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EFFECT OF TREATED AND UNTREATED SUGARCANE BAGASSE WITH OR WITHOUT ENZYME SUPPLEMENTATION IN TOTAL MIXED RATION ON PERFORMANCE OF RED SOKOTO BUCKS

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ABSTRACT

A study was conducted to evaluate the feeding value of treated and untreated sugarcane bagasse with or without enzyme supplementation in total mixed ration (TMR) of fattening red Sokoto bucks. Sixteen bucks with a live weight of 10±2 kg were used with four bucks per treatment and allotted to two dietary treatments with two level of supplementation containing 40% of sugarcane bagasse in a 2×2 factorial arrangement in a completely randomized design. The feeding and metabolism trial lasted for 90 and 21 days respectively. The enzyme was included based on the manufacturer's recommendation and the diets were offered at 3% body weight. The Crude protein (CP) content of experimental diet varies between 13.75% and 14.50% while Crude fibre (CF) ranged from 26.61% to 29.77%. The result of the feeding trial showed that there was no significant difference ($p>0.05$) in feed intake and final weight between bucks fed bagasse with enzyme and bucks fed bagasse without enzyme. Bucks fed treated bagasse had significantly ($p<0.05$) higher feed intakes (393.5g/d), total weight gain (5.2kg) and average daily gain (58g/d) compared to bucks fed untreated bagasse. Feed intake, weight gain and average daily gain of bucks fed treated bagasse with enzyme supplementation were significantly ($p<0.05$) higher compared to bucks fed untreated bagasse without enzyme supplementation. Nutrients digestibility follows similar pattern except for Dry matter (DM), CP, and CF which were not significant ($p>0.05$). It was concluded that urea treatment with enzyme supplementation has positive effect on performance (live weight gain of 61.94g/d) of fattening Red Sokoto bucks

Keyword: performance, enzyme, Red Sokoto

INTRODUCTION

Small ruminant animals continue to make substantial contribution to the economy of Nigeria as suppliers of food, raw materials and foreign exchange .Oni (2002) reported that sheep and goat account for about 36% total national meat supply and they have tremendous potential for growth. Goat also feature prominently in the economic and social lives of Nigerians .They serve as a quick source of income and a major role in dowry, ceremonies and ritual sacrifices. Goats have successfully served mankind with milk, meat, hair, leather and other products including manures, even though they are frequently objects of neglect and prejudice. Enhancement of goat meat

production needs the support of sustainable feed availability. Goats have different feeding behaviour, intake, diet selection, and rate of eating from other ruminants (Lu *et al.*, 2005).

According to federal department of livestock pest and control services (FDLPCS, 1992), inadequate feeding is the major constraint militating against successful livestock production in the semi-arid zone of Northern Nigeria. The severity of feed shortages occur during the long dry season when the available range forages are scanty and have dried, while crop residues their protein content of which is very low and there is marked decrease in voluntary intake and digestibility by the animals, leading to very low level of performance (Steinbach 1997). Smith *et al.* (1995) observed that dry season feeding of ruminant animals has always been a constant problem to livestock farmers as feed supplies are limited both in quantity and quality.

Bagasse is a fibrous sugarcane by-product containing high fibre (43%) and low nitrogen (0.2%), it has limited use in animal feeds without any proper treatment (Ramli *et al.,* 2005). However its low digestibility limits its use in the raw state (Anakalos and Anakalo, 2009). If Bagasse is used as a basal diet, it is important to give the correct supplementation in order to obtain satisfactory physical and economic responses. The supplementation must take account of the productivity of the animals (e.g. growing, fattening, and lactating, etc.), (Mahala *et al*., 2007).

The use of biotechnology such as exogenous enzymes to enhance quality and digestibility of fibrous forage is on the verge of delivering practical benefits to ruminant production systems. In this regard, cellulases and xylanases are respectively amongst the two major enzyme groups that are specified to break ß1-4 linkages joining sugar molecules of cellulose and xylans found in plant cell wall components (Dawson and Tricarico, 1999; Beauchemin *et al*., 2003). Several studies with exogenous enzymes have made mention of the increase of microbial activities in the rumen, which resulted in an enhancement of animal performance traits.

Results with exogenous enzymes addition in ruminant systems are variable and somewhat inconsistent (Beauchemin *et al*., 2003; Colombatto *et al*., 2003), making their biological response difficult to predict. Some studies have shown substantial improvement of feed digestibility and animal performance traits (Lewis *et al*., 1999; Rode *et al*., 1999; Yang *et al*., 1999 ; Nowak *et al*. 2003; Cruywagen and Goosen 2004), while others reported either negative effects or none at all (Vicini *et al*., 2003; Bowman *et al*., 2003; Baloyi, 2008). Therefore the present study intends to look into combining chemical treatment and enzyme supplementation to validate the use of enzymes in small ruminants.

MATERIALS AND METHODS

Experimental site

The experiment was conducted at Teaching and Research Farm of the Department of Animal Science, Ahmadu Bello University Zaria, located on latitude 11° 11' N and longitude 07° 38' E. Wikipedia (2014). It is situated at an altitude of 686m above sea level and lies within the Northern Guinea Savannah zone. The mean relative humidity is 21 and 72% during the harmatan and rainy season respectively. Annual rainfall ranges from 1102mm to 1904mm per annum which last from late April or early May to mid-October. The mean temperature fluctuates from 31°C maximum during the dry season to 18°C minimum during the wet season (Meteorological unit, IAR/ABU, 2014).

Source of Sugarcane Bagasse and treatment

Sugarcane bagasse was sourced from sugarcane processing centre at Kauran mata in Kano state. The bagasse was dried and ground into smaller particle sizes, it was then treated with urea at 5% (50g of urea was dissolved in one litre of water to treat one kg of bagasse). The treated bagasse was then parked in an improved cowpea storage (PIC) bags for two weeks, after which it was opened and aerated before inclusion in the TMR.

Experimental animals and management

Prior to the arrival of the bucks, the pens were cleaned and disinfected. On arrival, the bucks were quarantined for 2 weeks; and treated with ivomectin (ivomec®) and antibiotics (Tetracycline L.A) against internal and external parasites and they were vaccinated against PPR with TCRV. The bucks were then housed in individual pens and weighed every fortnight. They were fed total mixed ration at 4% of their body weight each. The ration was adjusted at regular intervals of two weeks along with changes in live weight.

Experimental design and diets

Sixteen Red Sokoto bucks with an average live weight of 10kg were used for the experiment. The bucks were allotted to four dietary treatments in a 2×2 factorial arrangement in a complete randomized design, to compare the effect of treated and untreated bagasse, with and without enzymes on the fattening performance of red Sokoto bucks. The test diets were designated as TB and UB containing 40% of bagasse with or without enzyme supplementation. Other feed ingredients include maize offal, cotton seed cake, bone meal, salt and premix. A commercial cocktail of cellulase, phytase and xylanase enzyme was included based on manufacturer's recommendation. Four animals were assigned per treatment and the experimental diets were formulated to be isonitrogenous and isocaloric. The trial last for 90 days.

Table 1: Gross composition of total mixed ration

	With enzyme		**Without enzyme**	
Parameters (%)	**TB**	**UB**	**TB**	**UB**
Maize offal	33.75	8.5	33.75	8.5
Bagasse	40	40	40	40
Cotton seed cake	23	48.23	23	48.23
Bone meal	2	2	2	2
Salt	1	1	1	1
Premix	0.27	0.27	0.27	0.27
Enzyme	20g	20g	0	0
Total	100.20	100.20	100	100
Calculated				
% CP	14	14	14	14
M.E (Kcal/kg)	2367	2318	2367	2318

Table 2: Chemical composition of total mixed ration

	With enzyme		Without enzyme	
Parameters (%)	**TB**	**UB**	**TB**	**UB**
Dry matter	94.88	94.91	94.52	94.38
Organic matter	89.12	88.78	88.64	89.49
Crude protein	14.13	13.75	14.50	14.38
Crude fibre	26.61	27.87	28.93	29.77
Ether extract	2.34	2.73	2.09	2.11
Acid detergent fibre	32.60	33.52	32.80	32.92
Neutral detergent fibre	68.88	69.04	68.30	68.94
Lignin	12.12	11.86	11.64	11.28

Digestibility study

At the end of the feeding trial, three bucks were randomly selected from each treatment group and housed in metabolic crates for easy, separate faecal and urine collection as described by (Osuji *et al.,* 1993). The animals were allowed 14 days for adjusting to the condition of the metabolic crates before commencement of the collection period which lasted for 7 days. The bucks were fed experimental diets at 3% of their body weight daily. Daily faecal output was weighed and 10% of each day collection was sub-sampled and oven dried at 60°C for DM determination. This was later bulked for laboratory analysis. Daily urine output was collected in a plastic container containing 10mls 0.1N H_2SO_4 placed under the metabolic crates, 10% of daily urine was collected from each buck and stored in the refrigerator. At the end of the 7 day collection period, 10% of the urine taken from each buck were bulked and sub-sampled and stored in the refrigerator for one day pending nitrogen determination.

Chemical Analysis

Proximate analysis of individual feed ingredients (treated bagasse, with and without enzyme, untreated bagasse with and without enzyme, maize offal, cotton seed cake,) and faecal samples were carried out by AOAC (2005) procedure. Acid detergent fibre (ADF) and Neutral Detergent fibre (NDF) were determined in all the feed ingredients according to van soest (1991).

Statistical Analysis

Data collected at the end of experiment were analyzed using GLM procedure of statistical Analysis (SAS, 2002). Significant treatment in means was compared and separated using Duncan Multiple Range Test (Duncan 1955).

RESULTS

The result of the effect of enzyme on performance of Red Sokoto bucks is presented in Table 3. There was no significant difference ($p>0.05$) on feed intake between bucks fed bagasse with enzyme supplementation and those fed bagasse without enzyme. Bucks fed bagasse with enzyme

supplementation had numerically higher feed intake (385.38g/d) compared to bucks fed bagasse without enzyme (382.86g/d). However, significant differences ($p<0.05$) were obtained in weight gain and average daily gain between bucks fed bagasse with enzyme supplementation and those fed bagasse without enzyme. Bucks fed bagasse with enzyme had higher weight gains (5.20kg) and average daily gain (57.7g/d) compared to bucks fed bagasse without enzyme with weight gain and average daily gain of (4.56kg and 50.6g/d) respectively.

Table 3: Effect of enzyme in TMR on performance of fattened Red Sokoto bucks

	Enzyme			
Parameters	**BE**	**BW**	**SEM**	**LOS**
Feed intake (g/d)	385.38	382.86	2.64	NS
Initial weight (kg)	9.56	9.75	0.37	NS
Final weight (kg)	14.76	14.31	0.34	NS
Total weight gain (kg)	5.20[a]	4.56[b]	0.26	*
Average daily gain (g)	57.77[a]	50.69[b]	0.88	*
FCR(kg/DMI/kg gain)	6.81	7.62		

[a, b, c] =Means with different superscripts along the row differs significantly ($p<0.05$). BE=bagasse with enzyme, BW=bagasse without enzyme.
SEM=standard error of means
LOS=level of significance

Table 4: Effect of urea treatment in TMR on performance of fattened Red Sokoto bucks

	Urea Treatment			
Parameters	**TB**	**UB**	**SEM**	**LOS**
Feed intake (g/d)	393.59[a]	374.65[b]	2.64	*
Initial weight (kg)	9.62	9.68	0.37	NS
Final weight (kg)	14.85	14.23	0.34	NS
Total weight gain (kg)	5.23[a]	4.53[b]	0.26	*
Average daily gain (g)	58.05[a]	50.41[b]	0.88	*
FCR(kg/DMI/kg gain)	6.92	7.51		

[a, b, c] =Means with different superscripts along the row differs significantly ($p<0.05$).
TB=urea treated bagasse, UB=untreated bagasse.
SEM=standard error of means
LOS=level of significance

Table 4 illustrates the effect of urea treatment on performance of fattened Red Sokoto bucks. It was observed that bucks fed urea treated bagasse had significantly ($p<0.05$) higher feed intake (393.5g/d), total weight gain (5.2kg) and average daily gain (58g/d) compared to bucks fed untreated bagasse with lower feed intake, total weight gain and average daily gain of (374.6g/d, 4.5kg, and 50.4g/d) respectively. However feed conversion ratio for bucks fed urea treated bagasse was lower (6.92) compared to those bucks fed untreated bagasse (7.51).

The result for the interaction between enzyme supplementation and urea treatment on performance of fattened Red Sokoto bucks is presented in Table 5 Significant difference ($p<0.05$) in feed intake, weight gain and average daily gain was observed between bucks fed urea treated bagasse with enzyme supplementation and bucks fed untreated bagasse without enzymes. However numerically higher feed intakes were obtained for bucks fed treated bagasse with enzyme supplementation (393.99g/d) compared to bucks fed treated bagasse without enzyme (393.19g/d).

Table 5: Interaction effect of enzyme and urea treatment in TMR on performance of fattened Red Sokoto bucks

	With enzyme		Without enzyme			
Parameters	**TB**	**UB**	**TB**	**UB**	**SEM**	**LOS**
Feed intake (g/d)	393.99^{a}	376.77^{b}	393.19^{a}	372.52^{b}	3.73	*
Initial weight (kg)	9.50	9.62	9.75	9.75	0.53	NS
Final weight (kg)	15.07^{a}	14.45^{ab}	14.62^{ab}	14.00^{b}	0.48	*
Total weight gain (kg)	5.57^{a}	4.82^{ab}	4.87^{ab}	4.25^{b}	0.37	*
Average daily gain (g)	61.94^{a}	53.61^{b}	54.16^{b}	47.22^{c}	1.24	*
FCR(kg/DMI/kg gain)	6.52	7.11	7.32	7.92		

$^{a, b, c}$ Means with different superscripts along the row differs significantly ($p<0.05$).
TB=urea treated bagasse, UB= untreated bagasse
SEM=standard error of means
LOS=level of significance

The effect of enzyme on nutrient digestibility and nitrogen balance of fattened Red Sokoto bucks results are presented in Table 6. There was no significant difference ($p>0.05$) for nutrient digestibility values for Organic matter (OM), and CP between bucks fed bagasse with enzyme supplementation and those without enzyme, but numerically higher nutrients digestibility was obtained for bucks fed urea treated bagasse (64.27 and 75.80) in OM, and CP respectively. However there was a significant ($p<0.05$) difference in nutrient digestibility of Dry matter (64.98), Ether extract (64.64), Acid detergent fibre (77.45), Neutral detergent fibre (76.77), and Lignin (42.62) for bucks fed urea treated bagasse compared to bucks fed untreated bagasse (63.22), (59.71), (74.67), (75.53) and (38.73) respectively. Table 7 also shows significant difference ($p<0.05$) in nutrient digestibility of almost all nutrients parameters between bucks fed urea treated bagasse and bucks fed untreated bagasse except for NDF digestibility in which no significant difference ($p>0.05$) was observed between the treatment groups.

Table 6: Effect of enzyme in TMR on nutrient digestibility and nitrogen balance of fattened Red Sokoto bucks

	Enzyme			
Parameters (%)	**BE**	**BW**	**SEM**	**LOS**
Dry matter	64.98[a]	63.22[b]	0.62	*
Organic matter	64.27	63.15	0.63	NS
Crude protein	75.80	76.50	0.59	NS
Crude fibre	80.73	80.78	0.45	NS
Ether extract	64.64[a]	59.71[b]	1.38	*
Acid detergent fibre	77.45[a]	74.67[b]	0.64	*
Neutral detergent fibre	76.77[a]	75.53[b]	0.53	*
Lignin	42.62[a]	38.73[b]	0.84	*

[a, b, c] =Means with different superscripts along the row differs significantly ($p<0.05$).
BE=bagasse with enzyme, BW=bagasse without enzyme,
SEM=standard error of means
LOS=level of significance

Table 7: Effect of urea treatment in TMR on nutrient digestibility and nitrogen balance of fattening Red Sokoto bucks

	Urea treatment			
Parameters (%)	**TB**	**UB**	**SEM**	**LOS**
Dry matter	66.26[a]	61.94[b]	0.62	*
Organic matter	65.76[a]	61.66[b]	0.63	*
Crude protein	77.44[a]	74.87[b]	0.59	*
Crude fibre	81.49[a]	80.01[b]	0.45	*
Ether extract	66.07[a]	58.27[b]	1.38	*
Acid detergent fibre	74.79[b]	77.32[a]	0.64	*
Neutral detergent fibre	76.12	76.19	0.53	NS
Lignin	43.65[a]	37.70[b]	0.84	*

[a, b, c] =Means with different superscripts along the row differs significantly ($p<0.05$).
TB=urea treated bagasse, UB= untreated bagasse
SEM=standard error of means
LOS=level of significance

DISCUSSION

The increase in total weight gain and average daily gain for bucks fed bagasse with enzyme could be attributed to the presence of enzyme in the diets which could be as a result of improved forage/fibre digestion and nutrient utilization which translates to higher weight gains. Evelyn (2004) reveals that adding enzymes to feeds may create a slow releasing mechanism in which the enzyme is released into the rumen fluid as the feed is digested. The enzyme may also remain in the lower digestive tract thereby contributing to the ruminal digestion of fibre or they could indirectly increase nutrient absorption in the lower tract by reducing the viscosity of intestinal digesta (McAllister *et al*., 1999).

Bucks fed urea treated bagasse had higher feed intakes as there were little leftovers in their feed troughs. This high feed intake suggests that urea treatment may had influence on the palatability of the bagasse or it might be as result of the aroma resulting from the fermentation process as opposed to the untreated bagasse. The total weight gain and average daily gain for bucks fed urea treated bagasse was higher which could be as a result of increased intake of energy and an accompanying improvement in the utilization of non-protein nitrogen leading to better nutrient utilization. The result obtained in this study was higher compared to that of Okafor *et al*. (2012) who reported a weight gain and average daily gain of 4.30kg and 47.78g/d for bucks fed *Gmelina aborea* leaf at 50% level of inclusion but lower than that reported by Abdu *et al.* (2012) who fed urea treated maize stover diet with *Zizyphus mauritiana* leaf meal inclusion and reported total gain of 5.66kg and average daily gain of 67.38g/d.

Higher digestibility values for DM, ADF, NDF, and LIG obtained in this study can be explained as a result of direct fibre hydrolysis of the enzyme, enhanced microbial attachment, and complementary actions with ruminal enzymes. This agrees with previous studies that shown an increase on NDF and ADF with the use of exogenous enzymes (Feng *et al*., 1996; Lewis *et al*., 1996; Beauchemin *et al*., 1997). Kung *et al*. (2000) reported that treatment of feeds with enzymes prior to feeding can improve digestibility via a number of different mechanisms. Rode *et al*. (1999) found that exogenous enzymes significantly increased DM, OM, NDF, ADF, and CP digestibility in dairy cows.

Nutrient digestibility's of all parameters differs significantly between bucks fed urea treated bagasse and untreated bagasse. The higher digestibility values can be attributed to the urea treatment of the bagasse resulting in an increase in the activity of rumen microorganism for better digestion, this agrees with the findings of (Abdu, 1998) who reported an increase digestibility of urea treated sorghum stover. However the result of nutrient digestibility reported in this study are higher compared to the values when *Zizyphus mauritiana* leaf meal where at various inclusion level as also reported by Abdu *et al*. (2012).

CONCLUSION

From the above study, it was concluded that feeding bagasse with enzyme supplementation enhance the performance of Red Sokoto bucks (live weight gain 57.77g/d) also Treatment and supplementation with enzyme has effect on performance (live weight gain of 61.84g/d)

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