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FEED INTAKE, DIGESTIBILITY AND NITROGEN BALANCE OF WEST AFRICAN DWARF GOATS FED MAIZE OFFAL AND SORGHUM BREWER'S GRAINS

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ABSTRACT

Feed intake, digestibility and nitrogen balance were determined in nine female West African dwarf (WAD) goats fed varying levels of maize offal (MO) and sorghum brewer's grains (SBG) using a randomised block design. The diets did not significantly affect the dry matter intake (DMI) or intake of crude protein (CP), neutral detergent fibre (NDF) and energy of the animals.

The feed intake, nutrient digestibility and nitrogen balance of the animals were significantly ($P < 0.05$) affected. However, digestibility and nitrogen balance increased with increasing levels of SBG in the diet. Inclusion levels of 40 % SBG and 24 % MO in the diet favoured growth rate and the feed utilization. Since MO and SBG are locally available and devoid of human competition, their utilization in small ruminant nutrition will meet dietary requirements at a reduced feed cost and reduction in environmental pollution.

Keywords: Goats; maize offal; brewer's grains; digestibility; nitrogen balance.
Short Title: Utilization of maize offal and sorghum brewer's grains by goats.

INTRODUCTION

With increasing population, especially in Nigeria, there is the need for improvement in the method of livestock production. Nutrition is probably the most important factor that affects livestock production. In the tropics, the major production problem is the supply of adequate feed and the low quality of feeds (Peters, 1988). Feed accounts for about 60-80 % of the cost of raising animals depending on the species, breeds and environment. The consequences of feed shortage is low productivity. Preston (1986) opined that feed intake influences the productivity of ruminants and is determined by both animal and feed factors.

The conventional sources of carbohydrates and protein for livestock feeds are the cereal grains, root crops, oil seed cakes and some animal protein sources like fish meal. These feedstuffs are expensive and some are valuable feeds for man, hence there is an active competition between man and animals for these food materials. Maize offal (MO) and sorghum brewer's grains (SBG) have the potential to wholly or partially replace the conventional grains in animal feeding. Some of the obvious advantages of MO and SBG are that they are relatively cheap, abundant and available, thus minimising the cost of feeding and reducing the occurrence of seasonal shortages of feeds for certain classes of livestock like the ruminants. Chemical analyses have shown that the protein content of MO and SBG is higher than that of their respective grains, but their utilizable energy content is lower (Oyenuga, 1968; Adeneye and Sunmonu, 1994). MO has a high protein level, which is attributed to the high protein concentration in the aleurone layer of the maize grain. The microbial action on the sorghum grain during the brewing process is chiefly responsible for the higher protein level observed in SBG. MO has about the same feeding value as wheat offal and it is often used to replace maize at high levels in poultry diets. SBG on the other hand is a feeding stuff of good potential in ruminant feeding.

The objective of this study is to determine the feed intake, digestibility and nitrogen balance of West African dwarf (WAD) goats fed varying levels of MO and SBG in their diets.

MATERIALS AND METHODS

Nine female WAD goats, 5 - 6 months old with mean live-weight of 7.78 ± 0.02 kg were randomly assigned to three treatments (A, B and C). Each treatment consisted of three animals fed diets A, B and C using a randomised block design.

There were three experimental diets, containing different combinations of MO and SBG with a fixed amount of cassava peels, palm kernel cake, oyster shell, common salt, mineral - vitamin premix and elemental sulphur (Table 1). The experiment lasted for 13 weeks.

Table 1. Ingredient composition of experimental ration.

Ingredients	Rations		
	A	B	C
Maize offal	40.0	32.0	24.0
Sorghum brewer's grains	24.0	32.0	40.0
Cassava peels	20.0	20.0	20.0
Palm kernel cake	14.0	14.0	14.0
Oyster shell	0.8	0.8	0.8
Common salt	0.5	0.5	0.5
Mineral-Vitamin premix*	0.5	0.5	0.5
Element sulphur	0.2	0.2	0.2

*The premix contains per kg diet: Vitamin A - 10,000,000 IU, vitamin D3 - 2,000,000 IU, vitamin E - 15,000 IU, Calcium - 600 mg, Zinc - 100 g, Phosphorus - 400 mg, Iron - 100 g, Antioxidant - 15 g, Iodine - 1 g, Manganese - 50 g, Selenium - 0.2 g, Cobalt - 0.5 mg.

Animals were placed in metabolic cages for digestibility study. Feed and water were offered *ad libitum* for 14 days. Total faeces, urine and refused feeds were collected and weighed in the last 7 days. Ten percent aliquots of each were kept for analysis. Urine samples were preserved at -5°C in a deep freezer until required for analysis. Feed and faecal samples were dried at 65°C to constant weight, milled and stored in airtight polythene bags. Oven dried samples were milled and analysed for crude protein according to AOAC (1984) procedure. The detergent fibre and lignin fractions of feeds and faeces were determined by methods of Van Soest and Robertson (1985).

Data obtained were subjected to analysis of variance (Steel and Torrie, 1980). Treatment means were compared using Duncan's multiple range test (Duncan, 1955).

RESULTS AND DISCUSSION

The chemical compositions of the diets are presented in Table 2. Dry matter content of the diets ranged from 94.01 % (Diet A) to 95.08 % (Diet C) and crude protein (CP) content from 18.99 % (Diet B) to 19.07% (Diet C). The values obtained exceeded the minimum protein requirement of 10-12 %
for ruminants (ARC, 1985). Values for neutral detergent fibre and acid detergent fibre, lignin,

Table 2. Chemical composition of diets.

	Rations		
Constituents (%)	A	B	C
Dry matter	94.01	95.04	95.08
Crude protein	19.05	18.99	19.07
Neutral detergent fibre	38.30	43.16	44.21
Acid detergent fibre	24.47	25.26	25.26
Lignin	6.38	5.26	3.16
Energy (Kcal/g)	5.28	5.18	5.18
N_2	3.05	3.04	3.06

nitrogen and energy are also shown in Table 2. The lignin intake for treatments A, B and C varied significantly ($P < 0.01$) with diet A having the highest value, followed by diet B and lastly diet C (Table 3). The lignin intake from the diets was a reflection of the lignin content of the diets rather than the DM intake.

Table 3 contains the dry matter (DM) and nutrient intake of the goats. The mean daily DM intake (DMI) was 64.94 g/kgw$^{0.75}$/day in diet A, followed by 62.03 g/kgw$^{0.75}$/day in diet C and 56.96 g/kgw$^{0.75}$/day in diet B. The differences were however not significant. The mean DMI from the three diets was 61.31 g/kgw$^{0.75}$/day and was higher than 58.00 g/kgw$^{0.75}$/day reported by Akinsoyinu (1985) for sheep and goats.

Table 3. Mean daily dry matter and nutrient intake (g/kgw$^{0.75}$)of diets fed to WAD female goats

Intake/day	Rations		
	A	B	C
Dry matter (g/kgw$^{0.75}$)	64.94 ± 1.87	56.96 ± 2.35	62.03 ± 1.42
% Body weight	3.75 ± 0.10	3.27 ± 0.12	3.54 ± 0.08
Energy (Kcal/kgw$^{0.75}$)	342.90 ± 9.98	295.07 ± 12.17	231.32 ± 7.36
Digestible Energy (Kcal/kgw$^{0.75}$)	261.15 ± 9.02	241.00 ± 11.56	254.20 ± 7.55
Metabolizable energy (Kcal/kgw$^{0.75}$)	214.14 ± 8.86	197.63 ± 11.60	208.44 ± 7.46
CP (g/kgw$^{0.75}$)	12.37 ± 0.36	10.82 ± 0.45	11.83 ± 0.27
Digestible CP (g/kgw$^{0.75}$)	8.26 ± 0.30	8.05 ± 0.46	8.60 ± 0.23
NDF (g/kgw$^{0.75}$)	24.87 ± 0.72	24.58 ± 1.02	27.42 ± 0.63
ADF (g/kgw$^{0.75}$)	15.99 ± 0.47	14.39 ± 0.59	15.67 ± 0.36
Lignin (g/kgw$^{0.75}$)	4.15 ± 0.12^{a}	3.00 ± 0.12^{b}	1.96 ± 0.05^{c}

abc: Means with different superscripts in a row are significantly different ($P < 0.01$).

When expressed as a percentage of the body weight, the DMI from the diets A, B and C were 3.75, 3.27 and 3.54 % respectively. These values fall within the range of 1.8 - 7.8 % BW recommended by Devendra and McLeroy (1982) for goats in the tropics. However, these values were higher than the 2.8 % BW of DMI suggested by Akinsoyinu (1985). Furthermore, the DMI of the three diets fell within the range of 2.33 - 4.27 % BW and 52.98 - 81.30 g/day/g/kgW$^{0.75}$ for goats and sheep by several workers in the temperate and tropical countries (Mba, Magui and Awah, 1982; Hadipanayiotou, 1990; Lu and Potchaiba, 1990; Adeneye and Sunmonu, 1994; Getachew, Said and Sundst, 1994; Houston et al, 1994 Murphy, Loerch and Smith, 1994). Also, the average daily gross energy intake from the diets followed the same trend as the DMI. The crude protein intakes reported here were in agreement with the observation of Lu and Potchaiba (1990).

Values obtained for DM digestibility of the diets are shown on Table 4. These digestibility coefficients were comparable to 78 - 79% and 78 - 80% DM digestibility coefficients observed by Hadjipanayiotou (1990) respectively for sheep and goats fed hay supplements with concentrates as well as those reported by Murphy et al. (1994) who fed concentrates at restricted intakes to lambs in complete diets .

Table 4: Mean apparent digestibility coefficients of diets fed to WAD female goats.

Parameters	Rations		
	A	B	C
DM	72.99 ± 1.04	79.18 ± 2.01	75.13 ± 0.85
Energy	76.16 ± 1.29	81.68 ± 1.78	79.11 ± 0.71
CP	66.79 ± 1.29	74.37 ± 2.49	72.67 ± 0.94
NDF	63.33 ± 1.4[a]	76.85 ± 2.24[b]	78.54 ± 0.77[b]
ADF	67.99 ± 1.23[a]	75.27 ± 2.39[b]	62.59 ± 1.88[a]
Lignin	57.66 ± 1.63[a]	63.38 ± 3.40[b]	44.90 ± 1.88[c]

abc: Means with different superscripts in a row are significantly different ($P < 0.01$).

The energy digestibility ranged from 76.16 to 81.68 %. These values were close to those reported by Tewe, Akinsoyinu and Ogissi (1982) for lambs fed grass with concentrate supplement, but much higher than values obtained by Adeleye and Ikhatua (1977) for sheep fed grass hay with concentrates and Mba et al (1982) for goats on a browse diet supplemented with concentrates.

The CP digestibility coefficients obtained in this study were comparable with those reported by Hadjipanaiotou (1990) for goats fed on hay plus concentrate diets and by Waghorn, Smith and Ulyati (1990) for sheep fed roughages and concentrates. However, our results were higher than 59.61 - 62.13 % CP digestibility reported by Mba et al (1982) who fed a browse diet supplemented with concentrates to WAD goats.

NDF digestibility coefficients of our diets were significantly affected ($P<0.05$) by treatment and higher than those reported by Murphy et al (1994) for goats fed forage and concentrate mixtures. The ADF digestibility of our diets were also affected ($P<0.05$) by treatment and higher than those of Murphy et al (1994) and Richards et al (1994). With these NDF and ADF digestibility values, it shows that the animals digested these feeds quite well, thus promoting the survival rate of the microbes in the rumen, thereby promoting the growth rate of the goats.

Table 5 shows the nitrogen intake absorbed and retained from the diets. There were no significant differences between the means of treatments A, B, and C for N-balance and retention. The average percentage of N lost in the faeces was 29.33% while the N absorbed (g/day) increased from 7.86 - 9.17 in favour of higher inclusion rates of SBG in the diets. The mean % N absorbed was 74.28%, comparing well with an average of 70.90% obtained by Adeneye and Sunmonu (1994) for sheep fed forage supplemented with concentrates. The nitrogen retained (g/day) followed the same trend as the nitrogen intake. Also, N retained as % N intake and of N absorbed also followed a similar trend as N intake. The implication is that with the addition of MO and SBG in the diet of goats, the animals had a better growth rate and increased productivity.

CONCLUSION

Since the two unconventional feeds, maize offal and sorghum brewer's grains are locally

Table 5. Mean nitrogen balance of female WAD goats fed with diets containing maize offal and sorghum brewer's grains.

	Rations			
	A	B	C	Mean
N Intake (g/day)	11.75 ± 0.26^a	12.65 ± 0.58^b	11.82 ± 0.32^a	12.07
Faecal N (g/day)	3.89 ± 0.13	3.47 ± 0.46	3.21 ± 0.09	3.52
(% Intake)	33.26 ± 0.96^a	27.46 ± 1.05^b	17.26 ± 0.92^c	29.33
Absorbed N (g/day)	7.86 ± 0.29^a	9.17 ± 0.22^b	8.61 ± 0.33^b	8.55
(% Intake)	66.78 ± 1.29^a	74.33 ± 2.48^b	72.65 ± 0.94^b	71.25
Urinary N (g/day)	2.34 ± 0.08	1.95 ± 0.11	2.08 ± 0.55	2.12
(% Intake)	20.01 ± 1.14^a	15.65 ± 1.48^b	17.61 ± 1.01^c	17.75
(% Absorbed)	29.87 ± 1.02^a	21.38 ± 1.25^c	24.28 ± 0.94^b	25.18
N Retained (g/day)	5.52 ± 0.25^a	7.22 ± 0.21^b	6.53 ± 0.30^b	6.42
(% Intake)	46.94 ± 1.44^a	59.03 ± 2.63^b	55.03 ± 1.21^c	53.67
% Absorbed	70.33 ± 0.92^a	78.93 ± 1.04^b	75.69 ± 0.87^c	74.98
N digestibility %	$55.78^a \pm 1.29$	$74.33^b \pm 2.48$	$72.65^c \pm 0.94$	71.25

abc: Means with different superscripts in a row are significantly different ($P < 0.05$).

available and devoid of human competition, their utilization in small ruminant diets will not only increase dietary protein supply but also reduce cost, environmental pollution and health hazard.

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