

Research article

FEED INTAKE AND NITROGEN METABOLISM BY WEST AFRICAN DWARF DOES FED NATURALLY FERMENTED MAIZECOB BASED DIETS

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Abstract

The study evaluated the performance and nitrogen metabolism by twelve (12) West Africa dwarf (WAD) goats with average weight of 9.10 ± 0.55 kg fed naturally fermented maizecob diets. Animals were randomly allotted to three maizecob based diets; maizecob/cassavapeel (MC/CsP), maizecob/brewers' grain (MC/BG) and maizecob/cassavapeel/brewers' grain (MC/CsP/BG) with four goats per diet in a completely randomized design. Feed intake (FI), average daily weight gain (ADWG) and feed conversion ratio (FCR) were evaluated in a feeding trial, after which a metabolism trial was conducted using the same goats. Results obtained revealed that performance of animals in terms of FI was significantly ($P < 0.05$) higher for animals fed MC/BG (354.43g/day) while animals on MC/CsP had the least (334.42g/day). The ADWG ranged from 29.00 – 38.44g/day across the treatments with animals on diet MC/BG recording the highest (38.44g/day) and those fed MC/CsP had the least value (29.00g/day). Significant ($P < 0.05$) differences were observed in the FCR. Animals on diet MC/BG had the least FCR (9.22). Nitrogen metabolism showed significant ($P < 0.05$) differences. Nitrogen intake, nitrogen balance, and nitrogen

retention were higher for animals on MC/BG and the values ranged from 5.59-8.75g/day, 1.68-3.72g/day and 30.05-42.51% respectively. Results suggest that fermented maizecob with brewers grain combination was better tolerated and utilized by goats than other combinations. **Copyright © WJASR, all rights reserved.**

Key words: fermentation, maizecob based diet, performance, West African dwarf goats

Introduction

The huge global increase in human population has led to an increase in food demand and this has resulted in an increase in livestock production, as it is the main source of high quality protein intake by man. Ruminants which are the major provider of meat and milk consumed by man depend largely on natural pasture which is inadequate in quality and quantity or may not be available at all especially during the dry periods of the year. This short fall results in low productivity and even death of the animals and consequently, a great economic loss to the farmer. To ensure the continuous supply of protein by these animals in season and out of season, the use of alternative feed resources has earlier been reported [1] and persistently been advocated. Although most alternative feed materials are highly lignified and of low protein value, thereby limiting their intake and utilization by animals, this could possibly be surmounted by their combinations with feed materials of higher nutritive value.

Nigeria is rated the largest producer of cassava in the World with over 50 million metric tonnes annually [6]. Cassava tuber is a multipurpose agricultural product that is consumed by man as food and exploited for various industrial and agricultural uses. The skin (cassava peel) is obtained by its removal from the tuber either manually or mechanically during the conversion of cassava tuber to other products. Cassava peel is a rich source of energy in ruminant feeding [4]. Maizecob is perhaps one of the most prominent cereal crop by- product in Nigeria and a potentially valuable feed resource for ruminants [2]. Maizecob is an energy source for ruminants, has low palatability and poor in nutrients, due to its nutrient inadequacy, it must be fortified with other feed materials that furnish these essential nutrients [8, 9] to give a balance ration for ruminants. Brewer's grain is a by- product of the beer brewery industry. It is an energy- protein rich concentrate with high digestibility and can be combined with maizecob to improve the nutritional value of maizecob, and also to serve as 'conditioner' (to improve the moisture content of maizecob during the process of ensiling for easy compaction). The study was conducted to evaluate the utilization of naturally fermented maizecob based diets by goats as sustainable feed in the absence or scarcity of grass.

Materials and methods

Experimental site

The study was conducted at the Dairy Unit of the Teaching and Research Farm, University of Ibadan, Nigeria (7° 27'N and 3° 45'E) with mean temperature of 27 °C and average annual rainfall of about 1250 mm.

Experimental diets preparation

Composite maizecob and fresh cassava peels were collected from maize shelling and cassava processing centres respectively in Ibadan. The cassava peel was wilted for 12 hrs prior to ensiling to reduce the moisture content. The maizecob and cassava peels were chopped using an automated chopper for easy compaction and mixed with other ingredients in the proportions specified below (Table 1) and packed in 120L plastic drums lined with polythene sheets for the feeding trial and in 4L laboratory mini silos for chemical analysis. The mixtures were compressed manually in the silos, sealed, weighted with a sand bag and covered with a plastic lid. The material was fermented for 21 days under anaerobic condition before feeding out.

Management of animals

A total of twelve (12) West African dwarf (WAD) does weighing $9.10 \pm 0.55\text{kg}$ were used for the study. Animals were sourced from neighbouring villages to Ibadan and randomly allotted to the three diets of four animals per diet in a completely randomized design. On arrival, the goats were placed on prophylactic treatments through the administration of antibiotics (Long acting) at 1ml/10kg. Animals were also treated against ecto and endoparasites using 10%levamisol and diasuntol, respectively and allowed an adaptation period of four weeks.

Feeding trial

Thereafter, animals were tagged and kept in individual pens with wood shavings. Pens were well ventilated , cleaned daily and wood shavings were changed fortnightly. Animals had free access to fresh feed and water daily. Animals average daily intake, average daily weight gain were calculated. The experiment lasted for a period of 12 weeks excluding the four weeks of adaptation .

Nitrogen metabolism study

Three goats per treatment making a total of nine were selected and randomly allotted to individual metabolic crates adapted for separate collection of faeces and urine. Nitrogen metabolism trial was conducted in the last 7-day of the feeding trial after 7- day adjustment period. Experimental diets offered and left –over were weighed daily for each animal. The weight difference between them was the feed intake. Samples of experimental diets and Ten percent (10%) of faeces collected each day were oven dried at 65°C . The oven dried feed and fecal samples were milled and stored in air tight – containers until required for analysis. Daily urine samples from each goat was collected in sample bottles containing 10mls of 10% concentrated sulphuric acid to prevent loss of nitrogen and refrigerated until required for analysis. Nitrogen balance by the goats was calculated as the difference between nitrogen intake and nitrogen excreted from faeces and urine while nitrogen retention was computed from nitrogen balance expressed as a percentage of nitrogen intake.

Chemical analysis

Samples were taken from the mini silos for proximate and detergent fibre analyses determination using the methods of [3] and [18] respectively.

Experimental Design and statistical analysis

The experimental design adopted in this study was the completely randomized design. Data obtained from nitrogen metabolism was analysed using one- way analysis of variance (ANOVA) of statistical analysis software [15] and means were separated using the Duncan Multiple Range Test [5].

Results and Discussion

The chemical composition of the experimental diets is presented in Table 1. The crude protein values which ranged from 16.18-22.06% were above the recommended protein level (10-12%) by [11] for ruminants. This therefore suggests the adequacy of the diets to meet the protein requirement of goats. These values were higher than (3.54-6.35%) reported by [10] for lime treated maize cob diets. Crude fibre obtained were relatively numerically of the same range (18.11-22.13%). This implies that the diets could have same potential of meeting the animals fibre requirement. The ash which represents the mineral concentration of the diets are relatively the same (4.92-5.61%).

Table 1. Ingredient and chemical compositions of experimental diets (%)

Ingredient	Diets		
	MC/Csp	MC/BG	MC/Csp/BG
Maizecob	13	13	13
Cassava peels	80	-	40
Brewers' grain	-	81	41
Palm kernel cake	5	5	5
Urea	1	-	-
Dicalcium phosphate	0.5	0.5	0.5
Sulphur	0.5	0.5	0.5
Chemical composition (%)			
Neutral detergent fibre	46.03	39.12	40.15
Acid detergent fibre	29.11	23.03	27.23
Nitrogen free extract	50.28	45.07	45.40
Ether extract	7.11	9.15	8.05
Crude protein	16.18	22.06	19.50
Crude fibre	20.97	18.11	22.13
Ash	5.46	5.61	4.92
Dry matter	35.63	37.43	36.17

MC/Csp(Maizecob/Cassava peel),MC/BG(Maizecob/brewers' grain),MC/Csp/BG
 (Maizecob/Cassava peel/brewers' grain)

Performance of experimental goats

Performance of goats fed fermented maizecob diets is shown in Table 2. There were significant differences ($p < 0.05$) in all the parameters measured except for daily intake on percentage bodyweight. However, animals fed diet

MC/BG had the highest feed intake (354.43g/day) and while those on MC/CsP recorded the least intake. Similarly, animals on the same diet MC/BG had the highest average weight gain (38.44g/day) and the best feed conversion ratio among the diets. These results are indications that goat prefer fermented MC/BG combination, could utilize the diet with lesser efficiency to produce a unit weight gain. Weight gain obtained in this study were higher than values (15.24 – 32.35g/day) reported by [12], 16.07-22.79g/day reported by [17], but intake were similar to dry matter intake range of (336.39-392.46g/day) for WAD goats fed graded levels of *Moringa oleifera* leaf meal as reported by [17]. The highest value obtained in this study is relatively higher than 215.30 -290.25g/day reported by [7] who fed cassava residues and agro- industrial by products to WAD goats. However, a reverse result of least feed intake (190.27g/day) and daily weight gain (14.68g/day) was reported by [9] who fed dried ground corn cob based meals to WAD goats.

Table 2: Performance characteristics of West African dwarf goats fed naturally fermented maizecob based diets

Parameters	Diets			SEM
	MC/Csp	MC/BG	MC/Csp/BG	
Initial weight (kg)	9.10	9.45	9.56	1.08
Final weight (kg)	11.71 ^b	12.19 ^a	12.16 ^a	1.19
Average daily intake (g/day)	334.42 ^b	354.43 ^a	340.61 ^b	27.13
Average daily weight gain (g/day)	29.00 ^c	38.44 ^a	32.88 ^b	3.36
Feed conversion ratio	11.53 ^a	9.22 ^c	10.36 ^b	1.73

Means abc along the same row with identical superscripts are not significantly different. (P>0.05), MC/Csp (Maizecob/Cassava peel), MC/BG (Maizecob/brewers' grain), MC/Csp/BG (Maizecob/Cassava peel/brewers' grain)

Nitrogen metabolism of West African dwarf goats fed naturally fermented maizecob based diets.

Nitrogen metabolism of goats fed fermented maizecob based diets is presented in Table 3. Significant differences were observed across the diets for the parameters measured. Nitrogen (N) intake (8.75g/day) for goats fed MC/BG was highest and varied significantly (p<0.05) from those on MC/CsP (5.59) and MC/CsP/BG (6.97g/day). The highest nitrogen intake value recorded for animals on diet MC/BG could be attributed to the high protein content of the diet. This is in agreement with the view of [16] that as the level of crude protein in a diet increases, nitrogen intake also increased. This findings is however lower than the range (22.11- 26.53g/day) reported by [10] who fed lime treated maizecob supplemented with concentrate diet to Red Sokoto bucks.

Faecal nitrogen was also higher in animals on diet MC/BG (4.03g/day) and differed significantly (P<0.05) from animals on diets MC/CsP and MC/CsP/BG. The higher values observed in animals on diets containing brewers' grain could be due to the crude protein combination and nature of the protein in the diets. [14] reported that high protein concentration in a diet changes the pattern of nitrogen excretion towards increasing nitrogen excretion in faeces.

Urinary nitrogen values ranged from 0.97-1.15g/day and varied significantly ($p<0.05$) across the diets with animals on diet MC/CsP/BG having the highest value (1.15g/day) while animals on MC/CsP and MC/BG had lower values 1.04 and 0.97g/day respectively. The results obtained could be a pointer to nitrogen intake by the animals, the crude protein in the diet, its solubility thereby affecting the level of ammonia produced in the rumen and its overall utilization by the animals.

Nitrogen balance which is determined by the nitrogen ingested and excreted was also significantly ($p<0.05$) different. Values ranged from 3.72- 1.68g/day with animals on diet MC/BG having the highest value (3.72g/day) followed by animals on diet MC/CsP/BG (2.44g/day) and MC/CsP (1.68g/day). The result generally revealed a positive nitrogen balance as nitrogen intake was higher than nitrogen excreted. This further suggests that the diets were able to meet the animals' requirements for nitrogen.

Nitrogen retention which is expressed as percentage of intake also showed significant ($P<0.05$) difference. The values were significantly higher in animals on diet MC/BG (42.51%) while those on MC/CsP (30.05%) had the least value. This could also be attributed to the protein concentration in the diet as well as the nitrogen intake by the animal. This findings is supported by the reports of [13] who reported an increase in N intake and retention as the level of protein in diet of sheep increased.

Table 3. Nitrogen Balance of West African dwarf goats fed naturally fermented Maizecob diets

Parameters	Diets			SEM
	MC/CsP	MC/BG	MC/CsP/BG	
Nitrogen(N)intake (/day)	5.59 ^c	8.75 ^a	6.97 ^b	0.46
Faecal N (g/day)	2.86 ^c	4.03 ^a	3.38 ^b	0.13
Urinary N (g/day)	1.04 ^{ab}	0.97 ^b	1.15 ^a	0.35
N- balance (g/day)	1.68 ^c	3.72 ^a	2.44 ^b	3.67
N- retention (%)	30.05 ^c	42.51 ^a	35.01 ^b	8.14

Means abc along the same row with identical superscripts are not significantly different. ($P>0.05$), MC/Csp (Maizecob/Cassava peel), MC/BG (Maizecob/brewers' grain), MC/Csp/BG (Maizecob/Cassava peel/brewers' grain)

Conclusion

From the results of the study, it may be concluded that

- Feeding fermented maizecob based diets to goats can confer nutritional benefits on the animals in terms of weight gain
- The positive nitrogen balance observed in the animals reveals that the diets could meet the nitrogen requirements of goat hence can be used as sustainable feed for goats during scarcity or absence of forages.
- The better results obtained by animals fed MC/BG indicated that the diet was better utilized by the animals

- The test ingredients that could contribute to environmental degradation could be harnessed as source of dietary roughage for ruminants.

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