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Short Communication

Performance characteristics of West African dwarf goat fed *Rhizopus* treated sawdust

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Feed intake and weight gain of West African dwarf (WAD) goats consuming *Rhizopus* treated sawdust were determined. 27 WAD goats in a 3 x 3 Latin square design with a 196 day period consumed normal diet with 20% untreated sawdust (Treatment 1, control), while Treatments 2 and 3 contained fungus treated sawdust at 20 and 25%, respectively. Crude protein, crude fibre and ether extract consumed increased ($P < 0.05$) by the addition of the fungus treated sawdust for Treatment 3. In contrast, the lignin intake was significantly lower ($P < 0.05$) in Treatments 2 and 3. The weight gain of the experimental animals was highest in Treatment 3. In conclusion, fungus treated sawdust-based diet for growing WAD goats may improve performance as a result of increasing feed intake and live weight gain.

Key words: *Rhizopus oligosporus*, feed intake, weight gain, solid state fermentation.

INTRODUCTION

Fear about the future availability of grains for use in animal feed around the world has been evident of discussions at various meetings and conferences recently (Best, 2006). Grimes (2006) forecasted an increase in the price of maize over the next 10 years because of competition for grains from industrial processors. The great impact on maize supplies is coming from the fast-growing biofuel industry that converts grains into ethanol. Hale (2006 reported that about 13% of the corn consumed in the USA goes into ethanol production and by 2012 the percentage is likely to have grown to 39% and hence endanger future food security.

Impact on the grain market from biofuel expansion could be solved if attention is paid on the biological treatment of the huge quantity of the fibrous crop residues. Annual quantity of fibrous residues from cereal crops available in Africa was put at about 340 million tonnes. These enormous amounts represent potential valuable materials for future biotechnology exploitation. If the huge amount could be recycled or converted to useful feedstuff, the whole environment will be cleaned of pollution, thereby improving human health.

The waste agricultural residues consist mostly of polysaccharides which are poorly digested by ruminants due to the presence of lignin which is recalcitrant to microbial degradation. Lignin also constitutes a physical barrier to the extraction and utilization of other components. The physical barrier of lignin could be broken either by physiccal, chemical or biological treatments. The biological treatment of fibrous materials is not entirely new and the biotechnological techniques are gradually being introduced in the field of animal nutrition and production throughout the globe. Most fungi are capable of degrading various varieties of substrates (Sancholle and Losel, 1995) and their role in the nutrition of animals (Belwu, 1999; Belewu, 2000; Belewu and Ademilola, 2002; Belewu et al., 2004; Belewu and Belewu, 2005; Belewu, 2006) and human beings (Yang et al., 1993) are well documented. The present study was designed to examine the effect of *Rhizopus oligosporus* on feed intake and weight gain of West African dwarf goat.

MATERIALS AND METHODS

R. oligosporus which was isolated from fermented Bambara nut was collected from the Department of Microbiology, University of Ibadan, Nigeria. The fungus was maintained on potato dextrose agar (PDA).

Khaya senegalensis sawdust was collected from the Sawmill area of Ilorin, metropolis, Nigeria. It was sun-dried and later autoclaved at 121°C and 15 psi for 15 min so as to get rid of any possible microbes. The substrate was later left to be cooled before inoculation with the fungus.

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Table 1. Feed composition of the experimental diet.

Parameter (%)	Treatment		
	1	2	3
Cassava waste	58.00	58.00	53.00
Saw-dust	20.00	20.00a	25.00a
Soybeans	20.00	20.00	20.00
Vitamin-mineral premix	1.00	1.00	1.00
Salt	1.00	1.00	1.00
Total	**100.00**	**100.00**	**100.00**

a: fungus treated sawdust.

Spores of *R. oligosporus* were harvested and adjusted to 10^7 – 10^8 spores per ml. Each bag of the cooled and sterilized sawdust was inoculated with 5 ml of the spores suspension. The inoculated substrate was incubated at temperature of between 34 and 45°C until the mycelium enveloped the substrate between 21 and 25 days. The fungus treated substrate was oven dried at the end of the 25th day so as to terminate the fungus growth. The spent substrate was later used in the formulation of the experimental diets.

The experimental diets consist of Treatment 1 (control) with 20% untreated sawdust while Treatments 2 and 3 contained fungus treated sawdust at 20 and 25% inclusion levels, respectively. Other ingredients are as shown in Table 1.

Twenty seven West African dwarf (WAD) goats (Initial BW = 4.7 to 4.8 kg) used for the study were treated against ecto- and endoparasites and later randomized against the experimental diets in a 3 x 3 Latin square design model for a 196 day period. The animals were fed and watered *ad libitum*.

The proximate composition of the experimental diets was determined by the methods of AOAC (1990) while fibre fractions were determined by the method of VanSoest (1965).

All data collected were subjected to analysis of variance of a 3 x 3 Latin square design model while treatment means were separated by the method of Duncan (1955) multiple range test.

RESULTS AND DISCUSSION

The proximate composition of the experimental diets is shown in Table 2. The crude protein content of the experimental diets varied from 33 to 57%. The fungus treated sawdust based diets recorded the highest crude protein content compared to the Treatment 1 (Control). The increased crude protein of the fungus treated sawdust based diet supported the reports of various workers (Rolz et al., 1986; Jacqueline et al., 1996; Belewu, 2001; Belewu, 2006). In contrast, the incubation of the sawdust with the fungus reduced the crude fibre content and the fibre fractions probably due to the enzymatic action of the fungus on the fibre fractions. This is in agreement with previous reports (Belewu, 1999; Belewu, 2001; Belewu, 2002; Miszkiewicz et al., 2004; Belewu, 2006).

The ether extract content increased numerically from 3.6 to 4.3 in Treatment 1 (control) and Treatment 3, respectively. Biological treatment of the sawdust with the fungus reduced the lignin content significantly ($P < 0.05$; Table 2) presumably because of the enzymatic action of the fungus, *R. oligosporus* which could have degraded and solubilized the various fibre fractions for their own growth.

Table 2. Proximate composition of the experimental diet.

Parameter (%)	Treatment		
	1	2	3
Dry matter	91.02	88.10	89.60
Crude Protein	10.09	13.43	14.89
Crude Fibre	13.73	11.58	7.76
Ether extract	3.57	4.13	4.26
Neutral detergent fibre	58.59	50.19	49.63
Acid detergent fibre	50.86	44.55	42.17
Lignin	9.01	7.08	6.45

Table 3. Feed intake and weight gain of the experimental animals (g/day).

Parameter (g/day)	Treatments		
	1	2	3
Dry matter	327.67a	325.97a	382.29b
Crude Protein	33.05a	43.78b	56.93c
Crude Fibre	29.67a	37.75b	44.99c
Ether extract	11.69a	13.89b	15.79c
Lignin	29.52a	23.08b	24.65b
Acids detergent fibre	166.65a	145.21b	161.21a
Weight gain (g)	200.00a	360.00b	538.00c
Feed efficiency	0.61	1.10	1.41

Means with similar superscripts are not significantly different ($P > 0.05$) from each other.

Average dry matter intake (Table 3) for all treatments was between 326 and 382 g per day. The dry matter intake increased ($P< 0.05$) by 16.5% for Treatment 3. The increment was attributed to improved palatability especially for Treatment 3. In previous research with goats and rats, dietary addition of fungus treated diets (Belewu and Ademilola, 2002; Belewu 1999; Belewu, 2001; Belewu et al., 2002) caused an increased of drymatter intake owing to improved palatability. It is suggested that feeding of diet containing fungi might improve its palatability and increase the feed intake.

Crude protein intake was higher for the fungus treated based diet probably due to the addition of microbial protein by the fungus. Also the crude fibre intake followed similar trend as the protein intake due to the enzymes secreted by the fungus which could have defiberized the sawdust. This assertion supported the findings of Miszkikiewics et al. (2004) who used similar fungus for the preparation of tempe in Indonesia.

The significant weight gain of animals (Table 3) on the fungus treated based diet could be due to the higher feed intake of the experimental animals since the sawdust was pre-digested by the fungus before its inclusion in the diet. This confirms the assertion of Belewu and Ademilola, 2002 that pre-treatment of dry grass with fibrolytic enzymes improved *in vitro* ruminal fiber digestion. Additionally, the dietary inclusion of fungus-based diet which improved the weight gain of the experimental animals could presumably be due to increased feed efficiency. The increased feed efficiency of the fungus treated sawdust based diets (Treatments, 2 and 3) could probably be as a result of direct improvement in the nutrient content of these diets. Generally, the feeding of fungus treated diet to ruminant animals increase feed efficiency because of direct incorporation of fatty acids and microbial protein (Miszkiewicz et al., 2004).

Conclusion

Feeding of *Rhizopus* treated sawdust to WAD goat improved the feed intake, feed efficiency and body weight gain of the experimental animals than those on Treatment 1 (Control, no fungus treatment). Hence, fungus treatment of sawdust would be a management tool for increasing the performance characteristics of WAD goat as well as solving the problem of environmental pollution.

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