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Nutrients intake and weight gain of West African dwarf goats fed maize offal substituted with urea-molasses treated cassava peel diets

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Abstract

A study that involved 20 West African dwarf (WAD) goats aged 1½ - 2 years with an average live weight of 13.86 ± 0.14 kg was carried out to evaluate nutrients intake, digestibility, weight gain, nitrogen balance and feed to gain ratio of WAD goats fed maize offal substituted with urea-molasses treated cassava peels meal. The goats were divided into 5 groups of four goats per group and allotted to individual pens in a completely randomized design. The experimental period lasted 63days excluding two weeks of adaptation. Five diets were formulated such that maize offal was substituted with ensiled urea-molasses cassava peels at ratio 0% (A), 20% (B), 30% (C), 40% (D), 50% (E) respectively. The dry matter ranged from 91.26 (diet E) to 91.69% (diet A) while diet B had highest NDF (32.39%) and energy (16.61KJ/100gDM). The crude protein content ranged between 16.31 (diet A) and 23.30% (diet E) and increased with the increased inclusion of urea-molasses treated cassava peel meal in the diets. Nutrients intake, apparent digestibility, daily weight gain, nitrogen balance and feed to gain ratio were significantly ($p<0.05$) influenced by the treatments except hemicelluloses and cellulose. The highest dry matter (549.42g/day) and crude protein (108. 95g/day) intake were observed in goats fed diet C. All the diets were adequately utilized however, goats fed diet B have the best weight gain (61.90g/day) and convert their feed to flesh better (8.52) than others goats. Hence, the diet was palatable, acceptable and tolerable to the goats without a sign of ill-health. Thus, maize offal replaced with ensiled 20% urea-molasses treated cassava peels meal could be a good source of protein and energy that would enhance nutrient utilization by ruminants during difficult months of the dry season.

Key words: Goats, nutrient intake, nitrogen balance, urea-molasses, weight gain,

Introduction

Animal feed has always been a major limiting factor in the growth of the livestock industry in developing countries. Most of the feed ingredients are imported and a large proportion of foreign exchange is spent for this purpose. Thus, goat can be sustained with post harvest crop residues silage during difficult months of the dry season. Cassava is a staple crop often sown in Nigeria to balance up for carbohydrate in the diet (FAOSTAT/FAO, 2003). Hydrogen cyanide (HCN) toxicity is considered to be a limiting factor in using high level of cassava peels and leaves in the diets of both ruminant and monogastrics. This HCN could be gotten rid-off if properly dried and processed (Tewe, 1992). Besides, cassava can play a major role in replacing grain in animal ration in developing countries (Omoike, 2006). Cassava peels form the bulk of residues from cassava root after post-harvest and processing. It is a good source of energy in ruminant feeding systems, serving either as the main basal diet or as supplement. Ruminants can be fed not only on cassava tuber, but also the stem, leaves, peel and other by - products of the tuber (Fajemisin *et al.*, 2012)

Consequently, a volume of thought has also

been invested in carrying out research on cassava peel which over the years has often been regarded as waste (Aro *et al.,* 2009). This research work makes use of cassava peel that has been sun dried and ensiled with other ingredients such as the molasses and urea fertilizer. This study is therefore, aimed at evaluating the effect of replacement of maize offal by urea-molasses treated cassava peel in diets of WAD goats.

Materials and methods

Site of experiment and collection of materials

The experiment was carried out at the Teaching and Research Farm of the Federal University of Technology, Akure. The chemical analysis was carried out at the nutrition laboratory of the Department of Animal Production and Health, Federal University of Technology, Akure (Latitude 7^0 18"Nand Longitude 5^0 10"E). The maize offal was bought at maize mill at the Owena Artillery Barracks, Akure. Palm kernel cake, premix, bone meal and salt were purchased from a reputable feed mill located at Oluyole Estate, Orita-Obele, Akure. The cassava peels were gotten at a 'garri' processing plant located at Igbatoro road, Akure.

Ensiling procedure

The ensiling was carried out at the Teaching and Research Farm of the University. The sun-dried was divided into two equal parts, while urea-molasses solution was prepared by adding 5 kg of urea fertilizer and 5 litres of molasses weighed into 100 litres drum capacity and water was added to make up to 100 litres of urea-molasses solution The two diluents were thoroughly mixed with hand so that there was no settled particle at the base of the drum.

Consequently, the sun-dried cassava peels and urea – molasses solution mixed thoroughly at ratio 2:1 (2 kg of cassava peels and 1 litre of urea – molasses solution) and ensiled in a big "drum" of about 150 litres capacity that has its inside lined with nylon. The urea – molasses treated cassava peel meal was covered with nylon and sand was put on top of the nylon to prevent air from penetrating. This ensiled cassava peel meal was left for 28 days thereafter; the silage was opened and air – dried for three days and kept for experimental diets preparation.

Experimental diets preparation

Five experimental diets were formulated such that maize offal was replaced with urea-molasses treated cassava peels at varying levels of 0% (A), 20% (B), 30% (C), 40% (D) and 50% E. Other ingredients added to make complete diets included; palm kernel cake, poultry litter, bone meal, salt and vitamin-mineral premix as shown in Table 1

Table 1: Gross composition of maize ofall substituted with urea-molasses treated cassava peels diets fed to West African Dwarf goats

Ingredients	Diets				
	A	**B**	**C**	**D**	**E**
Maize offal	50.00	30.00	20.00	10.00	-
Urea-molasses treated cassava peels	-	20.00	30.00	30.00	50.00
Palm kernel cake	30.00	30.00	30.00	30.00	30.00
Poultry litter	17.00	17.00	17.00	17.00	17.00
Bone meal	2.00	2.00	2.00	2.00	2.00
Salt	0.50	0.50	0.50	0.50	0.50
Vitamin-mineral premix	0.50	0.50	0.50	0.50	0.50

Animal procurement and management

Twenty (20) WAD goats of 1½ -2years old, weighed averagely 13.86 ± 0.14 kg were selected from the flock of goats unit of the Teaching and Research Farm, Federal University of Technology, Akure and treated against endo and ecto-parasites using Kepromec® at the rate of 1 ml per 10kg body weight. The goats were fed the experimental diets and drinkable water *ad libtum* at 7.00am throughout the experimental period of 63 days excluding 14 days of adaptation. The goats were weighed before the commencement of the experiment and were repeatedly weighed weekly in the morning before feeding to observe any weight change using spring-balance (hanging scale).

The daily feed intake was determined by deducting the refusals from the quantity offered. The goats were transferred to metabolic cages during the last fourteen days of the experimental period for collection of faeces and urine. The first 7 days was allowed for acclimatization while the last 7 days was used for separate collection of faeces and urine. The urine samples were collected in containers that contained 1mL each of 25 % H_2SO_4 in order to trap ammonia. Faeces and urine were collected daily, measured and stored in refrigerator until they are required for chemical analysis.

Laboratory analysis

The laboratory analysis was done in the Nutrition laboratory of the Department of Animal Production and Health, Federal University of Technology, Akure, Ondo State, Nigeria.

The samples of feed, faeces and urine were analyzed for chemical composition according to the methods of AOAC (2002). Neutral detergent fibre (NDF) and acid detergent fibre (ADF) were determined using the analytical procedures of Van Soest *et al*., (1991)**,** macro elements were determined by atomic absorption spectrophotometer (AAS) model 490 Gallenkamp, London after digestion using perchloric acid and aqua fortis.

Experimental design and statistical analysis

The experimental design was of completely randomized design and all data obtained were subjected to analysis of variance (ANOVA) and treatment means were compared by the method of Duncan's Multiple Range Test using SPSS (2006) version 15.0

Results and discussion

The chemical composition of the experimental diets fed to the WAD goats is shown in Table 2. The dry matter (DM) of the diets ranged between 91.26 (diet E) and 91.69% (diet A) which compared favourably to dry matter values reported by Fajemisin *et al.,* (2012) when cassava peel diets fed to goats was substituted with *Cajanus cajan* hay. The observed highest crude fibre content (19.90%) was observed in diet C while the least value (13.53%) was obtained in diet A. Crude protein values increased with the increased quantity of urea-molasses treated cassava peels in the diets. The crude protein contents of the diets were more than the critical 7% CP recommended for ruminant animals by McDonald *et al.* (1995). It implied that the CP content of the diets was adequate to support the goats during growth and reproduction. The soluble carbohydrate content of the diets ranged from 45.89 (diet E) to 52.83% (diet A). The highest Neutral detergent fibre (32.39%), Acid detergent fibre (23.84%) and Acid detergent lignin (17.51%) values were observed in diet B. These observed values were similar to the values reported by Fajemisin *et al.*(2015) when differently processed corncob meals based diets were fed to West African dwarf sheep.

Table 2: Chemical composition of the maize offal substituted with urea-molasses treated cassava peel diets fed to West African Dwarf goats.

Parameters	Diets				
	A	B	C	D	E
Dry matter	91.69	91.39	91.56	91.27	91.26
Crude protein	16.31	18.20	19.83	22.10	23.30
Crude fibre	13.54	19.90	18.05	16.93	14.10
Ether extract	6.14	5.05	5.19	4.29	4.99
Ash	11.18	6.84	10.30	9.06	11.72
Nitrogen free extract	52.83	50.01	46.63	47.62	45.89
Neutral detergent fibre	27.81	32.39	31.16	28.76	31.82
Acid detergent fibre	19.45	23.84	22.78	21.40	23.43
Acid detergent lignin	16.54	17.51	16.71	15.59	16.76
Hemicellulose	8.36	8.55	8.38	8.36	8.38
Cellulose	2.91	6.33	6.07	5.81	6.67
*Gross energy KJ/100gDM	16.11	16.61	16.08	16.09	15.78

*Calculated Gross energy= %CP x 16.7 + %EE x 37.7 + %CHO x 16.7 (Ekaneyake *et al.*,1999)

Table 3 shows the results of the nutrients intake of the WAD goats fed the experimental diets. All parameters determined were significantly ($p<0.05$) influenced by the inclusion of urea-molasses treated cassava meal in the diets except hemicelluloses and cellulose. The DMI ranged from 351.55 (diet E) to 549.42g/day (diet C), this observation could be attributed to the protein quality, palatability and acceptability of the experimental diets. The average voluntary dry matter intake values of the goats were above 3.5% of the body weight recommended for small ruminants by McDonald *et al*. (1995). This observation also agreed with the report of Ahamefule, (2005) that higher level of crude protein stimulates dry matter intakes. The CP intake by the goats fed diet C was 108.95g/day and least CP intake was recorded for goats fed diet E. The highest crude fibre (105.01g/day) consumption was observed in goats fed diet B while the least value was recorded for goats fed diet E. The soluble carbohydrate intake (263.89g/day) observed in treatment B was the highest, while goats fed diet E had the least (161.33g/day).

The fibre fractions intake was significantly ($p<0.05$) influenced by the treatment, this might be attributed to the varying concentrations of the protein content of the diets. However, highest contents of NDF (171.20g/day) and ADF (125.80g/day) were observed in goats fed diets C and B respectively compared to control diet. It implied that the diets furnished enough protein that enhanced fibre intake and degradability by the rumen microbes.

The apparent digestibility of nutrients was significantly ($P < 0.05$) influenced by the inclusion of urea-molasses treated cassava peel meals in the diets except ether extract (Table 4).

The highest apparent digestibility coefficients observed in goats fed diet E suggested that inclusion of ensiled urea-molasses treated cassava peels can improve digestibility of the feed (Nisa *et al.*, 2004), which improved voluntary feed intake (Ahamefule, 2006). The research findings of Fajemisin *et al.* (2008) supported the fact that adequate nitrogen in all the diets enhanced the activities of rumen microbes which eventually improved the nutrients digestibility of the goats**.**

Table 3: Nutrients intake (g/day) of West African Dwarf goats fed maize offal substituted with urea-molasses treated cassava peel diets.

Parameters	Diets					
	A	B	C	D	E	SEM
Dry matter	453.08^{c}	527.68^{b}	549.42^{a}	457.71^{c}	351.55^{d}	18.57
Crude protein	73.90^{e}	96.04^{c}	108.95^{a}	101.15^{b}	81.91^{d}	3.43
Crude fibre	61.35^{d}	105.01^{a}	99.17^{b}	77.49^{c}	49.57^{e}	5.72
Ether extract	27.82^{a}	26.65^{a}	28.51^{a}	19.64^{b}	17.54^{b}	1.30
Ash	50.65^{b}	36.09^{d}	56.59^{a}	41.47^{c}	41.20^{c}	2.01
Nitrogen free extract	239.36^{c}	263.89^{a}	256.19^{b}	217.96^{d}	161.33^{e}	9.84
Neutral detergent fibre	126.00^{c}	170.92^{a}	171.20^{a}	131.64^{b}	111.86^{d}	6.52
Acid detergent fibre	88.12^{c}	125.80^{a}	125.16^{a}	97.95^{b}	82.37^{d}	4.94
Acid detergent lignin	74.94^{b}	92.40^{a}	91.81^{a}	71.36^{b}	58.92^{c}	3.47
Hemicellulose	37.88	45.12	46.04	38.26	29.46	1.65
Cellulose	13.18	33.40	37.47	26.59	23.45	2.29
Energy KJ	72.99^{b}	87.65^{a}	88.35^{a}	73.65^{b}	55.47^{c}	3.81

abc = means on the same column with different superscripts are significantly varied ($P < 0.05$)

Table 4: Apparent digestibility of West African Dwarf goats fed maize offal substituted with urea-molasses treated cassava peels diets

Parameters	**Diets**					
	A	**B**	**C**	**D**	**E**	**SEM**
Dry matter	56.72^{c}	81.56^{a}	75.58^{b}	72.93^{b}	85.35^{a}	2.67
Crude protein	58.49^{d}	65.54^{c}	68.32^{bc}	72.89^{ab}	75.55^{a}	1.72
Crude fibre	55.38^{d}	57.63^{cd}	61.73^{bc}	64.29^{b}	77.59^{a}	2.20
Ether extract	64.94	65.55	68.10	68.49	69.08	0.87
Nitrogen free extract	56.51^{c}	65.62^{b}	74.64^{a}	78.09^{a}	78.57^{a}	2.37
Neutral detergent fibre	57.81^{d}	60.31^{cd}	63.53^{c}	67.61^{b}	75.48^{a}	1.72
Acid detergent fibre	58.91^{c}	66.99^{b}	68.11^{b}	68.22^{b}	73.13^{a}	1.35
Acid detergent lignin	55.19^{d}	58.78^{c}	62.19^{b}	62.53^{ab}	65.79^{a}	1.05
Hemicelluloses	56.53^{b}	68.69^{a}	68.86^{a}	70.19^{a}	72.03^{a}	1.63
Cellulose	54.94^{c}	61.87^{b}	67.00^{a}	68.44^{a}	71.49^{a}	1.64
Energy	56.72^{c}	61.56^{b}	65.58^{ab}	68.93^{a}	70.35^{a}	1.45

abc = Means in the same row with different superscripts are significantly varied ($P < 0.05$)

Table 5 presents the performance characteristics of the goats, all the parameters determined were significantly ($p<0.05$) influenced by the treatment with the exception of initial and final live weight. Weight gain per day ranged between 19.68g/day (diet D) and 61.90g/day (diet B) and significantly ($p<0.05$) influenced by the treatment. However, the daily weight gain of goats fed diets B might be attributed to the protein quality of the diet and dry matter intake. This agreed with the findings of Adebowale and Taiwo (1996) that weight gain was dependent on dry matter intake, protein quality and digestibility of the nutrients. The nitrogen balance of the goats fed control diet was lower compared to other goats, this observation could be attributed to low protein intake and nitrogen loss in urine and faeces. The highest feed to gain ratio was recorded for goats fed diet D and the least value was recorded for the goats fed diet B however, the goats fed diet B utilized their feed better than the other goats. It implied that the diet furnished enough protein and energy that enhanced the growth performance of the goats fed diet B.

Table 5: Performance of West African Dwarf goats maize offal substituted with urea -molasses treated cassava peel diets

Parameters	Diets					
	A	B	C	D	E	SEM
Nitrogen intake	11.84^{b}	15.37^{ab}	17.43^{a}	16.18^{ab}	13.11^{ab}	0.75
Faecal nitrogen	5.69^{b}	7.77^{ab}	9.08^{a}	7.20^{ab}	5.98^{b}	0.44
Urinary nitrogen	0.78^{a}	0.46^{b}	0.52^{ab}	0.61^{ab}	0.43^{b}	0.05
Nitrogen balance	5.37^{b}	7.14^{ab}	7.83^{ab}	8.37^{a}	6.70^{ab}	0.40
Initial weight	13.85	13.85	13.87	13.86	13.87	0.23
Final weight	16.50	17.75	17.50	15.10	15.48	0.66
Daily weight gain	42.06^{b}	61.90^{a}	57.62^{a}	19.68^{d}	25.56^{c}	4.52
Feed/gain ratio	10.77^{bc}	8.52^{c}	9.54^{c}	23.26^{a}	13.75^{b}	1.48

abc = means on the same column with different superscripts are significantly varied ($P < 0.05$)

Conclusion

This study revealed that maize offal substituted with urea-molasses treated cassava peel meal could meet the protein and nutrient requirements of the West African Dwarf goats. The goats fed diet B convert their feed to flesh better than other goats. The performance of the WAD goats in terms of nutrients intake, daily body weight gain and feed to gain ratio were optimal at 20% urea-molasses treated cassava peel meal. Hence, maize offal substituted with ensiled 20% urea-molasses treated cassava peels meal could be a better source of protein and energy to support goat production, purposeful use of cassava waste and reduce environmental pollution.

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