The Performance of West African Dwarf (WAD) Goats Fed Graded Levels of *Rhizopus oligosporus*-Treated Rice Husk (RoTRH)

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Abstract: A study was carried out to determine the effect of graded levels of *Rhizopus oligosporus*-treated rice husk (RoTRH)on the feed and nutrient intake, body weight gain and nutrient digestibility of WAD goats using thirty-six (36) West African Dwarf (WAD) goats. They were randomly assigned to four (4) treatments of three (3) replicates with three (3) animals per replicate in a Completely Randomized Design Model and fed the experimental diets for a period of eight (8) weeks. Data collected were subjected to analysis of variance using a Completely Randomized Design Model ($p < 0.05$). The findings of the study were that dry matter and nutrient intake, body weight gain and nutrient digestibility of the WAD goats were comparable across the treatments. It was concluded that fungal treatment of rice husk using *R. oligosporus* improved its nutritional value thus making *RoTRH* a valuable feedstuff for ruminant nutrition and thus its use was recommended in the diets of WAD goats.
Keywords: *Rhizopus oligosporus,* goats, nutrient, digestibility

INTRODUCTION

Goats have been reported by Ayoade *et al.* (1993) to constitute about thirty-four million and five hundred thousand (34,500,000) of the small ruminant population in Nigeria. They provide meat, milk, skin and are used as a ready source of cash, means of exchange for labour, ceremonies and ritual sacrifices. The productivity of goats just like any other animal is influenced by its nutrition which is in turn affected by breed, feed and environmental factors. Natural pastures and crop residues available for ruminants during the dry season are usually fibrous and devoid of most essential nutrients including proteins, energy, minerals and vitamins which are required for increased rumen microbial fermentation and improved performance of the host animal. Aina (1996) observed that dietary supplementation generally increases feed intake and live weight gain in ruminants. Maize and other conventional feed ingredients are both expensive and subjects of strong competition between livestock and human population. Large amounts of lignocellulosic by-products are generated through forestry and agricultural practices, paper-pulp industries, timber industries and many agro-industries and they pose an environmental pollution problem. One of such lignocellolosic waste of great importance and produced in abundance in the tropics and sub-tropics where rice is grown is rice (*Oryza sativa*) husk. They contain enough cellulose to make them excellent sources of energy for ruminants but they are poor quality feeds due to low digestibility, poor palatability, low protein content and bulkiness. Therefore, this study was to investigate the performance (dry matter and nutrient intake, body weight gain and nutrient digestibility) of WAD goats fed graded levels of *RoTRH.*

MATERIALS AND METHODS

The study was carried out at the Teaching and Research Farm of the Department of Animal Production, University of Ilorin, Ilorin, kwara State. Feed ingredients used in formulating the diets were obtained from feed millers in Ilorin, Kwara State. Rice husk was collected from rice millers in Minna metropolis, Niger State. It was soaked in water for twenty-four hours after which the excess water was strained using a muslin cloth. The soaked rice husk was then packaged in polythene bags at 1kg per bag ready for autoclaving at 121^0C, 15psi for 30 minutes so as to get rid of any microbes that could be present in the husk. The *Rhizopus oligosporus* which was obtained from the Department of Microbiology, University of Ilorin, Kwara State, Nigeria was sub-cultured on Potato Dextrose Agar (PDA) by transferring the spores aseptically from the cultures to freshly prepared PDA-containing Petri-dishes. The PDA was amended with streptomycin^R to suppress any bacterial growth and later autoclaved at 121^0C, 15psi for 15 minutes to sterilize it. The Petri-dishes were later incubated at ambient temperature for four (4) days to stimulate the fungal growth. The cooled autoclaved rice husk was replicated thrice. Suspension of actively growing mid-log phased culture of *R. oligosporus* was individually adjusted to 5×10^4 spores/ml with distilled water in line with the methods of Sani *et al.* (1992). Twenty (20) ml from the suspension was used to inoculate one (1) kg of cooled autoclaved rice husk in layers in a container, covered and incubated at room temperature for eight (8) days

when the fungus had enveloped the substrate. Growth was terminated by oven-drying at 80^{0}C for twenty-four hours. Four different diets were formulated for the animals designated as T_1, T_2, T_3 and T_4. T_1 was the control diet with 0 % inclusion of *RoTRH* while T_2, T_3 and T_4 had the palm kernel cake (PKC) fraction replaced with *RoTRH* at 10 %, 20 % and 30 % respectively.

Thirty-six (36) apparently healthy weaned WAD goats of mixed sexes with average weight of 7.12 kg were randomly assigned to four Treatment groups each having nine (9) animals in a Complete Randomized Design (CRD). Prior to their arrival, the pens were washed, disinfected and allowed to dry. On arrival, the animals were given prophylactic treatment and were allowed a pretreatment period of two (2) weeks to enable them acclimatize after which they were fed twice daily; in the morning at 7:30 a. m. and in the evening at 16:00 p. m, with known quantities of the experimental diets and the left-over collected prior to introduction of the next feed. Salt licks and water were provided ad-libitum. The body weights were taken at the start of the experiment and at the end of the experiment which lasted eight (8) weeks. At the end of the eighth (8) week of the experiment, representative goats were taken and subjected to a seven-day digestibility trial in metabolic cages to enable faecal collection. The faecal samples were weighed after which they were packaged, labeled and stored for laboratory analysis. Data collected were subjected to analysis of variance (ANOVA) by means of general linear procedure (GLM) of SAS 9.2 Version 6. Where means were significant, they were separated using Duncan Multiple Range Test of the statistical package SAS 9.2.

RESULTS AND DISCUSSION

The proximate composition and energy values of the experimental diets containing graded levels of *RoTRH* are presented in Table 2. The decline in the crude protein and ether extract contents of the experimental diets with increase in dietary levels of *RoTRH* can be attributed to the variation in these nutrients' contents of the *RoTRH* when compared to that of the palm kernel cake which was substituted for the *RoTRH*. The said nutrients of the rice husk were improved by fungal fermentation with *R. oligosporus* thereby making it meet up with the minimum requirements for ruminant animals. On the contrary, the crude fiber and ash contents of the fungus – treated diets increased with increase in the dietary levels of the *RoTRH*. The crude fiber and Ash contents of the *RoTRH* (21.85 % and 24.09 % respectively) were much higher than the crude fiber and ash values for palm kernel cake (15.93 % and 4.51 % respectively) from this study. Oloche *et al.* (2015) reported an increase in crude fiber content of diets when high fiber-containing sweet orange peel meal was used to replace maize offal. According to Mbata *et al.* (2009), there was a decline in the carbohydrate content of maize-based foods due to the addition of legumes.

The nutrient intake and body weight gain of WAD goats fed diets containing graded levels of *RoTRH* is presented in Table 3. Feed intake according to Ahamefule and Elendu (2010) is affected by palatability, gut fill and retention time in the rumen. The high feed intake suggests that the fungal treatment of the rice husk did not reduce palatability of the diets. The crude protein content of the experimental diets were higher than 7 % requirements for goats, hence its adequacy supported the high feed intake recorded in this study. The degradation of the secondary metabolites could have equally enhanced palatability and by extension the feed intake. However, the feed intake reduced in animals fed T_4 (30 % inclusion of *RoTRH*) diets. The crude protein, ether extract, crude fiber, ash and nitrogen free extract intakes increased with increase nutrient content of the diets. Belewu *et al.* (2010) reported an increase in crude protein intake with increase in dietary crude protein content. The high crude fiber intake with increase in the dietary levels of the *RoTRH* might be due to the increased solubility of the crude fiber fractions hence making it readily absorbable by the system (Yahaya, 2008). Higher protein contents of diets have been reported to positively enhance intake of other nutrients. The weight gain reported for the animals fed dietary levels of *RoTRH* compared favourably with those fed the T_1 (Control) diets. This positive performance could be as a result of the increased amount of protein reaching the small intestine in line with the findings of Belewu *et al.* (2003). The availability of the nutrients above the minimal dietary requirements could be responsible for the high growth performance and weight gain of the experimental animals.

The Dry matter and nutrients digestibility of WAD goats fed diets containing graded levels of *RoTRH* is presented in Table 4. The digestibility of feedstuffs is the major determinant of the quality of the feedstuff. According to Oloche *et al.* (2015), high dry matter digestibility of a feed material is an indication that the feed material did not impact negatively on the rumen microbes nor decrease digestibility. The high dry matter and crude protein digestibilities reported in this study may be attributed to degradation and detoxification of the rice husk prior to inclusion in the experimental diets. Belewu and Yahaya (2008) reported high dry matter and crude protein digestibilities in Red Sokoto Goats which they attributed to the degradation and

detoxification of the shea butter cake with *Aspergillus niger* prior to inclusion in the diet. The high crude fiber digestibility in this study could be due to the availability of soluble carbohydrates for rumen microbes which helped in promoting an efficient and healthy microbial population. This microbial population helped in achieving more efficient and more complete fiber digestion thereby bringing about higher digestibility. (Arigbede *et al*., 2011). However, the low NFE digestibility in animals fed T_4 (30 % inclusion of *RoTRH*) could be due to an increase in the dietary levels of the secondary metabolites with increase in the dietary level of *RoTRH* above 20 %. According to Olajide *et al*. (2009), a decrease in the dry matter and nutrient digestibility with increase in the secondary metabolites in a diet might be as a result of increase in substitution levels of feed ingredients in the diet. Hu et al. (2005) reported that in ruminants, there's a strong link between decreased rumen motility and frequency of bloat due to saponin-rich feeds. According to Nupo *et al*. (2013), tannins are known to be bitter and form high polyphenol complexes with proteins thereby making it unavailable in the diet. The effects of tannins on ruminants varies from beneficial to adverse depending on the nature and amount consumed (Makkar, 2003). The findings in this study suggest that *RoTRH* can serve as a very valuable alternative and cheap feed ingredient for feed production. The encouraging performances by the animals can be attributed to the improvement in the physical and nutritive quality of the rice husk via fermentation with *R. oligosporus* fungus thereby aiding improved utilization of the diets containing the *RoTRH*.

CONCLUSION AND RECOMMENDATION

It can be concluded from this study that the inclusion of *RoTRH* in the diets of goats is an effective means of reducing the level of dependence on and competition for conventional feedstuffs between man and livestock.

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Table 4.1 Composition of Experimental Diets

Ingredients (%)	T_1	T_2	T_3	T_4
Cassava peels	62.00	62.00	62.00	62.00

Palm kernel cake	35.00	25.00	15.00	5.00
RoTRH	0.00^{a}	10.00^{b}	20.00^{c}	30.00^{d}
Bone meal	1.00	1.00	1.00	1.00
Salt	1.00	1.00	1.00	1.00
Vitamin/Mineral premix	1.00	1.00	1.00	1.00
Total	100.00	100.00	100.00	100.00

RoTRH - *Rhizopus oligosporus* – Treated Rice husk
a - Control
b - 10 % *RoTRH*
c - 20 % *RoTRH*
d - 30 % *RoTRH*

Table 2: Proximate Composition and Energy values of Experimental Diets containing Graded levels of *RoTRH*

Parameters (%)	T_1	T_2	T_3	T_4	±SEM	Remarks
Dry matter	91.35^{a}	90.72^{b}	91.38^{a}	90.41^{c}	0.13	*
Crude protein	11.37^{a}	9.84^{b}	9.64^{c}	8.09^{d}	0.35	*
Crude fiber	23.55^{d}	25.15^{c}	25.94^{b}	26.89^{a}	0.37	*
Ether extract	2.79^{a}	2.30^{c}	2.57^{b}	1.58^{d}	0.14	*
Ash	10.93^{d}	13.53^{c}	15.82^{a}	14.84^{b}	0.55	*
NFE	42.70^{a}	39.90^{b}	37.41^{d}	39.07^{c}	0.58	*
NDF	47.84^{a}	42.95^{b}	39.01^{c}	33.28^{d}	1.61	*
ADF	36.76^{a}	34.79^{b}	32.36^{c}	30.54^{d}	0.72	*
ADL	18.63^{b}	18.77^{ab}	18.79^{ab}	18.99^{a}	0.04	*
Hemicelluloses	11.07^{a}	8.16^{b}	6.65^{c}	2.75^{d}	0.91	*
Cellulose	18.13^{a}	16.02^{b}	13.57^{c}	11.54^{d}	0.76	*
TDN	73.84^{a}	61.41^{b}	64.69^{ab}	63.42^{b}	0.08	*

T_1 - Control T_2 - 10 % *RoTRH* T_3 - 20 % *RoTRH* T_4 - 30 % *RoTRH* NFE - Nitrogen Free Extract NDF - Neutral Detergent Fiber ADF - Acid Detergent Fiber ADL - Acid detergent Lignin NS- Not Significant ($p > 0.05$) *- Significant ($p < 0.05$) SEM- Standard Error of Means

Table 3: Nutrient intake and Body Weight Gain of WAD Goats fed diets containing graded levels of *RoTRH*

Parameters intakes (g/animal/day)	T_1	T_2	T_3	T_4	±SEM	Remarks
Dry matter	362.01^{a}	355.02^{c}	360.00^{b}	359.92^{b}	1.32	*
Crude protein	41.16^{a}	33.76^{c}	35.06^{b}	29.11^{d}	1.30	*
Crude fiber	85.25^{d}	89.29^{c}	93.38^{b}	96.78^{a}	1.33	*
Ether extract	10.10^{b}	7.56^{c}	11.23^{a}	4.93^{d}	0.73	*
Ash	39.57^{d}	48.03^{c}	56.95^{a}	53.41^{b}	1.98	*
NDF	144.50^{a}	125.49^{b}	117.27^{c}	97.92^{d}	5.07	*
ADF	111.05^{a}	101.65^{b}	97.28^{c}	89.81^{d}	2.35	*
ADL	56.28	54.84	56.49	55.87	0.29	NS
Hemicellulose	33.45^{a}	23.84^{b}	19.98^{c}	8.10^{d}	2.77	*
Cellulose	54.77^{a}	46.81^{b}	40.78^{c}	33.93^{d}	2.33	*
NFE	154.60^{a}	143.43^{b}	132.33^{c}	141.16^{b}	2.43	*
Initial body weight (kg)	7.390	7.220	7.250	7.190	0.03	NS
Final body weight (kg)	8.020^{a}	7.910^{ab}	8.010^{a}	7.840^{b}	0.05	*
Body Weight Gain (kg)	0.63^{c}	0.69^{b}	0.76^{a}	0.65^{c}	0.02	*

Table 4: Dry Matter and Nutrients Digestibility of WAD Goats Fed Diets Containing Graded Levels of *RoTRH*

Parameters digestibility (%)	T_1	T_2	T_3	T_4	±SEM	Remarks

Dry matter	87.43[a]	74.87[b]	81.51[ab]	81.41[ab]	0.021	*
Crude protein	89.02[a]	76.85[b]	85.11[ab]	83.50[ab]	0.019	*
Crude fiber	85.88[a]	75.71[b]	81.60[ab]	84.04[a]	0.019	*
Ether extract	86.91[a]	73.35[b]	87.03[a]	82.93[ab]	0.022	*
NFE	89.08[a]	77.74[b]	80.96[a]	79.80[b]	0.021	*
NDF	77.21[a]	70.67[b]	72.54[b]	69.67[b]	0.013	*
ADF	75.34[a]	71.78[b]	71.23[b]	73.35[ab]	0.006	*
ADL	69.33[b]	68.27[b]	70.87[b]	74.38[a]	0.015	*
Hemicellulose	73.67	75.33	75.87	76.31	0.009	NS
Cellulose	79.52[a]	76.85[ab]	76.24[ab]	75.97[b]	0.015	*

T_1-Control T_2 - 10 % *RoTRH* T_3 - 20 % *RoTRH* T_4 - 30 % *RoTRH* NFE - Nitrogen Free Extract NDF- Neutral Detergent Fiber ADF- Acid Detergent Fiber ADL- Acid detergent Lignin NS- Not Significant ($p > 0.05$) *-Significant ($p < 0.05$) SEM-Standard Error of Mean