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GROWTH PERFORMANCE AND NUTRIENT DIGESTIBILITY OF WEST AFRICAN DWARF SHEEP FED HIGH ROUGHAGE DIET CONTAINING *Saccharomyces cerevisiae*

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ABSTRACT

A twelve-week study was conducted to determine the effects of dietary inclusion of yeast (Saccharomyces cerevisiae) on growth performance and nutrient digestibility of West African dwarf (WAD) sheep. A total of 12 lambs (6 rams and 6 ewes) were randomly allotted to three treatment diets as follows: treatment I was a high roughage diet with no inclusion of S. cerevisiae; treatment II was a high roughage diet with 0.75 g of S. cerevisiae per kg of diet; treatment III was a high roughage diet with 1.5 g of S. cerevisiae per kg of diet. The chemical composition of the high roughage diet is as follows: dry matter (89.20%), organic matter (85.87%), crude protein (13.21%), crude fibre (16.40%), ether extract (3.30%), ash (4.33%), nitrogen free extract (51.96%), neutral detergent fibre (45.25%) and acid detergent fibre (26.62%). Each group was made up of four replicates with one sheep serving as a replicate. There were significant ($p < 0.05$) differences among treatments in average daily feed intake (ADFI), and average daily weight gain (ADWG) while final body weight (FBW) and feed conversion ratio (FCR) were not significantly ($p > 0.05$) affected. There were significant ($p < 0.05$) differences among treatments in dry matter (DM), organic matter (OM), crude protein (CP), crude fibre (CF), neutral detergent fibre (NDF) and acid detergent fibre (ADF) digestibility coefficients values. Based on these results addition of 1.5 g of S. cerevisiae per kg of diet is recommended.

Key words: yeast, ruminant, protein, faeces, fibre

INTRODUCTION

The demand for animal protein in Nigeria has been on the increase because of the rise in human population. The intake of animal protein in Nigeria stands at 3.5 g/caput/day. This is still far less than the 35 g/caput/day recommended by World Health Organization (WHO) (Ironkwe and Amefule, 2008). There is a public and scientific concern about the widespread use of antibiotics and the possibility for transfer of antibiotic resistance to human pathogenic bacteria (Parvez *et al*., 2006). Also, the presence of antibiotic residues in the meat may adversely affect human consumers. For these reasons the European Union banned the use of antibiotics for non-therapeutic purposes in Jan 01, 2006 (Parvez *et al*., 2006). It is therefore imperative to find safe alternatives to the use of antibiotics. Yeast and fungal probiotics, such as *S. cerevisiae* and Amaferm (*Aspergillus oryzae*), have yielded better results in adult ruminants (Fuller, 1999). The most common marketed products for ruminants contain live yeast (*S. cerevisiae*) which is widely used as feed additive because of its beneficial effects on animal performance (Ali and Goksu, 2013; Hassan and Saeed, 2013). Yeasts are most efficient when the rumen is not functioning optimally and when diets are overloaded with easily fermentable energy components or are poor in nutrients. Unlike the destructive action of antibiotics, S. *cerevisiae* is able to grow rapidly in the rumen and facilitate fiber digestion. Micro-nutrients found in *S. cerevisiae* also stimulate cellulolytic bacteria growth. *S. cerevisiae* in the rumen can utilize the remaining dissolved oxygen and save anaerobic microorganisms from the toxic effect of oxygen. Live yeasts are also able to improve the rumen maturity and stabilize the ruminal pH, thus reducing the risk of acidosis by competing with lactic acid-producing bacteria (McDonald *et al*., 2002; Chaucheyras-Durand *et al*., 2008). Supplementation of yeast in the ruminant diet is known to improve feed intake (Robinson and Garrett, 1999), milk production (Abd El-Ghani, 2004), weight gain (Salama *et al*., 2002), digestion (Jouany *et al*., 1998), numbers of anaerobic and cellulolytic bacteria (Newbold *et al*., 1995) and alter the patterns of volatile fatty acids (Arcos-Garcia *et al*., 2000) or even supply the animal with unknown growth factors (Girard and Dawson, 1995). Against these backdrops, the present study was conducted to determine the effects of dietary inclusion of yeast (*S. cerevisiae*) on growth performance and nutrient digestibility of West African dwarf sheep.

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MATERIALS AND METHODS

The study was carried out at the Sheep and Goat Unit of the Department of Animal Science Teaching and Research Farm, University of Nigeria, Nsukka, Enugu State, Nigeria. The study lasted 12 weeks. The yeast (*S. cerevisiae*) was procured from B.F.P. Dock Road, Felixstowe, U.K.

Experimental Animals and Management

A total of 12 lambs (6 rams and 6 ewes) with an average weight of 9.98 kg were used for the study. The lambs were randomly shared into three treatment groups of four sheep each and assigned to high roughage diet. Each group was made up of four replicates with one sheep serving as a replicate. Table 1 shows the composition of the experimental diet. The three dietary treatments were as follows: treatment I was a high roughage diet with no inclusion of *S. Cerevisiae*; treatment II was a high roughage diet with 0.75 g of *S. cerevisiae* per kg of diet; treatment III was a high roughage diet with 1.5 g of *S. cerevisiae* per kg of diet. About 500 g of each diet was given to each lamb daily in the morning and the left over feed was weighed the following morning so as to determine the daily feed intake by each lamb. Water was provided to all the lambs *ad libitum*. All the lambs were housed individually in pens and the initial weights of the lambs were measured. The weights of the lambs were measured weekly in the morning throughout the experimental period. These were used to calculate the daily weight gain of the lambs. Final body weights of the lambs were measured. Feed conversion ratio was calculated by dividing average daily feed intake with average daily weight gain. Twenty-one days before the experiment all lambs were allowed to acclimatize and the experimental diets were also gradually introduced. The lambs were vaccinated with PPR vaccine and dewormed with Albendazole. The lambs were also injected with Oxytetracycline LA at the rate of 1 ml per 10 kg body weight to prevent bacterial infections.

Digestibility Trial

At the end of 12 weeks feeding period two rams were selected from each treatment group for the digestibility trial. Digestibility trial was conducted to determine the digestibility coefficients of the diets using the quantitative collection of faeces. Total collection of faeces were undertaken for seven consecutive days after three days of adapting the growing lambs to the carrying of faecal bags.

Table 1: Percentage composition of the high roughage diet fed to the sheep

Ingredients	Percentage composition
Panicum maximum hay	60.00
Palm kernel cake	5.00
Bambara nut waste	5.00
Brewer's spent grain	29.00
Salt	0.50
Vitamins and minerals	0.50

The quantities of feed offered and the remnants were accurately measured to estimate daily intake during the seven days collection period. Faeces were collected and weighed every morning for each lamb before feed offer. The faeces of each lamb were weighed precisely and about 10% sub sampled and stored at −20 °C in a deep freezer. The faecal samples collected were preserved by wrapping them in polythene and kept in deep freezer. At the end of the collection period, samples of diets and faeces were thoroughly mixed and one sample of each was obtained, properly air dried and in air tight containers for the subsequent chemical analysis. The diets and faecal samples were analyzed for dry matter (DM), organic matter (OM), crude protein (CP), and crude fibre (CF) according to methods of AOAC (1995). The neutral detergent fibre (NDF) and acid detergent fibre (ADF) were determined according to the method of Goering and Van Soest (1970).

Statistical Analysis

Data collected were subjected to analysis of variance (ANOVA) in a completely randomized design (CRD) as described by Steel and Torrie (1980) using Statistical Package for the Social Sciences (SPSS, 2003). Significantly different means were compared using Duncan's New Multiple Range Test (Duncan, 1955).

RESULTS AND DISCUSSION

The effect of *S. cerevisiae* supplementation on growth performance and nutrient digestibility of West African dwarf sheep is presented in Table 2. There were significant ($p < 0.05$) differences among the average daily feed intake (ADFI), and average daily weight gain while final body weight (FBW) and feed conversion ratio (FCR) were not affected significantly ($p > 0.05$). The ADFI value (0.30 kg) for sheep fed 1.5 g *S. cerevisieae* per kg of diet and that (0.30 kg) of sheep fed 0.75 g *S. cerevisieae* per kg of diet were similar ($p > 0.05$) but were significantly ($p < 0.05$) higher than the ADFI value (0.25 kg) of sheep fed the control diet.

The ADWG value (0.06 kg) of sheep fed 1.5 g of *S. cerevisieae* per kg of diet and that (0.050 kg) of sheep fed 0.75 g of *S. cerevisieae* per kg of diet were similar ($p > 0.05$). The ADWG value (0.05 kg) of sheep fed 0.75 g of *S. cerevisieae* per kg of diet and that (0.04 kg) of sheep fed the control diet were also similar ($p > 0.05$). The ADWG value (0.06 kg) of sheep fed 1.5 g of *S. cerevisieae* per kg of diet was significantly ($p < 0.05$) higher than the ADWG value (0.04 kg) of sheep fed the control diet. Tripathi and Karim (2010) reported that yeast culture improved feed intake in growing lambs. The increased feed intake might have been influenced by increase in fibre digestibility stimulated by yeast supplementation (Abd El-Ghani, 2004). However, the result obtained in this

Table 2: Effect of *S. cerevisiae* supplementation on growth performance and nutrient digestibility of West African dwarf sheep

	Parameter	T1	T2	T3	SEM
Growth Performance	Average daily feed intake (kg)	0.25[b]	0.30[a]	0.30[a]	0.007
	Average initial weight (kg)	10.01	10.01	9.64	0.17
	Final body weight	13.26	14.19	14.56	0.25
	Average daily weight gain (kg)	0.04[b]	0.05[ab]	0.06[a]	0.003
	Feed conversion ratio	6.25	6.00	5.00	0.26
Nutrient digestibility	Dry matter (%)	68.21[b]	82.49[a]	83.90[a]	2.17
	Organic matter (%)	69.21[c]	82.76[b]	84.56[a]	2.08
	Crude protein (%)	72.84[c]	84.47[b]	86.12[a]	1.80
	Crude fibre (%)	64.94[c]	77.67[b]	80.86[a]	2.08
	Neutral detergent fibre (%)	53.17[b]	71.51[a]	74.85[a]	2.90
	Acid detergent fibre (%)	56.30[b]	71.62[a]	73.19[a]	2.31

[a,b,c] Means on the same column with different superscripts differ significantly at ($p < 0.05$); SEM = Standard error of the means

study is in contrast with Pienaar *et al*. (2012) who reported that yeast inclusion in the finishing diet of Mutton sheep did not affect feed intake in Mutton Merino lambs. The result of the study agrees with the report of Hassan and Mohammed (2014) who found that the final body weight (FBW) of lambs was not significantly ($p > 0.05$) affected by feeding them with diets containing supplementary *S. cerevisieae*. The higher ADWG could be attributed to enhanced feed consumption and absorption of nutrients due to *S. cerevisieae* supplementation. This agrees with Whitley *et al*. (2009) who reported improvement on the weight gain of growing sheep fed diet supplemented with yeast. However, the result disagrees with the report of Pienaar *et al*. (2012) which showed that *S. cerevisieae* supplementation did not affect average daily weight gain of animals fed such *S. cerevisieae* -supplemented diet. There were significant ($p < 0.05$) differences among treatments in DM, OM, CP, CF, NDF and ADF digestibility coefficients. The DM (83.90%), NDF (74.85%) and ADF (73.19%) digestibility coefficients for sheep fed 1.5 g of *S. cerevisieae* per kg of diet and those of sheep fed 0.75 g of *S. cerevisieae* per kg of diet were similar ($p > 0.05$) but were significantly ($p < 0.05$) higher than the DM (68.21%) NDF (71.51%) and ADF (56.30%) digestibility coefficients for sheep fed 0g of *S. cerevisieae* per kg of diet. Sheep fed 1.5g of *S. cerevisieae* per kg of diet had highest ($p < 0.05$) OM (84.56%), CP (86.12%), and CF (80.86%) digestibility coefficients. This was followed by the sheep fed 0.75 g of *S. cerevisieae* per kg of diet with OM (82.76%), CP (84.47%) and CF (77.67%) digestibility coefficients. Sheep fed 0 g of *S. cerevisieae* per kg of diet had lowest ($p < 0.05$) OM (69.21%), CP (72.84%) and CF (64.94%) digestibility coefficients. The enhanced digestibility due to *S. cerevisiae* supplementation might be improved by fermentation activities of the rumen bacteria, especially the cellulolytic strains. The increased digestibility can be due to stable rumen pH and removal of oxygen from the rumen in the yeast supplemented group. The stable rumen pH provides better environment for growth of rumen microbes, especially cellulose degrading bacteria and fungi (Ghazanfar *et al*., 2015). Addition of *S. cerevisiae* caused a significant improvement in CP and CF digestibility (Hassan and Mohammed, 2014). The results of the present study are in line with Gaafar *et al*. (2009) who reported increase in digestibility of DM and OM due to the addition of *S. cerevisiae* to diets. Increased digestibility of DM, NDF, hemicellulose, and CF has been reported with supplemental *S. cerevisiae* (Robinson, 2002). Our result support the findings of Haddad and Goussous (2005) who indicated that feeding yeast culture increased the digestibility coefficients of DM, OM, CP, NDF and ADF, which resulted in higher ADWG and better feed efficiency in fattening lambs fed 80% concentrate diet. In contract to our result, few researchers also reported no effect of yeast on the nutrient digestibility (Tripathi and Karim, 2010).

CONCLUSION

Results showed that the addition of 0.75 and 1.5 g of *S. cerevisiae* per kg of high roughage diet improved ADFI and ADWG. Digestibility of DM, OM, CP, CF, NDF, and ADF were also enhanced by the addition of 0.75 and 1.5 g of *S. cerevisiae* per kg of diet. Based on these results, addition of 1.5 g of *S. cerevisiae* per kg of diet is recommended.

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