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ORIGINAL RESEARCH ARTICLE

Nutritive value of some crop residues with or without baker's Yeast (*Saccharomyces cerevisiae*) as supplements for West African Dwarf sheep

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ABSTRACT

Two experiments were conducted to evaluate the growth performance, digestibility and nitrogen retention of sheep fed some crop residues with or without baker's yeast (Saccharomyces cerevisiae). In experiment I, sixteen West African Dwarf (WAD) sheep weighing 13.28±0.66kg were assigned to one of four total mixed diets containing one of the following: Brewers' dried grain (Control); Groundnut haulms (GNH); Guinea corn wastes (GCW) or Cowpea husk (CPH) with 4 animals per diet in a completely randomised design. In experiment II, sixteen WAD sheep weighing 17.85±0.40kg were assigned to the same diets with each animal on the GNH, GCW and CPH diets receiving 5g of baker's yeast supplementation per day. The animals were fed at 5% of their body weight. The experiments lasted 70 days each. On day 59 of each experiment, three animals per treatment were moved into individual metabolic cages to determine digestibility and nitrogen metabolism. In experiment I, there were no significant (P>0.05) differences in the average daily dry matter intake when the diets were fed without yeast supplementation. However, significant (P<0.05) reduction was observed for average daily dry matter intake in experiment II when animals were supplemented with baker's yeast: 774.11, 752.00, 726.67 and 740.92 g/day for BDG, GNH, GCW and CPH respectively. Average daily weight gain was significantly (P<0.05) different across treatments in experiment I. Average daily weight gains in this experiment were 91.00, 65.10, 51.00 and 69.02 g/day for BDG, GNH, GCW and CPH respectively. However, there were no significant (P<0.05) differences in the average daily weight gain and feed conversion ratio in experiment II. Nutrients digestibility was similar in both experiments I and II except the digestibility of crude protein in experiment I that was lower (P<0.05) for GCW compared to the other diets. There were no significant (P>0.05) differences in nitrogen metabolism for both experiments I and II. Groundnut haulms, Guinea corn wastes and Cowpea husk have the potential to sustain sheep production when supplemented with baker's yeast and effectively replace brewer's dried grain in their diets.

Key words: WAD sheep, crop residues, yeast, performance, nitrogen metabolism

INTRODUCTION

Nigeria is faced with a perennial problem of inadequate quality and quantity of ruminant feed resources. This has resulted in the low productivity of these animals. The natural vegetation which forms the bulk of the primary feed resources is of low nutritive value especially during the dry season. Heavy losses are usually recorded among ruminant animals that depend on natural vegetation for their sustenance during this period. The use of conventional feedstuffs which can salvage the situation is rather unsustainable due to high cost. Large quantities of crop residues are generated at the end of each harvest annually and these are of no utilizable value for man. Crop residues if properly harnessed can meet the nutritional needs of these animals as well as eliminate environmental nuisance associated when left unattended to. However, most of these crop residues are highly fibrous, have tough texture, exhibit poor digestibility and are deficient in essential nutrients (Osuji *et al*., 1995) and therefore requires promising methods of improving their utilization (Rekha *et al*., 2006). Groundnut haulms, Cowpea husk are among some of the crop residues of importance generated in enormous quantity at the end of each farming season. Probiotics are viable micro-organisms and, when administered in sufficient numbers, are capable of altering the microflora of the digestive tract of the host (Rook and Burnet, 2005) in a way, which results in improved health and production. Yeast (*Saccharomyces cerevisiae*), a direct-fed microbial is one of such probiotics that has the potential to improve the utilization of these crop residues by ruminant animals. Various yeast based products (live yeast, yeast culture extracts and *Aspergillus oryzea* fermentation end products) have been shown to increase daily feed intake and improve digestibility (Jouany, 2001), reduce methane production and stimulate rumen fungi (Chaucheyras *et al*., 1995), increase total number

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Table 1: Gross composition of total mixed diets in experiments I and II

Diets/Treatments	Control	GNH	GCW	CPH
Dried cassava peels	51.0	50.0	50.0	50.0
Palm Kernel Cake	11.0	11.0	11.0	11.0
Growers premix	1.0	1.0	1.0	1.0
Di-Calcium Phosphate	2.0	2.0	2.0	2.0
Salt	1.0	1.0	1.0	1.0
Urea	----	1.0	1.0	1.0
Brewers' Dried Grains	34.0	----	----	----
Groundnut Haulms	----	34.0	----	----
Guinea Corn Waste	----	----	34.0	----
Cowpea Husk	----	----	----	34.0
TOTAL	100.0	100.0	100.0	100.0
Calculated Crude Protein (%)	9.52	11.35	10.50	10.60

Growers premix: Vitamin A (7500000IU), Vitamin D3 (1000000IU), Vitamin E (1800mg), Vitamin B1(500mg), Vitamin B2 (1000mg), Vitamin D- Pantothenic acid (3200mg), Vitamin B6 (180mg), Vitamin B12 (5mg), Vitamin C (5000mg), Vitamin K (700mg), Nicotinic acid (4000mg), Folic acid (50mg), Choline chloride (63000mg), Manganese (35000mg), Cu (1500mg), Cobalt (180mg), Iron (10000mg), Iodine (720mg), Zinc(15000mg).
Control (Brewers' dried grain) **GNH (**Groundnut haulm) **GCW** (Guinea corn waste) and **CPH** (Cowpea husk)

of beneficial microorganisms and cellulolytic bacteria, increase ruminal pH, reduce lactate accumulation, decrease oxygen concentration in the rumen fluid and reduce ruminal ammonia concentration (Denev *et al.*,2007). However, reports on performance responses of ruminants, including lambs, fed on yeast and yeast cultures have been variable. Kamra *et al.* (2002), Yang *et al*. (2004), Mahender *et al.* (2005) and Kawas *et al.* (2007) did not observe any effect of yeast feeding on dry matter intake, nutrient digestibility and growth. Agarwal *et al.* (2002), Erasmus *et al.* (2005), Mahender *et al.* (2005), Kim *et al.* (2006) and Kawas *et al.* (2007) reported that growth rate and efficiency of gain were similar or reduced whereas Lesmeister *et al.* (2004) and Stella *et al.* (2007) reported improved weight gain, feed consumption and feed efficiency of gain on yeast supplementation. Haddad and Goussous (2005) and Stella *et al.* (2007) did not also observe increased dry matter intake. The present study was carried out to determine the performance, digestibility and nitrogen metabolism of West African Dwarf (WAD) sheep fed some crop residues with or without bakers' yeast supplementation.

MATERIALS AND METHODS

Experimental site

The two experiments were conducted at the Sheep Unit of the Teaching and Research Farm, University of Ibadan, Ibadan. The location is 7º 27'N and 3º 45'E at altitude 200-300 m above sea level. The climate is humid tropical with mean temperature of 25-29ºC and the average annual rainfall of about 1250 mm.

Animals and feeding management

Experiment I

Sixteen West African Dwarf (WAD) sheep aged between 8-10 months and weighing 13.28±0.66kg were randomly allotted to one of four groups with 4 animals

Table 2: Chemical composition of the total mixed diets (g/100gDM).

	D i e t s			
Parameters(%)	Control	GNH	GCW	CPH
Dry matter	91 46	93.33	95.74	92 61
Ether extract	18.39	18.28	18.00	19.53
Ash	15.27	11.53	21.86	15.49
Crude protein	11.10	13.85	11.89	12.15
Neutral Detergent Fibre	66.77	57.03	62.39	63.08
Acid Detergent Fibre	34.96	46.80	53.32	58.17
Acid detergent Lignin	14.52	11.61	17.68	16.65
Hemicellulose	15.80	19.16	19.07	15.10
Cellulose	32.44	27.34	28.46	32.86

Control (Brewers' dried grain) **GNH (**Groundnut haulm) **GCW** (Guinea corn waste) and **CPH** (Cowpea husk)

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Table 3: Performance characteristics of sheep fed crop residues with or without baker's yeast in experiments I and II

	Diets			
Parameters	Control	GNH	GCW	CPH
Experiment I				
Initial body weight (kg)	13.50	12.75	12.75	14.13
Average daily DM intake (g)	620.08	571.00	552.66	630.01
Average daily gain (g)	91.00[a]	65.10[b]	51.00[c]	69.02[b]
Feed conversion ratio (FCR)	7.00[a]	9.25[b]	10.25[c]	9.75[b]
Experiment II				
Initial body weight (kg)	18.00	17.50	17.62	18.25
Average daily intake (g)	774.11[a]	752.00[b]	726.67[d]	740.92[c]
Average daily gain (g)	53.58	58.03	58.04	51.89
Feed conversion ratio (FCR)	14.45	12.96	12.52	14.47

[a, b, c, d]: Means in the same row with different superscripts are significantly different (P<0.05)
Control (Brewers' dried grain) **GNH (**Groundnut haulm) **GCW** (Guinea corn waste) and **CPH** (Cowpea husk)

per group in a complete randomized design. Each group was assigned to a total mixed diet containing one of the following: Brewer's Dried Grain (BDG) (control); Groundnut haulms (GNH); Guinea Corn Waste (GCW) and Cowpea Husk (CPH). Prior to the experiment, all the animals were treated against endo- and ecto-parasites. The animals were offered the diets without yeast supplementation. The animals were provided with clean and fresh water *ad libitum* and fed at 5% of their body weight. The trial lasted 70 days, including a 14-day adaptation period and 56-day data collection period.

Experiment II

In experiment II, sixteen West African Dwarf (WAD) sheep weighing 17.85±0.40kg were randomly assigned to the same diets as in experiment I with 4 animals per diet. Each animal on the GNH, GCW and CPH also received 5g of baker's yeast supplementation per day. The animals were managed as in experiment I.

Feed intake and weight gain

The feed intake was determined in both experiments by subtracting the left over from previous day's feeding from the amount of feed offered. Animals were weighed at the beginning of the study and subsequently on weekly basis to determine weight gain. Feed conversion ratio (FCR) was determined based on the average body weight gain and average feed intake.

Digestibility and nitrogen metabolism

On day 59 of experiments I and II, three animals were randomly selected and moved into metabolic cages with facilities for total collection of faeces and urine to determine digestibility and nitrogen metabolism for 12 days (7 days preliminary and 5 days collection). Faecal and urine output were measured on daily basis and 10% aliquot collected and bulked at the end of the collection period.

Table 4: Nutrient digestibility of WAD sheep fed crop residues with or without baker's yeast in experiments I and II

Parameters (%)	Control	GNH	GCW	CPH
Experiment I				
Dry matter	51.45	60.27	54.68	62.28
Crude protein	83.52a	85.97a	74.63b	81.63a
Ether extract	73.76	78.61	80.31	80.83
Neutral Detergent Fibre	66.91	67.42	65.93	72.18
Acid Detergent Fibre	64.28	60.90	60.28	69.87
Experiment II				
Dry matter	66.34	75.13	68.46	70.83
Crude protein	82.66	87.44	84.18	85.51
Ether extract	73.48	84.39	80.13	79.66
Neutral Detergent Fibre	77.03	80.04	76.95	78.41
Acid Detergent Fibre	75.95	75.84	72.91	76.69

[a, b, c, d]: Means in the same row with different superscripts are significantly different (P<0.05)
Control (Brewers' dried grain) **GNH (**Groundnut haulm) **GCW** (Guinea corn waste) and **CPH** (Cowpea husk)

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Table 5: Nitrogen metabolism of WAD sheep fed crop residues with or without baker's yeast in experiments I and II

Parameters (g/day)	Diets			
	Control	GNH	GCW	CPH
Experiment I				
Nitrogen intake	9.28	11.47	10.57	12.73
Faecal nitrogen	1.57	2.31	3.73	2.33
Urinary nitrogen	0.48	0.87	0.79	0.67
N-balance	7.23	8.29	6.05	9.73
N-retention (%)	87.97	87.30	74.45	85.86
Experiment II				
Nitrogen intake	12.58	15.55	13.24	13.55
Faecal nitrogen	3.18	3.09	3.12	3.11
Urinary nitrogen	0.54	0.55	0.59	0.63
N-balance	8.86	11.91	9.52	9.89
N-retention (%)	70.43	76.59	71.90	72.99

[a, b, c,d]: Means in the same row with the same superscripts are not significantly different (P>0.05)
Control (Brewers' dried grain) **GNH (**Groundnut haulm) **GCW** (Guinea corn waste) and **CPH** (Cowpea husk)

The 10% aliquot of bulk samples were used for chemical analysis. The faecal samples were oven dried at 65^{o}C for 48 hours, milled and stored in polythene bags. The urine samples were preserved with few drops of concentrated H_2SO_4 and stored in a freezer at -4^{0}C until required for laboratory analysis.

Chemical analysis
Samples from each of the diets and faeces were analysed for proximate composition and urine samples for nitrogen according to the method described by AOAC (1990). Acid detergent fibre, neutral detergent fibre and acid detergent lignin were determined according to Van Soest *et al*. (1991).

Statistical analysis
Data were analyzed using analysis of variance (ANOVA) procedure of SAS (2002) in a Completely Randomized Design (CRD) and means were separated using Duncan's Multiple Range Test (Steel and Torrie, 1980)

RESULTS AND DISCUSSION
Diet composition
The gross and chemical compositions of the total mixed diets used in experiments I and II are shown on Tables 1 and 2.

Dry matter intake
In experiment I, there were no significant (P>0.05) differences in the average daily dry matter intake when the diets were fed without yeast supplementation (Table 3). Adegbola (2002) and Ngele *et al.* (2009) observed improved intake of rice straw in rams when treated with urea. The similarity in the intakes of GNH, GCW and CPH when compared with BDG can therefore be attributed to the inclusion of urea in these diets that probably enhanced rumen fermentation. However, significant (P<0.05) reduction was observed for average daily dry matter intake in experiment II when animals were supplemented with baker's yeast (Table 3). This is contrary to the observation of Wohlt *et al*. (1991) that yeast supplementation increased average daily intake. Kamra *et al.* (2002), Yang et al. (2004), Mahender *et al.* (2005) and Kawas *et al.* (2007) however, did not observe any effect of yeast feeding on dry matter intake.

Weight gain and FCR
Significant (P<0.05) differences were observed in the average daily weight gain for animals in experiment I (Table 3). Animals on the control (BDG) diet had the highest daily weight gain while the poorest weight gain in this experiment was observed for animals on the GCW diet. Brewer's dried grain is known to contain appreciable amount of escape protein which may have contributed to the highest weight gain observed in this treatment. On the contrary, the presence of tannins in GCW is known to depress intake and digestibility of nutrients which are important factors to achieving optimal weight increases (Brown, 2008: Vasta *et al.*, 2009). In experiment II no significant (P>0.05) differences in average daily gain were observed across the treatments. This however, is contrary to the reports of Haddad and Goussous (2005) and Kawas *et al*. (2007) that yeast supplementation increased average daily gain in lambs, goats and calves. The observation in experiment II agrees with Pinos-Rodriguez *et al*. (2008) and Titi *et al*. (2008) that yeast

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supplementation had no effect on average daily gain of dairy calves and growth rate in kids and lambs. Feed conversion was significantly (P<0.05) affected by treatments in experiment I. The animals on BDG had the best feed conversion ratio while the poorest feed conversion was observed for animals on the GCW diet. The poor feed intake and digestibility of crude protein observed for GCW may largely be due to the poor feed conversion by animals on this diet. However, no differences were observed for feed conversion in experiment II when animals received yeast supplementation. Kawas *et al.* (2007) reported that yeast supplementation did not influence feed efficiency of lambs.

Nutrient digestibility

In experiment I, digestibility was not significantly (P>0.05) different across the treatments except for crude protein which was lower (P<0.05) for GCW. Brown (2008) and Vasta *et al*. (2009) suggested that the reduction in the digestibility of Guinea corn could be due to the presence of condensed tannins which probably bind the protein and prevented it from rumen microbial fermentation and enzymatic digestion in the small intestine. The digestibility of all the nutrients were not significantly (P>0.05) different in experiment II. Similar results have been reported by Kamra *et al.* (2002), Yang *et al.* (2004), Mahender *et al.* (2005) and Kawas *et al.* (2007) who also did not observe any effect of yeast feeding on nutrient digestibility in lambs and dairy calves.

Nitrogen metabolism

No significant (P>0.05) differences were observed in both experiments I and II for nitrogen metabolism. This is in agreement with earlier reports (Kamra *et al.*, 2002; Yang *et al.*, 2004; Mahender *et al.*, 2005; Kawas *et al.*, 2007).

CONCLUSION

The results of the study showed that groundnut haulms, Guinea corn wastes and Cowpea husk have the potential as feed resources to sustain sheep production especially in the dry season. The supplementation of these crop residues with baker's yeast enhanced their utilisation by WAD sheep and therefore could effectively replace brewer's dried grain in their diets.

CONFLICT OF INTEREST

There is no conflict of interest whatsoever in the execution of this study or in the publication of results obtained from the study.

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