, as reported by Alawa and Amadi (1991).

Conclusion

Based on the results of this study, it can be concluded that:

The decrease in daily weight gain and feed intake could be accountable for by the decrease in dry matter and crude protein intake and digestibility as sugarcane rind increased in the diet.

Crude fibre intake and digestibility increased as sugarcane peels increased in the diet, meaning that sugarcane peels is a good fibre source that can replace maize

offal in rabbit diet.

Inclusion of 30% SCR significantly improved thigh and head weight, while the inclusion did not adversely affect daily weight gain or other meat parts. This shows that the addition of sugarcane peels up to this level is of benefit for rabbit production.

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