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Free Choice Intake, Growth and Digestibility Responses by West African Dwarf Does Fed Pulverised Maize-Cob Based Diets

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ABSTRACT

In an effort to mitigate the effect of dry season on ruminant feeding, the use of alternative feed resources such as maize-cob, cassava peel and brewers' grain was investigated. Using twelve West African Dwarf (WAD) goats of average weight 9.05 ± 0.5 kg, the free choice intake, growth and digestibility were used as response criteria to pulverized maize-cob based diets {pulverized maize-cob/cassava peel (PMC/CsP), pulverized maize-cob/brewers'grain (PMC/BG) and pulverized maize-cob/brewers'grain/cassava peel (PMC/BG/CsP)}. Free choice intake was determined by cafeteria method using two indices; Coefficient of Preference (CoP) and Percentage preference (Pp) while for the growth study, animals were randomly allotted to the three dietary treatments, having four animals per treatment and digestibility of the diets was also evaluated. Results revealed crude protein and neutral detergent fibre contents range of 14.66 – 21.18% and 40.01- 51.14% respectively among the diets. Free choice intake of diets was significantly (P<0.05) affected by the dietary treatments. The PMC/CsP diet was inferred acceptable as the CoP was above unity (2.30), with the highest preference value (38.47%) and was ranked 1st. Intake, weight gain and feed/gain ratio were significantly (P<0.05) influenced by the dietary treatments. Animals fed PMC/CsP recorded the highest dry matter intake (309.45g/day) and lowest intake (290.27g/day) was obtained by animals on PMC/BG. Weight gain and feed/gain ratio ranged from 20.55-25.11g/day and 12.32–14.25 respectively. Digestibility of nutrients was significantly (P<0.05) different across the treatments with diet PMC/BG having the highest dry matter (50.26%), crude protein (58.41%) and neutral detergent fibre (43.48%). It was concluded that pulverized maize-cob based diets have the potential to sustain goat production during the period of forage scarcity.

Keywords: digestibility, pulverized, maize-cob based diet, goats, growth, free choice intake

INTRODUCTION

The supply of adequate nutrition is germane for optimum livestock production. One of the most challenging factors in achieving this is the scarcity of feed both in quantity and quality especially during the dry periods of the year, thus resulting in animal's low productivity and even death (Ibhaze *et al*., 2014). Agricultural crop residues and agro industrial by products have been found to have feeding values for ruminants, hence the need to harness the potential in these resources as alternative feed source in ruminant feeding system. Such crop residues and by products include maize-cob, cassava peel, and brewers' grain. Maize-cob is an energy source for ruminants, has low palatability and poor in nutrients. Due to its nutrient deficiency, it must be fortified with other feed materials that furnish these essential nutrients. Cassava peel is a source of energy in ruminant feeding with high concentration of soluble carbohydrate. It is relatively cheap and easily available due to the large quantity of cassava tuber produced and processed for consumption and industrial use. Brewers' grain is a by- product of grain processing in the brewery industry. It is a protein-rich concentrate with high digestibility. Goats are considered superior to other ruminant species in its utilization of poor quality, high fibre forages (Dominique *et al.*, 1991), hence they can be used in converting poor quality feed resources to useful animal products. The thrust of this study was to evaluate the free choice intake, growth and digestibility responses of West African dwarf goats fed pulverized maize-cob based diets during the period of feed scarcity.

MATERIALS AND METHODS

Experimental diets

Three maize-cob based diets were formulated. Maize-cobs were collected from a maize shelling centre, cassava peels (mixed varieties) was collected from a cassava processing centre and Brewers' grain was obtained from the brewery all in Ibadan.

Table 1: Ingredient (g/100g) and chemical composition of experimental diets

Ingredients	Treatment		
	PMC/CsP	PMC/BG	PMC/BG/CsP
Maize-cob	28.00	28.00	28.00
Cassava peel	60.00	-	30.00
Brewers' grain	-	60.50	30.00
Palm kernel cake	10.00	10.00	10.00
Urea	1.00	0.50	1.00
Dicalcium phosphate	0.50	0.50	0.50
Sulphur	0.50	0.50	0.50
Total	100.00	100.00	100.00
Chemical composition (%)			
Dry matter	90.90	90.57	90.06
Crude protein	14.66	21.18	18.62
Ether extract	5.10	8.42	7.14
Ash	5.32	7.36	7.96
Nitrogen free extract	55.77	40.69	42.18
Neutral detergent fibre	51.14	40.01	41.11
Acid detergent fibre	32.15	30.10	31.13
Gross energy (MJ/kgDM)	15.69	15.72	15.54

PMC/CsP (pulverized maize-cob/cassava peel), PMC/BG (pulverised maize-cob/brewers'grain), PMC/BG/CsP (pulverised maize-cob /brewers'grain/ cassava peel)

They were sundried until a practically low moisture content was obtained. Maize-cob and cassava peel were crushed and then pulverized separately using a hammer mill. Other ingredients were obtained from a reputable feed mill and all ingredients as shown in Table 1 were mixed together manually.

Management of experimental animals and measurements

In the free choice intake study, twelve WAD female goats with mean weight of 9.05 ± 0.5 kg were used. Goats were purchased from the surrounding village in Ibadan, Nigeria. The animals were immediately placed on prophylactic treatment through the administration of antibiotics (Tetracycline Long acting). Animals were also treated against endoparasites and ectoparasites using 10% levamisol and diasuntol respectively. Goats were adapted to the new environment for four weeks. An open pen with a concrete floor that had been designed to accommodate 10 – 15 matured goats was used. All the animals were pre-conditioned to the experimental diets for a period of 4 days after which they were offered 3kg each of the diet in plastic feeding troughs in triplicates which were placed in strategic locations within the pen. The goats were allowed to feed from 9:00 to 13:00h daily and for upward of 12 days. Animals had *ad libitum* access to fresh, clean water daily. Intake was measured by deduction of remnants from the amount of feed offered. The preferred feed was determined using two indices of CoP and Pp. The CoP was calculated as the ratio of individual diet intake to average intake of all the diets as described by Karbo *et al*. (1996) while the Pp was calculated as the ratio of individual intake to total intake multiplied by 100. Diet was inferred to be acceptable when the CoP was greater than unity while Pp was used for ranking the order of preference. In the growth study, twelve does of average weight 9.05 ± 0.5 kg were randomly assigned to the three experimental diets having four animals per treatment. They were all kept in individual pens and had free access to fresh feed and water daily. Animals were offered concentrate at 1% of their body weight and the test diet *ad-libitum*. The study lasted for a period of 90 days. Voluntary feed intake was calculated by deduction of remnants from the amount of feed offered. Weight of does were taken at the commencement of the study and weekly using a spring balance, feed/gain ratio was determined based on the body weight gain and feed intake. Digestibility trial was carried out using nine does. Animals were randomly selected from each treatment and confined in individual metabolic cages with facilities for total collection of faeces and urine as the study lasted fourteen days. During the last seven days, total feed refused, faeces and urine were measured on daily basis and 10% aliquot collected and bulked at the end of the collection. The 10% aliquot of bulk samples were used for chemical analysis. The faecal samples were oven dried at 65^0C for 48hours, milled and stored in air- tight containers. The urine samples were preserved with few drops of concentrated H_2S0_4 and stored in a freezer at -4^0C until required for laboratory analysis. Digestibility was calculated as follows (1);

$$\% \text{ Digestibility} = \frac{\text{Total nutrient consumed} - \text{Total nutrient excreted}}{\text{Total nutrient consumed}} \times 100 \quad \ldots\ldots\ldots\ldots\ldots\ldots (1)$$

Chemical analysis

Samples from each of the experimental diets and faeces were analysed for proximate composition and urine samples for nitrogen according to the method of (AOAC, 2005) and detergent fibre as described by Van Soest *et al*. (1991) respectively. Energy content of diets was determined using bomb calorimeter.

Statistical analysis

Data obtained were analysed using one-way analysis of variance (ANOVA) procedure of SAS (2000) in a Completely Randomized Design (CRD) and means were separated using Duncan's multiple range test of the same package.

RESULTS AND DISCUSSION

The ingredient and chemical compositions of experimental diets are shown in Table 1. The highest (21.18%) crude protein content was obtained in PMC/BG and the least (14.66%) was recorded for PMC/CsP. The crude protein range (14.66-21.18%) observed in this study was comparable with the reported values of 15.80-17.20%, 17.55-19.75% by Ajayi *et al*. (2014) and Adedeji *et al.* (2014) respectively in corncob diets. The crude protein obtained in all the diets exceeded 8% reported as limit required by rumen microbes for optimum activity (Norton, 1994). This suggests that the diets were adequate to meet the protein requirement for ruminants and effective rumen function. Crude fibre ranged from 19.15 – 24.10%. Neutral detergent fibre content of the diets which ranged from 40.01% in PMC/BG to 51.14% in PMC/CsP were similar to the range (51.40-55.20%) reported by Adedeji *et al.* (2014). The fibre fractions contents of the diets suggested that they could be adequate to meet the fibre requirements of the animals for proper rumen function.

Free choice intake of pulverized maize-cob based diets by WAD goats presented in Table 2 showed significant ($P<0.05$) difference. Diet PMC/CsP recorded the highest dry matter intake of 811.37g/day but least intake (150.95g/day) was observed in diet PMC/BG. Similar trends were observed in CoP and Pp. Animals showed ($P<0.05$) higher preference for PMC/CsP in spite of its lower protein content indicating that animals could consume more of a diet that they find more pleasant or palatable irrespective of the nutrient value. Ibeawuchi *et al.* (2002) opined that beyond nutritional composition, animals tend to consume more of palatable diets. Furthermore, the higher intake and preference for diets having cassava peel could be due to the powdery/fine form of the diets which encouraged intake. This observation corroborates the reports of Omokanye *et al.* (2001) and Lu *et al*. (2005) that particle size affects prehension, mastication, rate of passage and thus intake rate. Also, the low intake observed in diets PMC/BG and PMC /BG/CsP inspite of their higher protein contents may be due to the presence of brewers' grain which the animals found unpalatable due to its dried form unlike when ensiled as reported by Ibhaze (2015). Diar (1992) reported that ensiling improves acceptability of feed. Diet PMC/CsP was ranked first (1^{st}) among the dietary treatments due to its higher intake, percentage preference and Coefficient of preference. Performance of experimental animals is presented in Table 3. Dry matter intake, weight gain and feed/gain ratio obtained in this study showed significant differences ($P<0.05$) among the diets. Animals on PMC/CsP recorded the highest intake value (309.45g/day) among all the treatments while those on PMC/BG had the least (290.27g/day).

The higher value recorded by animals on PMC/CsP could be attributed to the same reasons as obtained in the free choice study. This indicates that powdery or fine form of diet reduces mastication, reduces gut fill and subsequently increase intake. The highest (309.45g/day) value obtained in this study is relatively lower than the range 364-457g/day obtained by Adedeji *et al*. (2014) who fed concentrate with varying inclusion levels of corncob and groundnut husk to West African dwarf goats and 529.00-559.00g/day by Ajayi *et al*. (2014) who also fed concentrate diets with corncob in varying inclusion levels to WAD goats. Weight gain of goats on PMC/BG and PMC/BG/CsP were not significantly ($P>0.05$) different but were significantly ($P<0.05$) lower than those on PMC/CsP. The highest (25.11g/day) weight gain recorded by goats on PMC/CsP could be attributed to the higher dry matter intake, better utilization of nutrients by the animals and invariably the overall performance of the animals. Dry matter intake is an important factor in the utilization of feed by ruminants and is a critical determinant of energy and performance in small ruminants (Devant *et al*., 2000). Results were comparable with a range of 4.76-40.79g/day reported by Fajemisin *et al.,* (2015) who fed differently processed corncob meal based diets to West African dwarf sheep but lower than the range of 49.04-70.83g/day reported by Ajayi *et al.* (2014) for WAD goats fed concentrate diet with corncob in varying inclusion levels and 47.60-59.50g/day reported by Adedeji *et al*. (2014) who fed concentrate with varying inclusion levels of corncob and groundnut husk to WAD goats. Goats on PMC/CsP had the best feed/gain ratio (12.32) when compared to goats on PMC/BG (14.13) and PMC/BG/ CsP (14.25). The significantly ($P<0.05$) lower value of feed gain ratio for animals on PMC/CsP implied that the animals on the diet utilized the feed with better efficiency. This therefore indicated that the animals consumed lesser feed to produce a unit weight gain.

Digestibility of nutrients is presented in Table 4. Significant ($P<0.05$) difference was observed across the treatments. The highest digestibility of all nutrients examined was recorded for PMC/BG.

Table 2: Free choice intake of pulverized maize-cob based diets by West African dwarf does

	Treatments			
Parameter	PMC/CsP	PMC/BG	PMC/BG/CsP	SEM
Dry matter intake(g/day)	811.37[a]	150.95[c]	280.31[b]	25.60
Coefficient of preference	2.30[a]	0.42[c]	0.79[b]	0.04
Percentage preference	38.47[a]	6.98[c]	13.26[b]	1.05
Rank	1st	3rd	2nd	

Means a,b,c on the same row with identical superscripts are not significantly (p>0.05) different

Table 3: Intake of pulverized maize-cob based diets by West African dwarf does

	Treatments			
Parameters	PMC/CsP	PMC/BG	PMC/BG/CsP	SEM
Initial weight (Kg)	9.16	9.05	9.26	1.10
Final weight (Kg)	11.33[a]	10.90[b]	11.13[a]	1.07
Total Dry matter intake (g/day)	309.45[a]	290.27[b]	296.23[b]	25.15
Dry matter intake (g/d/Kg$W^{0.75}$)	52.15[a]	40.94[b]	46.14[b]	2.79
Daily weight gain (g/day)	25.11[a]	20.55[b]	20.78[b]	2.25
Feed /gain ratio	12.32[b]	14.13[a]	14.25[a]	1.53

Means a,b,c on the same row with identical superscripts are not significantly (P>0.05) different
PMC/CsP (pulverized maize-cob/cassava peel), PMC/BG (pulverised maize-cob/brewers'grain), PMC/BG/CsP (pulverised maize-cob /brewers'grain/ cassava peel)

Table 4: Dry matter and nutrient digestibility (%) of pulverized maize-cob based diets by West African dwarf goats.

	Treatments			
Variables	PMC/CsP	PMC/BG	PMC/BG/CsP	SEM
DM intake (g/day)	301.17 [a]	195.30[c]	229.04[b]	30.11
Dry matter digestibility (%)	42.77 [b]	50.26[a]	47.09[b]	3.22
Crude protein digestibility (%)	48.35[b]	58.41[a]	52.27[a]	5.45
Neutral detergent fibre digestibility (%)	37.97 [b]	43.48[a]	31.78[b]	3.45
Acid detergent fibre digestibility (%)	20.21[b]	26.12[a]	17.35[bc]	2.76

PMC/CsP (pulverized maize-cob/cassava peel), PMC/BG (pulverised maize-cob/brewers'grain), PMC/BG/CsP (pulverised maize-cob /brewers'grain/ cassava peel)

Generally, the relatively low digestibility of the fibre fraction of the diets may be due to the presence of maize-cob which is a high roughage ingredient and the main component of the diets. However, higher digestibility of crude protein than fibre fractions was observed which may be due to the nature of the protein sources (urea, brewers' grain) which are by-pass protein that escapes rumen fermentation and goes to the abomasum for digestion and made available for the animal. This observation is consistent with the reports of Giri *et al*. (2000) and Aregheore (2000) who opined that digestibility of nutrients varies with nutrient composition. The highest neutral detergent fibre digestibility (43.48%) observed for animals on diet PMC/BG may be due to the higher protein content of the diet which encouraged rumen micro -organism proliferation which could have enhanced thorough digestion of ingesta. Findings in this study also corroborate the report of Preston and Leng (1987) that increased level of protein in ruminant diet improved the digestibility of such diet. It has also been reported that maximum dietary crude fibre digestion in the rumen occurs when dietary crude protein is between 12 and 16% (McAllan, 1991).

CONCLUSION

It can therefore be concluded that goats had a better preference and utilization for pulverized maize-cob and cassava peel mixture than the other combinations. Maize-cob, cassava peel and brewers' grain can be recycled as feed ingredients that can be converted to meat in goat production especially during unfavourable periods.

REFERENCES

Adedeji, O.Y., Ajayi, F.T., Falola, O.O., Aregbe, A.O. (2014). Intake and digestibility of West African Dwarf goats fed concentrate with varying inclusion levels of corn cob and and groundnut husk. Proc. 39th

Conf., Nigerian Society for Animal Production. 16- 19 March. Babcock Univ. IIishan – Remo, Ogun State, Nigeria. Pp 265 – 267

Ajayi, F.T., Ogunleke, F.O. Odejide, J.O. Tiamiyu, A.K. and Morakinyo, O.A. (2014). Feed intake and weight changes of West Africa Dwarf goats fed concentrate diet with corncob in varying inclusion levels. Proc. 39th Conf., Nigerian Society for Animal Production. 16- 19 March., Babcock Univ. IIishan – Remo, Ogun State, Nigeria. Pp 262 – 264.

AOAC, (2005). Official Methods of Analysis, 18th Ed., (Association of Official Analytical Chemists. Washington, D.C., USA, Pg 66-88.

Aregheore, E.M., (2000). Chemical composition and nutritive value of some tropical by-products feedstuffs for small ruminant's *in-vitro* and *invitro* digestibility. *Anim. Feed Sci. Technol*., 85: 99-109.

Devant, M., Ferret, A., Calsamiglia, S. and Casal, R. (2000). Effect of protein concentration and degradability on performance, ruminal fermentation and nitrogen metabolism in rapidly growing heifers fed high concentrate diets from 100-230 kg body weight. *J. Anim. Sci*., 78: 1667-1676.

Diar, H. A. (1992). Traditional fermentation technology and food policy in Africa. *Appropriate Tech*. 19 (3): 21-23

Dominique, B.M.F, Dellow, D.W and Barry, T. N. (1991). Voluntary intake and rumen digestion of low quality roughage by goats and sheep. *Journal of Agricultural Science* (Cambridge) 117 111-120.

Fajemisin, A.N., Chineke, C.M., Fadiyimu, A.A.and Fajemisin, A.J. (2015). Response of West African dwarf sheep to differently processed corncob meal based diets. *Nigerian Journal of Animal Production* 42 (1):162-170.

Giri, S.S., Sahon, A. and Pathak, N.N. (2000). Feed intake, digestibility plane of nutrition and live weight gain by crossbred growing bull fed on grainless diets containing different nitrogen sources. *Anim. Feed Sci. Technol*., 88: 195-203.

Ibeawuchi, J. A. Ahamefule, F. O. and Oche, J. E. (2002). An assessment of the nutritive value of the browse plants in Markurdi. *Nigerian Agricultural Journal.* 33:128-135

Ibhaze, G. A. (2015). Feeding quality of fermented maize-cob based diets as feed for West African Dwarf goats. *Applied Tropical Agriculture* 20 (1): 52 – 56

Ibhaze, G. A., Olorunnisomo, O.A., Aro, S.O. and Fajemisin, A.N. (2014). Intake, growth rate and feed conversion ratio of dry west African swarf does fed ensiled corncob based diets. Proc. 39th Conf., Nig. Soc for Anim. Prod. 16- 19 March., Babcock Univ. IIishan – Remo, Ogun State, Nigeria. Pp 239 – 242.

Karbo, N., Barnes, P. and Rudat, H. (1996)**.** Evaluation of browse forage preferability by sheep and goats in the Northern Guinea Savanah zone of Ghana. Bulletin of Animal Health and Production. *Bulletin of Animal Health and Production in Africa*, 44: 225-230.

Lu, C.D., Kawas, J.R. and Mahgoub, O.G. (2005). Fibre digestion and utilization in goats. *Small Ruminant Research*, 60: 45-52.

McAllan, A.B. (1991). Sources of nitrogen supplements to maximize cereal crop residue digestion in the rumen, In: Storage characteristcs digestbilkiuty and N-Balance in WAD sheep. *Nigerian Journal of Animal Production*. 35(2):223-230

Norton, B.W. (1994). Tree legumes as dietary supplements for ruminants. In: Gutteridge, R.C. and Shelton, H.M. (Editors) Tropical Tree Legumes in Tropical Agriculture. Cab International, Uk, 177-201.

Omokanye, A. T., Balogun, R. O., Onifade, O. S., Afolayan, R. A. and Olayemi, M.E. (2001). Assessment of preference and intake of browse species by Yankasa sheep at Shika Niger. *Small Ruminant Research, 42:* 203-210

Preston, T. R. and Leng, R. A. (1987). Matching ruminant production systems with available resources in the tropics and sub- tropics. Penambul Books Ltd: Armidale NSW, Australia. Pp 245

SAS (2000). Statistical Analysis System. SAS User's Guide Statistics Institute Inc.Version 8. North carolina USA. 27513

Van Soest, P. J., Robertson, J.B. and Lewis, B.A. (1991). Methods for dietary fiber, neutral detergent fibre and non- starch polyssacharides in relation to Animal nutrition. *Journal of Dairy Science*, 74:3583- 3597.

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