Assessment of nutrient intake and nitrogen utilization by West African dwarf goats fed milled bio-fibre waste rations

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SUMMARY

Nutrient intake and nitrogen utilization were investigated using twelve West African dwarf (WAD) goats weighing 9.05 - 9.26 kg for a period of fourteen (14) days. Three bio-fibre waste based rations; A (milled maize cob/cassava peel), B (milled maize cob/brewers' grain) and C (milled maize cob/brewers' grain/cassava peel) were formulated. Crude protein value of rations ranged from 14.66 - 21.18%, dry matter (90.06-90.90%) and neutral detergent fibre (40.01-51.14%). Dry matter intake was significantly ($P<0.05$) highest in ration A (273.76g/day) and least in ration B (176.88g/day). Crude protein intake was not significantly ($P>0.05$) different among the rations and ranged from 41.36-44.15g/day. Nitrogen utilization showed significant ($p<0.05$) difference in nitrogen balance and retention. Although, positive nitrogen balance was observed in all the animals, animals on ration A had the highest nitrogen balance (3.57g/day) and nitrogen retention (50.49 %) while those on ration B had the lowest values (1.24 and 18.73g/day) for nitrogen balance and retention respectively. It can be concluded that feeding the bio-fibre waste rations will provide the required nutrient for the animals for growth and production especially during periods of scarcity of grasses.

Keywords: agro-industrial residues, consumption, metabolism, pulverized, ruminant

INTRODUCTION

In livestock production, feed play a vital role in determining the profitability of the venture and providing a balanced ration for the animals is the aim of every farmer (Ibhaze *et al.,* 2014). However, in the tropics, inadequate nutrition is a great challenge contributing to production losses in ruminant animal production. Considerable research efforts

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(Olorunnisomo and Ososanya, 2002; Mubi *et al*., 2015; Ibhaze *et al.,* 2015; Fajemisin *et al*., 2016) have been made in circumventing this losses. One of such interventions is the use of bio-fibre wastes which are non-conventional feed resources. Bio-fibre wastes are fibrous materials considered to be valueless; of no economic importance or environmental enemies which are derived from processing of wood, any agricultural farm produce (Ajayi, 2016). Among such are cassava peels, maize-cobs and brewers' grain. These bio-fibres can serve as both fillers and nutrient providers in ruminant nutrition. However, their efficient utilization by animals can better be achieved when combined as a ration. In Nigeria, these materials are relatively cheap and readily available all year round. Nitrogen is one of the major constituents needed in production of amino acid required in tissue build up and development as well as synthesis of microbial protein, hence should be quantitatively and qualitatively adequate to ensure normal body functions (Bender, 2006). Nitrogen balance status shows the extent to which the body is maintaining adequate protein balance. Positive nitrogen balance is an anabolic state for optimal muscle growth. The West African dwarf goat is well adapted to the southern part of Nigeria and their rearing as well as consumption have no religious taboo. The thrust of this study is to evaluate the nutrient intake and nitrogen utilization by West African dwarf goats fed cassava peel, maize cob and brewers' grain (bio-fibre waste) combination as a ration.

MATERIAL 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 at 220m above sea level) with mean temperature of 27 °C and average annual rainfall of about 1350mm and humidity of 18% (Olorunnisomo and Abiola, 2015)

Animal studies

Twelve (12) West African dwarf (WAD) goats weighing 9.05 - 9.26 kg were used. On arrival, the goats were placed on prophylactic treatment against infections using oxytetracycline (Long acting) at 1ml/10kg body weight of the goats. Animals were also treated against ecto and endoparasites and allowed an adaptation period of fourteen days. Thereafter, animals were randomly assigned to the three rations of four animals per ration in a completely randomized design and housed individually in metabolic cages with facility for feeding, watering and separate collection of faeces and urine. Experimental feeds were offered *ad libitum* for 14 days. Feed offered, feed orts and faeces voided were weighed

and recorded in the last 7 days. Feed intake, feacal output and urinary output were measured. Ten per cent of ort and faeces voided were taken daily, dried at 65°C to constant weight, milled and kept in airtight containers until required for analysis. The urinary output was collected daily in sample bottles with 10mls of 10% concentrated sulphuric acid to prevent loss of nitrogen and refrigerated until required for analysis. Nitrogen balance by the goat was calculated as the difference between nitrogen intake and excreted from faeces and urine while nitrogen retention expressed as a percentage of nitrogen intake.

Table 1. Ingredient (g/100g) compositions of milled bio-fibre waste rations.

Ingredients	Bio-fibre waste rations		
	A	B	C
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

A=MMC/CsP (milled maize-cob/cassava peel), B=MMC/BG (milled maize-cob/brewers'grain), C=MMC/BG/CsP (milled maize-cob /brewers'grain/ cassava peel)

Chemical analysis

Dry matter and proximate composition of feed and faeces were determined using AOAC (2005) methods while fibre fractions (neutral detergent fibre, acid detergent fibre and lignin) were determined as described by Van Soest and Robertson (1991).

Experimental design and statistical analysis

The experimental design adopted was the completely randomized design. Data obtained were subjected to one-way analysis of variance (ANOVA) using the statistical package (SPSS, 1999) and significant means were separated using the Duncan Multiple Range Test of the same package.

RESULTS AND DISCUSSION

The chemical compositions of the rations are presented in Table 2. Dry matter content ranged from 90.06% (Ration C) to 90.90% (Ration A). Crude protein concentration (14.66–21.18%) obtained were higher than 8% recommended for ruminant's maintenance (Norton, 2003) implying that the rations were adequate in protein to meet the protein need of the rumen microbes for their effective function. The NDF (neutral detergent

fibre) ranged from 40.01-51.14% and the ADF (Acid detergent fibre) varied from 30.10-32.15%. The fibre fractions obtained were indicative of the potential of the rations to support rumen microbial fibre requirement. The NDF values were similar to the range reported by Ajayi *et al.* (2014) for concentrate diet containing varying inclusion levels of corncob and higher than values (39.12-46.03%) reported by Ibhaze *et al*. (2014) for ensiled corncob based diets.

Table 2. Chemical composition (%) of milled bio-fibre waste rations.

Parameters	Bio-fibre waste rations		
	A	B	C
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/kg DM)	15.69	15.72	15.54

abc = Means on the same row but with different superscripts are statistically different
A=MMC/CsP (milled maize-cob/cassava peel), B=MMC/BG (milled maize-cob/brewers'grain), C=MMC/BG/CsP (milled maize-cob /brewers'grain/ cassava peel)

Table 3: Nutrient intake (g/day) by West African Dwarf goats fed milled bio-fibre waste rations

Components	Bio-fibre waste rations			SEM
	A	B	C	
Dry matter	273.76^{a}	176.88^{b}	206.27^{a}	20.43
Crude protein	44.15	41.36	42.65	3.13
Ether extract	15.36	16.44	16.35	1.65
Ash	16.02^{ab}	14.37^{bc}	18.23^{a}	1.27
Nitrogen free extract	93.67^{a}	79.47^{b}	96.61^{a}	5.42
Neutral detergent fibre	154.02^{a}	78.14^{c}	94.16^{b}	7.32
Acid detergent fibre	96.99^{a}	58.79^{c}	71.30^{b}	4.95

abc = Means on the same row but with different superscripts are statistically different
A=MMC/CsP (milled maize-cob/cassava peel), B=MMC/BG (milled maize-cob/brewers'grain), C=MMC/BG/CsP (milled maize-cob /brewers'grain/ cassava peel)

Nutrient intakes of experimental animals are presented in Table 3. Significant differences ($P<0.05$) were observed in the dry matter intake, ash, nitrogen free extract and fibre fractions. Dry matter intake is one of the determinant factors in feed utilization, energy intake and overall performance of ruminants (Ajayi *et al.,* 2012). Goats on ration A had the highest dry matter intake (273.76g/day) while those on ration B had the lowest intake (176.88g/day). The significantly ($P<0.05$) higher dry matter intake observed in animal on ration A could be that the animals found the

ration more palatable in spite of its lower crude protein content (Ibeawuchi *et al.,* 2002, Ahamefule and Elendu, 2010). However, results obtained in this study were higher than 176.62-195.61g/day reported by Oloche *et al. (*2015) for WAD goats fed diets containing different levels of sweet orange peels and gamba grass. Crude protein intake was lower than 74.0-106.2g/day reported by Mohammed *et al.* (2014) for WAD goats fed poultry litter waste and fore-stomach digesta.

Table 4: Nitrogen utilization by West African dwarf goats fed milled bio-fibre waste rations

Variables	Bio-fibre waste rations			SEM
	A	B	C	
Nitrogen intake (g/day)	7.07	6.62	6.83	0.38
Faecal Nitrogen (g/day)	2.85^{b}	4.02^{a}	3.43^{ab}	0.15
Urinary Nitrogen (g/day)	0.65^{b}	1.36^{ab}	1.73 ^{a}	0.18
N-balance (g/day)	3.57^{a}	1.24^{b}	1.67 ^{b}	0.64
N-retention (%)	50.49^{a}	18.73^{c}	24.45^{b}	7.84

abc= Means on the same row but with different superscripts are statistically different
A=MMC/CsP (milled maize-cob/cassava peel), B=MMC/BG (milled maize-cob/brewers'grain), C=MMC/BG/CsP (milled maize-cob /brewers'grain/ cassava peel)

The highest nitrogen intake value (7.07g/day) as shown in Table 4 was obtained in animals on ration A but was not significantly (P>0.05) different from other rations. This could be a reflection of higher dry matter intake by the animals on the ration. The nitrogen intake observed in this study was slightly lower than 8.75g/day obtained by Ibhaze and Fajemisin (2015) for WAD goats fed naturally fermented maize cob based diets and 11.75-12.65g/day reported by Olorunnisomo and Ososanya (2002) for WAD goats fed maize offal and sorghum brewers' grains. Nitrogen balance and retention which are functions of nitrogen ingested and digested were significantly (P<0.05) higher in diet A.

The highest N- retention value (50.48%) obtained in diet A is an indication of lesser excretion of nitrogen by the animal suggesting better nitrogen utilization and performance of animals on the diet. The higher N-retention observed in ration A could possibly be due to the higher nitrogen intake by animals on the ration. It was also observed that all the animals had positive nitrogen balance. This is a pointer that the nitrogen was well metabolized and utilized by the animals for muscle growth as nitrogen intake was higher than nitrogen voided. This also suggests that all the rations were adequate to meet the protein requirements for effective rumen microbial activity. However, nitrogen balance values obtained in this study were comparable to 1.57-2.43g/day reported by Ukanwoko and Ibeawuchi (2009) for WAD bucks fed poultry waste-cassava peels based diets.

The goats weight ranged from 9.05-9.26 and the final body weight ranged from 10.90-11.33kg while the average daily gain (20.55-25.11g/day) in a growth study was earlier reported (Ibhaze *et al*., 2016).

The protein composition of WAD goat meat ranges from 89.77- 90.43% as reported by Eneji *et al*. (2015) of WAD goats fed cassava peel based diets. The protein composition of milk from these goats under investigation ranged from 3.92-4.22% as earlier reported by Ibhaze *et al*. (2014). These values further attests to the efficient utilization of the diets for growth and production.

CONCLUSIONS

This study showed that all the bio-fibre wastes based rations had adequate nutrient profile which could assuage the problem of poor growth and support good performance in WAD goats especially during the dry periods. The positive nitrogen balance obtained suggested that animals consumed adequate protein and attained normal anabolic state

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