Performance of West African Dwarf Goats fed maize stover based diet supplemented with Roxazyme G2® in the dry season in Abeokuta, Nigeria

Yusuf, *K. O., Adebesin, O. A., Sanni, A. Y., Aderinboye, R. Y., Oni, A. O., Adelusi, O.A. and Isah, O. A.

Animal Nutrition Department, College of Animal Science and Livestock Production, Federal University of Agriculture, P.M.B. 2240, Abeokuta, Nigeria.

Email: yomowumi@gmail.com / kaflak2001@yahoo.com

Abstract

The study was carried out to investigate the effect of exogenous fibrolytic enzyme additive (containing cellulase, xylanase and beta glucanase) on the growth performance and nutrient digestibility parameters of West African dwarf (WAD) goats fed total mixed ration in the dry season. A total of sixteen (16) WAD goats were subjected to a 70-day feeding trial in a completely randomized design. A total mixed ration was formulated with enzyme added at 0.0, 0.2, 0.4 and 0.6g/kg DM. Feed intake and weight changes of the goats were monitored. Nutrient digestibility and nitrogen utilization were also determined. Enzyme additive significantly ($P < 0.05$) improved daily feed intake and weight gain of the goats. The best feed conversion ratio (8.34) was obtained at 0.4g/kg DM enzyme inclusion level. Crude protein digestibility was also highest (81.01%) at 0.4g/kg DM enzyme inclusion level. The enzyme could be included in a total mixed ration for West African Dwarf goats at 0.4g/kg DM for improved feed intake, weight gain and nutrient digestibility.

Keywords: Dry season, Growth performance, Nutrient Digestibility, Total mixed ration.

Introduction

Ruminant animals are important aspect of livestock production in the world. They are kept worldwide for their numerous economic and social contributions (Okoruwa *et al.*, 2013). In Nigeria, ruminant animal production is a very important component of agricultural sector. The nation's meat supply is almost exclusively derived from ruminant livestock (Okoruwa and Njidda, 2012). Goats play a significant role in livelihood of the rural populace in most developing countries. Apart from serving as a vital protein source, it also provides income for meeting urgent household needs (Peacock *et al.*, 2005). Scarcity of forage during the dry season is a common problem limiting goat production in tropical areas (Nwaigwe, 2011). Efforts are being made by ruminant nutritionists for alternative

feed resources such as browse plants and agro-industrial by-products which can supply some of the nutrients need of goats. These are however, limited by their content of anti-nutritional factors and low digestibility. Low forage digestibility limits the intake of available nutrients by ruminants and invariably nutrient excretion.

Adequate feeding of ruminants in the dry season is usually a challenge to farmers in Nigeria hence, the feeding of crop residues and agro-industrial by-products which are high in fibre become rampant among farmers. The primary objective of using feed enzyme is to enhance availability of nutrients that are locked within cell wall components. Recent studies have shown that adding exogenous fibrolytic enzymes to ruminant diets increase average daily growth rate in yearling calves (Yusuf *et al.*,

2013) and milk production in dairy cow (Yang *et al.*, 1999). These increases in performance are due to increase in feed digestion (Beauchemin *et al.*, 2003). Several studies have examined the use of exogenous enzymes in diets of cattle (Yusuf *et al.*, 2013; Beauchemin *et al.*, 2003). There is paucity of information on the effect of exogenous fibrolytic enzyme in the diet of small ruminants. Hence, the aim of this research was to examine the effect of enzyme additive on growth performance and nutrient digestibility of WAD goats fed total mixed ration in the dry season.

Materials and Methods

Experimental site

The experiment was carried out at the Goat Unit of the Directorate of University Farms (DUFARMS), Federal University Agriculture, Abeokuta, Ogun State. The region is within the South Western part of Nigeria at latitude 70°N and 70.58°S and longitude 30.20°E and 4.37°W at Alabata, Odeda Local Government Area of Ogun State, Nigeria.

Test ingredients and experimental diets.

The test ingredient Roxazyme G2® an exogenous fibrolytic enzyme (containing cellulase, xylanase and beta -glucanase) was obtained commercially. Four total mixed rations (TMR) were formulated with enzymes included at 0, 0.2, 0.4 and 0.6g/kg DM. The gross composition of the experimental diets (TMR) is as shown in the Table 1

Experimental animals and management

A total of sixteen growing (WAD) goats were used for the experiment. The animals were housed in individual pens which was thoroughly washed and disinfected. The weight of the animals ranged from 8kg to 11kg, they were divided on weight equalization basis into four treatment group. Each treatment groups had four

animals each. The animals were dewormed and treated against ecto-parasite before the commencement of the experiment. They were given an adjustment period of two weeks during which they were given maize Stover and concentrate. They were fed at 5% of their body weight at 09.00hrs everyday throughout the ten weeks (70 days) experimental period. Clean water was provided *ad-libitum*. Voluntary intake was determined as the difference between feed offered and feed refused. Each animal was weighed before the commencement of the experiment and thereafter fortnightly to monitor weight changes.

At the end of the eighth week, all the animals in each treatment were moved to the metabolic cages for digestibility and nitrogen utilization study. The first seven (7) days served as adjustment period while the last seven (7) days were for total collection of faeces and urine. Digestibility was carried out as described by McDonald *et al.*, (1987). Nitrogen loss from the urine by volatilization was prevented by rinsing the urine bottle with 10% H₂SO₄ and stored in the freezer till needed for analysis of nitrogen content (AOAC, 2000).

Statistical analysis

All data collected were analyzed using one way analysis of variance in a completely randomized design and significant means were separated using Duncan's Multiple Range Test (SAS, 2003).

Results and Discussion

Table 2 shows the chemical composition of the experimental ration fed to the animals. The dry matter and crude protein of the ration were 93.00% and 14.95% respectively. The dry matter value was high and this is because all the ingredients were

Table 1: Gross Composition (g/kg) of the Experimental Diets (Total Mixed Ration)

Ingredients	Enzyme Inclusion Levels			
	T ₁ (0)	T ₂ (0.2)	T ₃ (0.4)	T ₄ (0.6)
Maize Stover	300.00	300.00	300.00	300.00
Maize	100.00	100.00	100.00	100.00
Wheat Offal	250.00	250.00	250.00	250.00
Soyabean Meal	100.00	100.00	100.00	100.00
Palm kernel Cake	200.00	200.00	200.00	200.00
Bone Meal	30.00	30.00	30.00	30.00
Common Salt	15.00	15.00	15.00	15.00
*Premix	5.00	5.00	5.00	5.00
Roxazyme G2	-	+	++	+++
Total	1000	1000	1000	1000
Calculated Analysis (%)				
Crude Protein	14.03	14.03	14.03	14.03
Crude Fiber	15.58	15.58	15.58	15.58

*Premix: Vitamin A 8,000,000 I.U. Niacin 15,000mgr Manganese 80gr. Vitamin D 1,600,000 I.U. Vitamin B12 10mgr Zinc 50gr. Vitamin E 5,000 I.U. Pantothenic Acid 5,000mgr Iron 20gr. Vitamin K 2,000mgr Folic Acid 500mgr Copper 5gr. Thiamine B 1,500mgr Biotin 20mgr Iodine 1.2gr. Riboflavin B2 4,00mgr Choline Chloride 200gr Selenium 200mgr. Pyridoxine B6 1,500mgr Antioxidant 125gr Cobalt 200mgr.

in the dry form. The crude protein value was a bit higher than 9-14% reported by Aduku (1993) as crude protein requirement for sheep and goats in Nigeria. The Neutral Detergent Fibre (NDF), Acid Detergent Fibre (ADF), and Acid Detergent Lignin (ADL) values were also high (85.00%, 62.33% and 50.33% respectively). This is an indication that the diet is rich in fibre which is necessary for proper rumen function. Ash was 16.00%, meaning that the ration is rich in minerals.

Result of the growth performance is shown in Table 3. There were no significant ($P>0.05$) difference in all the parameters measured except daily feed intake, daily weight gain and feed conversion ratio. Daily feed intake was highest at T4 (431.07 g/d) and lowest at the control (396.07 g/d). The improvement in the daily feed intake when compared with the control is in line with the report of Yusuf *et al.*, (2013) that exogenous enzyme additive improves feed intake as a result of its positive effect on nutrient digestibility. The daily weight gain

was highest (50.54 g/d) and has the same value at T3 and T4. This is an indication that animals on these treatments utilized the nutrients in the feed better as a result of enzyme inclusion which improved fibre degradation in the rumen. Beauchemin *et al.*, (2003) reported that exogenous enzyme improved forage utilization by ruminants. Exogenous fibrolytic enzyme improved the feed intake and weight gain of goats (Tit and Lubbadah, 2004). The feed conversion

Table 2: Chemical composition of the Total Mixed Ration (%)

Parameters	%
Dry matter	93.00
Crude protein	14.95
Ether extract	9.17
Ash	16.00
Neutral detergent fibre	85.00
Acid detergent fibre	62.33
Acid detergent lignin	50.33
Cellulose	12.00
Hemicellulose	22.67

ratio was highest ($P<0.05$) in T1 (14.78) and best (lowest) in T3 (8.34). This is an indication of proper utilization of the feed by the animals on this diet.

Table 4 shows the effect of enzyme additive on apparent nutrient digestibility. There were significant ($P<0.05$) differences in all the parameters measured among the treatments except dry matter, acid detergent lignin and hemicellulose digestibility. Crude protein (CP) digestibility (81.01%) was highest at T3 although, there was no significant ($P>0.05$) difference between this value and what was obtained at T2 and T4. Ash, ether extract, neutral detergent fibre, acid detergent fibre and cellulose digestibility followed the same trend. This is an indication that exogenous enzyme additive used in this study significantly ($P<0.05$) improved all the apparent nutrient digestibility parameters measured except dry matter, acid detergent lignin and hemicellulose digestibility. This was in line with the reports of Rode *et al*, (1999) and Yusuf *et al*, (2013) that exogenous fibrolytic enzyme supplementation improves fibre digestion and total tract digestion of feed. Yang *et al*, (1999) also reported that enzyme supplementation increase the rate of degradation in the rumen.

Table 5 shows the effect of enzymes additive in total mixed ration at different

level on nitrogen utilization by West African dwarf goats. There were no significant ($P>0.05$) differences among all the parameters measured hence, any of the diets could be fed to enhance nitrogen utilization. However, animals fed enzyme additive have higher numerical values than those fed the control diet. This is also an indication that exogenous fibrolytic enzyme additive promote nitrogen utilization in WAD goats

Conclusion

From the result of the experiment, it can be concluded that the enzyme ROXAZYME G2® increased daily feed intake and daily weight gain of WAD goats. It also enhances crude protein, acid detergent fibre (ADF), and neutral detergent fibre (NDF) digestibility and promotes nitrogen utilization. ROXAZYME G2® can be added to a total mixed ration for goats at a level of 0.4g/kg DM for improved performance during the dry season.

References

- Aduku, A.O. 1993. Tropical feedstuff analysis table. Department of Animal Science, Faculty of Agriculture, Ahmadu Bello University, Samaru, Zaria, Nigeria.
- A.O.A.C. 2000. Official Methods of

Table 3: Growth performance of West African Dwarf goats fed experimental diets

Parameters	Treatments				SEM
	T ₁	T ₂	T ₃	T ₄	
Average Initial Weight (kg)	8.83	8.67	8.67	8.67	0.49
Average Final Weight (kg)	10.33	10.67	11.50	11.50	0.40
Average Weight gain (kg)	1.50	2.00	2.83	2.83	0.33
Daily Weight gain (g/d)	26.79 ^c	35.71 ^b	50.54 ^a	50.54 ^a	5.96
Total feed intake (kg)	22.18	22.28	23.60	24.14	0.37
Daily feed intake (g/d)	396.07 ^c	397.86 ^c	21.43 ^b	431.07 ^a	10.17
Feed conversion ratio	14.78 ^a	11.14 ^b	8.34 ^c	8.53 ^b	2.00

^{abc} means in the same row having different superscript are significantly different ($p<0.05$).
T₁, T₂, T₃ and T₄ represent enzyme inclusion at 0.0, 0.2, 0.4, and 0.6g/kg DM

Table 4: Apparent nutrient digestibility (%) of West African dwarf goats fed experimental diets

Parameters	Treatments				SEM
	T ₁	T ₂	T ₃	T ₄	
Dry Matter	74.33	75.26	75.11	75.00	0.59
Crude Protein	77.46 ^b	80.51 ^a	81.01 ^a	79.89 ^a	1.67
Ether Extracts	76.24 ^c	82.86 ^b	85.28 ^a	83.89 ^b	1.68
Ash	64.65 ^b	68.03 ^b	73.77 ^a	70.97 ^a	2.08
Neutral Detergent Fibre	59.24 ^b	62.16 ^b	65.67 ^a	65.23 ^a	1.65
Acid Detergent Fibre	56.84 ^b	58.48 ^a	59.88 ^a	59.61 ^a	1.04
Acid Detergent Lignin	52.82	54.20	55.04	55.23	0.82
Cellulose	51.79 ^b	54.47 ^b	63.45 ^a	63.37 ^a	3.27
Hemicellulose	47.58	48.12	49.67	48.33	1.62

^{ab} means in the same row having different superscript are significantly different ($p < 0.05$).

T₁, T₂, T₃ and T₄ represent enzyme inclusion at 0.0, 0.2, 0.4, and 0.6g/kg DM

Table 5: Nitrogen utilization (%) of West African dwarf goats fed experimental diets

Parameters	Treatments				SEM
	T ₁	T ₂	T ₃	T ₄	
Total nitrogen intake (g/day)	12.24	12.40	12.38	12.36	0.01
Faecal nitrogen (g/day)	4.81	4.74	4.67	4.67	0.03
Urinary nitrogen (g/day)	0.08	0.09	0.07	0.07	0.00
Nitrogen output (g/day)	4.89	4.83	4.74	4.74	0.03
Nitrogen absorbed (g/day)	7.35	7.57	7.64	7.62	0.03
% Nitrogen absorbed	60.05	61.05	61.71	61.65	0.02

^{abc} means in the same row having different superscript are significantly different ($p < 0.05$).

T₁, T₂, T₃ and T₄ represent enzyme inclusion at 0.0, 0.2, 0.4, and 0.6g/kg DM

Analysis, 18th Ed., Association of Official Analytical Chemists. Arlington, VA.

Beauchemin, K. A., D. Colombatto, D. P. Morgavi, and W.Z. Yang. 2003. Use of exogenous fibrolytic enzymes to improve feed utilization by ruminants. *Journal of Animal Science* 81(Suppl.2):E37-E47.

Mc Donald P., Edwards, R.A and Greenhalgh, J.P.D. 1987. Animal Nutrition 4th

Edition. Longman Scientific and Technical Company England 154–176

Nwaigwe, C.O., Nwankpa, C.A. and Nwaigwe, C.U. 2011. The effect of sawdust/ poultry litter and *Brachiaria ruziziensis* silages on the performance of West African dwarf

goats. *Asian Journal of Biotechnology* 3: 581-587

Okoruwa, M.I., Obiku, A. and Agbonlahor, I. 2013. Rumen indices and performance response of West African dwarf (WAD) sheep as influenced by orange with pineapple pulps. *International Journal of AgriScience* 3(11): 862-870.

Okoruwa, M.I. and Njidda, A.A. 2012. Rumen characteristics and nitrogen utilization of West African dwarf sheep as influenced by Guinea grass and dried pineapple pulp. *Pakistan Journal of Nutrition* 11(6): 580-583.

Peacock, C., Devendra, C., Ahuya, C., Roets, M., Hossain, M. and Osafo, E. 2005. Goats. In: Owen, E.; Kitalyi, A.; Jayasuriya N.; Smith, T.; (eds),

- Livestock and wealth creation: Improving the husbandry of animals kept by resource-poor people in developing countries.* Nottingham University Press, United Kingdom, pp361-385
- Rode, L.M., Yang, W.Z. and Beauchemin, K.A. 1999.** Fibrolytic enzyme supplements for dairy cow in early lactation. *Journal of Dairy science.* 82:2121-2126.
- SAS (2003)** tatistical Analysis systems. SAS user's guide. NY., Cary: SAS Institute Inc.
- Titil, H., and W. F. Lubbadah. 2004.** Effects of feeding cellulose enzyme on productive responses of pregnant and lactating ewes and goats. *Small Ruminant Research* 52:137-143.
- Yang, W.Z., Beauchemin, K.A. and Rode, L.M. 1999.** Effects of an enzyme feed additive on extent of digestion and milk production of lactating dairy cows. *Journal of dairy science.* 82: 391-403.
- Yusuf, K.O., Isah, O.A., Onwuka, C.F.I., Olanite, J.A., Oni, A.O. and Aderinboye, R.Y. 2013.** Effects of enzyme additive on nutrient intake, digestibility and rumen metabolites of yearling cattle fed grass-hay based diet. *Nigerian Journal of Animal Science* 15:155-167.