NUTRIENT DIGESTIBILITY AND NITROGEN BALANCE OF WEST AFRICAN DWARF GOATS FED *PLEUROTUS TUBER-REGIUM* DEGRADED CASSAVA ROOT SIEVATE

[*]Jiwuba, P.C., **Ahamefule, F.O., *Onwujiariri, E.B., **Jiwuba, L.C., *Azodo, N.L. **Ikwunze, K. and Nwefuru, M.O.

**Department of Animal Production Technology, Federal College of Agriculture, P.M.B.7008, Ishiagu, Ebonyi State, Nigeria.*

***College of Animal Science and Production, Department of Animal Production and Management, Michael Okpara University of Agriculture, Umudike, Nigeria.*

****Department of Biotechnology, National Root Crops Research Institute, P.M.B, 7006, Umudike, Abia State,Nigeria.*

Corresponding author: jiwubapc@gmail.com

ABSTRACT

An experiment was conducted to evaluate the apparent nutrient digestibility and nitrogen balance of West African dwarf (WAD) goats fed diets containing Pleurotus tuber-regium degraded cassava root sievate (PTR-CRS). Four experiment diets were formulated to contain 0, 20, 40 and 60% of PTR-CRS and designated as T_1, T_2, T_3 and T_4 respectively and fed to the animals in a 4x4 Latin square design pattern. The apparent nutrient digestibility coefficient showed higher ($p < 0.05$) DM, CP and crude fibre digestibility for T_4 compared to other treatments. Nitrogen intake and N balance, differed significantly ($P < 0.05$) with goats on T_4 having the best results. It could therefore be concluded that goats on T_4 had the highest dry matter, crude protein and crude fibre digestibilities. In addition, nitrogen intake and retention was highest at T_4, hence the inclusion of 60% PTR-CRS is recommended for enhanced N utilization and apparent nutrient digestibility by WAD goats.

INTRODUCTION

Cassava root sievate (CRS) is the waste, which results from processing cassava root into fufu, a popular West African food. The sievate is the solid waste produced as a product of cassava root production and made up of 88.60, 2.57 and 13.38% dry matter, crude protein and crude fibre respectively (Jiwuba *et al*., 2018); it constitutes about 25% of the whole plant (Aderemi and Nworgu, 2007). Jiwuba *et al*. (2018) reported 3.79 MJ/kg gross energy value for cassava root sievate meal. They are usually discarded poorly as waste heaps near streams or homes where they are soaked, fermented and processed thereby producing a strong offensive smell and contaminations; hence the need to add value to this agro-waste. The low protein content (Jiwuba *et al*., 2016), high cyanide content (Ubalua and Ezeronye 2008; Morgan and Choct 2016) and high fibre contents are the limiting factor in the utilization of cassava root sievate by goats. Due to high lignin content of cassava root sievate, its utilization is impaired in goat feeding. These have affected the general performance of animals fed such diet; hence the needs to improve the nutritive value of cassava root sievate through biodegradation (use of white rot fungi). The *Pleurotus* species have been shown to be more efficient (Taniguchi *et al*., 2005). The *Pleurotus tuber-regium* have different ability to grow on agro waste and decompose its structural carbohydrate because of the variation in culture behaviour and culturing conditions. Information on cassava root sievate biodegradation in goat feeding is virtually non-existing. The study was therefore designed to determine the apparent nutrient digestibility and nitrogen balance of West African dwarf goats fed diets containing *Pleurotus tuber-regium* degraded cassava root meal.

MATERIALS AND METHODS

The experiment was carried out at the sheep and goat Unit, Federal College of Agriculture Ishiagu, The dried cassava root sievate were sourced from Akawa, Nneato, Umunneochi L.GA. Abia State. The dried cassava root sievate were coarsely milled using a blur mill to reduce its particle size and create a greater surface area for microbial activity. Treatment of cassava root sievate with *Pleurotus tuber regium* was by inoculation of composted cassava root sievate with slides of the *Pleurotus tuber regium* in white perforated bucket were kept on a concrete floor at room temperature covered with polythene sheet and allowed to ferment for 45 days. The Experimental diets designated as T_1, T_2, T_3, T_4 were formulated from non-biodegraded cassava root sievate, biodegraded cassava root sievate, brewers dried grain, palm kernel meal, soybean meal, bone meal, salt and premix. The biodegraded cassava root sievate replaced the non - biodegraded cassava root sievate at, 0, 20, 40 and 60% respectively as shown in Table 1.

Table 1: Composition of the Experimental Diets

	Dietary levels (%)			
Ingredients	T_1 (0%)	T_2 20%)	T_3 (40%)	T_4 (60%)
Non-biodegraded cassava root sievate	60.0	40.0	20.0	0.0
Biodegraded cassava root sievate	0.0	20.0	40.0	60.0
Brewers dried grain	15.0	15.0	15.0	15.0
Palm kernel meal	14.0	14.0	14.0	14.0
Soybean meal	7.0	7.0	7.0	7.0
Bone meal	3.0	3.0	3.0	3.0
Salt	0.5	0.5	0.5	0.5
Premix	0.5	0.5	0.5	0.5
Total	100	100	100	100

Four WAD bucks of about 6 – 8 months old were used for this experiment. The animals were subsequently transferred to previously disinfected individual metabolism cages provided with facilities for collecting faeces and urine. They were fed four experimental diets in a 4 x 4 Latin square design. Each animal received the experimental diets consecutively in 4 phases. During phase 1, which lasted for 28 days, each animal received 1.5kg of an assigned experiment diet for 21 days. During this period, each animal had access to free drinking water daily. Total faeces and urine voided by the experimental animals were collected during the last 7 days (22-28). During phases 2 - 4, each animal was offered each of the remaining 3 experimental diets in rotational periods of 28 days each. The last 7 days in each of the feeding periods, was used for total urine and faecal collection. Each animal constituted a replicate while each feeding phase represented an observation. The quantity of each diet offered to the goats during each period ensured about 5% left over. The left overs were collected after 24 hours, weighed and used to determine the voluntary intake. Total faeces were collected in the mornings before feeding and watering during days 22 - 28 of each period. The faeces weighed fresh, dried and bulked for each animal. A sub-sample from each animal was dried in forced draft oven at 100-105^{0}C for 48 hour and used for DM determination. Total urine for each animal was collected daily in the morning before feeding and watering. The urine trapped in a graduated transparent plastic container placed under each cage and to which 15ml of 25% H_2SO_4 was added daily to curtail volatilization of ammonia from the urine. The total volume of urine output per animal was measured and about 10% of the daily outputs was saved in plastic bottles numbered and stored in a deep freezer at 5^{0}C. At the end of each 7 – day collection period, the sample collections were bulked for each animal and sub-samples taken for analysis. The experimental design used was 4 x 4 Latin square experiment. Data obtained were analyzed using analysis of variance (ANOVA) as described by SAS (2008). Significant means were separated using the Duncan Multiple New Range Test.

RESULTS AND DISCUSSION

The apparent nutrient digestibility coefficient of WAD goats fed *Pleurotus tuber regium* degraded cassava root sievate in their diets are presented in Table 2. Dry matter digestibility (DMD), crude protein digestibility (CPD) and crude fibre digestibility CFD) were positively ($p<0.05$) influenced by the experimental diets diets. The DM digestibility of this study ranged between 64.25 and 69.97% and compared well with the range of 63.44 – 71.56% reported by Hamchara *et al*. (2018) for goats fed oil palm fronds treated with *Lentinus sajor-caju* but lower than 82.20 – 88.70 % for WAD goats fed fungal treated rice straw in their diets as reported by Wuanor and Carew (2018). The variations may be attributed to age of the goats and the diets fed to the animals. CP and CF were least digested in T_1 (63.79% and 55.90%) and best digested in T_4 (80.34% and 68.19%), respectively. The highest ($P<0.05$) digestibility coefficient of crude protein obtained in treatment T_4 showed that the dietary protein was better utilized by the animals fed diet T_4 relative to others. This could be attributed to the fact that treatment of lignocellulosic feedstuffs with white rot fungi improves the available amino acid content of the residual biomass. Akinfemi and Ogunwole (2012) noted that fungal treatment of rice straw did not only improved the CP contents but also enhanced digestibility of the diets. Furthermore, Ahemefule (2005) observed that dietary protein enhanced digestibility. The reported CP digestibility coefficient in this study compared with 71.60 -78.80% for WAD goats fed fungal treated rice straw in their diets as reported by Wuanor and Carew (2018). The results of crude fibre digestibility in this study showed that crude protein content of diets were positively correlated with the CPD and CFD. This agreed with earlier reports (Fasae *et al*., 2005) that CFD and CPD decrease with decreasing level of CP in diets. A very important consideration in the utilization of nutrients by animals may be the synchronization of nutrients especially protein and energy. This may explain why the digestibility coefficient of CP and CF increased from treatment $T_1 – T_4$, in the same pattern with DM. The reported CF digestibility coefficient in this study is in agreement with the findings of Wuanor and Carew (2018) for WAD goats fed fungal treated rice straw in their diets.

Table 2: Apparent Nutrient Digestibility Coefficient of African Dwarf Goat fed biodegraded Cassava root sievate in their diets.

	Dietary levels				
Parameter (%)	T1 (0%)	T2 (20%)	T3 (40%)	T4 (60%)	SEM
Dry Matter	64.25[b]	65.35[b]	66.19[b]	69.97[a]	0.71
Crude Protein	63.79[d]	68.00[c]	73.96[b]	80.34[a]	1.66
Crude Fibre	55.90[d]	58.31[c]	64.25[b]	68.19[a]	1.28
Ash	51.96	50.95	51.04	51.48	0.06
Ether Extract	52.87	53.08	53.03	53.54	1.23
Nitrogen fee extract	57.63	55.73	55.63	57.36	0.97

[a-d] means on the same row with different subscript are significantly ($P < 0.05$).

Table 3 shows the nitrogen utilization of WAD goats fed *Pleurotus tuber-regium* degraded cassava root sievate (PTR-CRS) in their diets. The Nitrogen intake (g/day) obtained in this study (12.39-19.62 g/d) followed a particular trend, increasing with increasing levels of PTR-CRS. There was significant ($p<0.05$) difference for Nitrogen intake with T_4 been significantly ($p<0.05$) higher than T_3, T_2 and T_1. The higher N intake observed for the WAD goats in T_4 maybe attributed to the higher CP of the diet. The nitrogen retention increased ($p<0.05$) for WAD goats fed graded levels of *Pleurotus tuber regium* degraded cassava root sievate based diets; indicating that protein supplementation increased nitrogen retention. The high nitrogen balance and nitrogen retention percentage observed in this study, may be attributed to high digestibility of nutrients and low reduction in total N excreted among the *P. tuber regium* degraded CRS diets which resulted to higher utilization of nitrogen from microbial protein, suggesting that the nitrogen was well tolerated and utilized by the WAD goats. The increased Nitrogen retention values among the treatment groups further indicated the potentials of *Pleurotus tuber regium* degraded cassava root sievate to enhance N utilization among the WAD goats.

Table 4: Nitrogen Balance of West African Dwarf Goat fed biodegraded Cassava root sievate in their diets.

Parameters	T_1	T_2	T_3	T_4	SEM
Nitrogen Intake ((g/day)	12.39^{d}	15.63^{c}	17.45^{b}	19.62^{a}	0.69
Urinary Nitrogen(g/day)	1.42	1.23	1.3	1.08	0.08
Faecal Nitrogen (g/day)	3.77	3.72	3.69	3.57	0.08
Total Nitrogen Output(g/day)	5.19	4.95	4.99	4.65	0.12
Nitrogen balance (g/day)	7.22^{d}	10.68^{c}	12.46^{b}	14.97^{a}	0.72
Nitrogen retention (g/d $Wkg^{0.75}$)	4.40^{d}	5.79^{c}	6.49^{b}	7.52^{a}	0.30
Nitrogen utilization (%)	58.16^{c}	66.41^{b}	69.41^{b}	75.09^{a}	1.72

$^{a-d}$ means on the same row with different subscript are significantly ($P < 0.05$).

CONCLUSION

The results revealed that replacement of non-biodegraded cassava root sievate with *Pleurotus tuber-regium* degraded cassava root sievate in West Africa Dwarf (WAD) enhanced crude protein and crude fibre digestibility. The results also showed enhanced nitrogen utilization by the goats fed *Pleurotus tuber-regium* degraded cassava root sievate in their diets. *Pleurotus tuber-regium* degraded cassava root sievate can, therefore be included up to 60% to improve nutrient digestibility and nitrogen utilization in West Africa Dwarf (WAD) goats.

REFERENCES

Aderemi, F.A., and Nworgu F.C. (2007). Nutritional status of cassava peels and root sievate biodegraded with *Aspergillus niger*. American-Eurasian *J. Agric. and Environ. Sci.*2: 308-311.

Ahamefule, F.O. (2005). Evaluation of Pigeon Pea cassava peel based diet for goat production in South-Eastern Nigeria. Ph.D Thesis Michael Okpara University of Agriculture, Umudike, Nigeria.

Akinfemi, A. and Ogunwole, O.A. (2012). Chemical composition and *in vitro* digestibility of rice straw treated with *Pleurotus ostreatus*, *Pleurotus pulmonarius* and *Pleurotus tuber-regium.* S*lovak J. Anim. Sci. 45(1): 14-20.*

Fasae, O. A., Alokan, J. A. and Onibi, G. E. 2005. Feed intake and digestibility in Yankasa sheep fed diets containing varying levels of *Leucaena leucocephala* leaf residue. Nig. J. Anim. Prod. 32 (1): 88-93.

Hamchara, P., Chanjula, P., Cherdthong, A. and Wanapat, M. (2018). Digestibility, ruminal fermentation, and nitrogen balance with various feeding levels of oil palm fronds treated with *Lentinus sajor-caju* in goats. Asian-Australasian Journal of Animal Sciences, 31(10): 1619-1626. DOI: https://doi.org/10.5713/ajas.17.0926

Jiwuba, P.C, Onwujiariri, E.B. and Kadurumba, O.E. (2018). Carcass yield, organ response and cost/benefit evaluation of West African dwarf goats fed yellow root Cassava Peel-Centrosema leaf meal based diets. *Nigerian Journal of Animal Production.* 45(2): 342 – 351.

Jiwuba, P.C., Ezenwaka L.C, Ikwunze K., & Nsidinanya N.O. (2016). Blood profile of West African Dwarf goats fed provitamin A cassava peel-centrosema leaf meal based diets. Analele Stiintifice ale Universitatii,, Alexandru Ioan Cuz", Sectiunea Genetica si Biologie Moleculara TOM XVII, Fascicula 3: 27-134.

Morgan, N.K., and Choct, M. (2016). Cassava: Nutrient composition and nutritive value in poultry diets. *An. Nutr.*2: 253-261.

SAS (2008). Statistical Analysis System. User's guide: statistics. SAS Institute Inc. Cary NC 27513 USA.

Taniguchi, M., Suzuki, H., Watanabe, D., Sakai, K., Hoshino, K. and Tanaka, T. (2005). Evaluation of pre-treatment with *Pleurotus ostreatus* for enzymatic hydrolyses of rice straw. J. BioSci. Bioeng. 100(6): 637-643.

Ubalua, A.O., and Ezeronye, O.U. (2008). Growth Responses and Nutritional Evaluation of Cassava Peel Based Diet on Tilapia (*Oreochromis niloticus*) Fish Fingerlings. *J. Food Technol.*,6: 207-213.

Wuanor, A.A, and Carew, S.N (2018). Nutrient Digestibility, Carcass Yield and Production Economics of West African Dwarf Goats Fed Pleurotus Tuber-Regium Biodegraded Rice Straw and Maize Offal -Brewer Yeast Slurry Mixture. Journal of Animal Husbandry and Dairy Science, 2(1): 13-21.