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IMPROVING GROWTH PERFORMANCE OF *YANKASA* RAMS FED CHEMICAL-TREATED GROUNDNUT SHELLS SUPPLEMENTED WITH EXOGENOUS ENZYMES

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ABSTRACT

This study evaluated the effect of chemical treated groundnut shells supplemented with xylanase and glucanase in rations of *Yankasa* rams on growth performance in Nigeria. It was carried out at the Small Ruminant Unit of Adamawa Sta\te University Teaching and Research Farm, Mubi. The study was designed in a 4×2 factorial arrangement with 4 rams per treatment in a completely randomised design. The experimental animals were housed in well ventilated environment and they were comfortable. Basic routine management were carried out. The experimental rations were formulated to meet the requirements of the rams. The experiment lasted for 90 days. Parameters under consideration were weight gain, feed intake and feed conversion ratio. Significant ($P<0.05$) and non-significant ($P>0.05$) effects were observed from the results obtained. The results show that rams receiving glucanase and untreated groundnut shells improved both weight gain (8.71 kg) and average daily weight gain (103.64 g/d); and increased both feed intake (65.79 kg) and average daily feed intake (783.20 g/d). However, feed conversion ratio was relatively least in the group of rams receiving urea treated groundnut shells (7.18) compared to other treatments. It was concluded that untreated and urea treated groundnut shells supplemented with glucanase could improve weight gain, feed intake and feed efficiency in *Yankasa* rams.

Keywords: Feed conversion ratio, feed intake, glucanase, lime, urea, weight gain, and xylanase

INTRODUCTION

Groundnut shells is one of the crop residues readily available at no cost especially in regions (Kano, Kaduna, Adamawa, Taraba, Benue, Bauchi, Jigawa, etc.) where groundnut is one of the major crops been cultivated. It has been found to contain a lot of fibre with less degradability in the rumen (Millam and Abdu, 2017), and low digestibility, therefore, it is usually considered as poor-quality crop residue (Wadhwa and Bakshi, 2013). In this region, groundnut shells emanate as the threshing by-product which usually has a disposal problem. The common methods of handling its disposal are mostly either by incineration or land dumping (FAO, 2005). However, burning will emit smoke and particulate matter which causes air pollution and greenhouse effects, while land dumping makes land unavailable for cultivation (Grandawa, 2014).

Transforming groundnut shells into a valuable feed ingredient or product would be a better method to utilize them, thereby solving the disposal problems faced by producers; and provide low cost and readily available feed resource (for feeding small ruminants) in communities where it is produced whilst removing the waste (Ozung *et al*., 2011). Even though groundnut shell is regarded as poor-quality feed material, the deficient nutrients can be alleviated through processing and supplementation. These can be done through physicochemical processing of the groundnut shell and exogenous fibrolytic enzyme supplementation (Abdel Hameed *et al*., 2013; Beauchemin *et al*., 2019).

Physicochemical processing of fibrous feed materials has been reported to enhance the quality of crop residues by improving its digestibility and boosting performance of animals as compared to the unprocessed material; by ensuring increased fermentable substrates in the rumen; and increased efficiency of nutrients in ruminants (Sarnklong *et al*., 2010). Furthermore, exogenous fibrolytic enzymes have been reported to be a more practical and capable additive for improving the nutritional value of crop residue by enhancing its dry matter digestibility; and increased feed efficiency in animals (Sujani and Seresinhe, 2015; Arriola *et al*., 2017). Therefore, the objective of this study was to evaluate the growth performance in *Yankasa* rams fed chemical treated groundnut shells supplemented with xylanase and glucanase.

MATERIALS AND METHODS

Description of Study Area

The study was conducted at the Small Ruminant Unit in Adamawa State University Teaching and Research Farm, Sahuda road, Mubi. The University is located between latitude 10°16.6'6.9" north of the equator and longitude 13°16'1.2" east Greenwich Meridian with 560 meters above sea level. The dry season of the area commences in November and ends in March, while the raining season begins from April and end in late October with mean annual rainfall of about 1050 mm. The relative humidity is extremely low (20-30%) between January and March but reaches a peak of about 80% in August and September. The maximum temperature can rise up to 40°C particularly in April while the minimum temperature is about 12°C between December and January (Weather Station, 2020).

Source and Processing of Groundnut Shells

The groundnut shells used in this study were obtained from a local farmer in Dirbishi Ward, Mubi South Local Government Area (LGA) of Adamawa State. The groundnut shells were milled using a local grinding machine to a size of 0.5 cm, then stored in bags until required for further use. The processed groundnut shells were treated with urea, lime and urea-lime at

five percent each (i.e., five grams urea dissolved in one litre of water to treat one kilogram of groundnut shells; five grams of lime dissolved in one litre of water to treat one kilogram of groundnut shells; and 2.5 grams of urea plus 2.5 grams of lime mixed together dissolved in one litre of water to treat one kilogram of groundnut shells respectively). The solution (either that of urea, lime or urea-lime) was uniformly sprayed on the milled groundnut shells and mixed thoroughly using a shovel on a clean concrete floor (Can *et al*., 2004). The treated groundnut shells were ensiled in airtight Perdue Improved Cowpea Storage (PICS) bags for a period of 21 days as described by Al-masri and Guenther (1999). Thereafter, the treated groundnut shells were spread on a polythene sheet to air-dry for seven days, bagged and stored before the commencement of the experiment. The other ingredients (maize offal, cotton seed meal, bone meal and salt) used for the experimental rations were obtained from *TIKE* livestock market, Mubi South LGA, Adamawa State. The enzymes (xylanase and Glucanase) were purchased from RONOZYME® Multi Grain (MG), DSM Nutritional Products Ltd, Switzerland: xylanase (Endo-1, 4-β-xylanase; EC 3.2.1.8) and glucanase (endo-1, 3 (4)-β-glucanase; EC 3.2.1.6 and endo-1, 4-β-glucanase; EC 3.2.1.4).

Ration Preparation and Proximate Composition

Eight rations were formulated using computer (least-cost ration formulation) to include the groundnut shells (untreated and treated), maize offal, cotton seed cake, bone meal and salt with the enzyme (Table 1). The formulation was made to meet the requirements of the rams. The enzymes were incorporated in the rations at same rate as recommended by the manufacturer (100 g per tonne). Each ration was thoroughly mixed at a time on a clean concrete floor using shovel, then bagged and kept safe for the experiment. A sample from each experimental ration was collected, and the proximate and cell wall compositions was determined using the procedures described by AOAC (2005) and Van Soest *et al*. (1991) respectively as shown in Table 2.

Ethical Approval

All research protocols and use of animals were approved by Adamawa State University Institutional Animal Care and Ethics Committee (ADSUIACEC/2020/006). It certifies that the procedures adhere to the International standards on animal use and practice.

Table 1: Gross composition of the experimental rations

Ingredients (kg)	Xylanase				Glucanase			
	UGNS	UTGNS	LTGNS	ULGNS	UGNS	UTGNS	LTGNS	ULGNS
Groundnut shells	40.00	40.00	40.00	40.00	40.00	40.00	40.00	40.00
Maize offal	32.50	48.00	46.10	55.00	32.50	48.00	46.10	55.00
CSC	25.50	10.00	11.90	3.00	25.50	10.00	11.90	3.00
Bone meal	1.50	1.50	1.50	1.50	1.50	1.50	1.50	1.50
Salt	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50
Xylanase	0.10	0.10	0.10	0.10	-	-	-	-
Glucanase	-	-	-	-	0.10	0.10	0.10	0.10
Total	100	100	100	100	100	100	100	100

UGNS: untreated groundnut shell, UTGNS: urea treated groundnut shell, LTGNS: lime treated groundnut shell, ULGNS: urea-lime treated groundnut shells, CSC: cotton seed cake

Table 2: Proximate composition (%) and fibre fractions (%) of the experimental rations

Parameters	Xylanase				Glucanase			
	UGNS	UTGNS	LTGNS	ULGNS	UGNS	UTGNS	LTGNS	ULGNS
ME (kcal/kg)	2915.43	3228.2	3268.59	3181.68	3057.61	3285.66	3049.61	3127.17
Dry matter	93.00	94.50	94.00	94.15	92.50	94.00	94.15	94.20
Crude protein	12.07	13.87	13.76	14.81	12.38	14.68	14.23	15.41
Crude fibre	5.45	5.50	5.50	5.50	6.60	6.70	6.70	6.90
Ether extract	5.50	6.50	7.00	6.50	6.00	7.50	3.00	4.00
Ash	13.00	7.00	6.00	8.00	8.00	5.00	6.00	5.00
Nitrogen free extract	56.98	61.64	61.74	59.35	59.53	60.13	64.23	62.89
NDF	51.71	55.02	53.00	55.00	54.75	52.70	55.00	55.05
ADF	43.30	43.40	42.25	41.25	40.27	40.72	40.15	40.96
Lignin	5.00	3.90	4.75	3.75	4.98	4.26	4.85	3.99

UGNS: untreated groundnut shell, UTGNS: urea treated groundnut shell, LTGNS: lime treated groundnut shell, ULGNS: urea-lime treated groundnut shells, CSC: cotton seed cake, ME: metabolizable energy, NDF: neutral detergent fibre, ADF: acid detergent fibre

Management of Experimental Animals

Thirty-two yearling (12-15 months) *Yankasa* rams with an average weight of 17 kg used for the study were purchased from the *TIKE* livestock market in Uba Town, Askira/Uba LGA, Borno State. Prior to the commencement of the experiment, the animals were ear-tagged (for identification). The rams were given prophylactic treatments, consisting of intramuscular injection of long-lasting antibiotics (Oxytetracycline LA®) and multivitamin at a dosage of 1 ml/10 kg body weight of the animals. They were drenched with one ml per 10 kg body weight of albendazole and treated against ecto-parasites with 0.5 ml per 10 kg body weight of ivermectin (Ivomec®). The rams were quarantined for four weeks. Adequate feed and clean fresh water were provided daily to the rams *ad libitum*.

Experimental Housing, Design and Data Collection

The experimental animals were housed in a well-ventilated, individual enclosure (1.5×1.5 m dimension) with corrugated iron roof, concrete floors and equipped with individual

feeders and water troughs. These stalls were washed properly and disinfected a week before the commencement of the feeding trial. Each ration was assigned randomly to a group of 4 rams in a 4×2 factorial arrangement in a Complete Randomised Design (CRD). The initial weights of the rams were taken at the beginning of the trial using the WeiHeng (WH-A series) potable electronic hanging scale (WH-A08). The subsequent weight of the rams were recorded fortnightly. Feed and clean fresh water was provided to the rams *ad libitum* throughout the period of the feeding trial which lasted for 90 days. Feed intakes were measured daily using kitchen electronic scale (WH-B05) while the feed-to-gain ratio were computed weekly until the end of the trial.

Statistical Analysis

The experimental data were analysed using the Generalised Linear Model procedure (PROC GLM) of SAS (2002). The effects of dietary treatments were tested at probability level of 95% ($P<0.05$) and significant difference among the treatment means were determined by Duncan Multiple Range Test.

RESULTS AND DISCUSSION

The means of the main effects and interaction of chemical treatment with enzyme supplementation in rations of *Yankasa* rams are presented in Table 3. It was observed that there was statistical ($P<0.05$) variation for all the growth parameters under consideration.

The supplementation of enzymes had non-significant ($P>0.05$) influence on the overall observed parameters measured for enzyme effect except final weight (FW) which recorded significant ($P<0.05$) difference. Higher significant ($P<0.05$) effect was observed in the group of animals receiving the glucanase enzyme for FW (25.73 kg). Although, no significant effects ($P>0.05$) were observed in most of the growth performance indicators regarding the enzyme effect, numerical improvements were recorded in the group of rams receiving rations containing glucanase for average daily weight gain (ADWG), average daily feed intake (ADFI) and feed conversion ratio (FCR). This is an indication that glucanase enzyme had a better enzyme activity over xylanase when fed along with chemical treated groundnut shells. The absence of statistical difference presented in this study is consistent with the study of (Mota *et al*., 2011), the authors reported that the supplementation of fibrolytic enzyme in the rations of finishing lambs were not affected by the treatment. In another study (Beauchemin *et al*., 1995; 1999), the authors reported that there was significant improvement in average daily gain and feed efficiency in growing beef cattle by adding enzyme product containing xylanase and cellulase to alfalfa hay with concentrate of up 30%. Improvement in the ADWG by glucanase addition may probably be due to improvement in the nutrient digestibility of the ration which reflects on improving the feed efficiency (Salem *et al*., 2011). Improved ADWG in the rams could also be explained by increase in nutrient availability to the animals for deposition and growth (Lewis *et al*., 1999).

Table 3: Growth performance in *Yankasa* rams fed experimental rations

Parameters (kg)	Initial weight	Final weight	Weight gain	ADWG (g)	TFI	ADFI (g)	FCR
Enzyme effect							
Xylanase (X)	17.68	23.11^{b}	5.43	64.70	50.31	598.96	9.83
Glucanase (G)	19.38	25.73^{a}	6.35	75.58	54.61	650.10	9.72
SEM	0.78^{NS}	0.82	0.50^{NS}	5.98^{NS}	2.57^{NS}	30.60^{NS}	0.91^{NS}
Chemical treatment effect							
UGNS	18.34	24.80	6.47	76.98	62.12^{a}	739.49^{a}	10.79^{b}
UTGNS	17.40	23.64	6.23	74.21	48.01^{b}	571.52^{b}	8.07^{a}
LTGNS	19.93	25.60	5.67	67.44	51.70^{b}	615.49^{b}	9.70^{ab}
ULGNS	18.44	23.65	5.20	61.93	48.02^{b}	571.62^{b}	10.54^{ab}
SEM	1.10^{NS}	1.16^{NS}	0.71^{NS}	8.45^{NS}	3.63	43.27	1.29
Interactions							
UGNS × X	18.08	22.30^{bc}	4.23^{d}	50.32^{d}	58.45^{ab}	695.78^{ab}	13.89^{c}
UTGNS × X	17.04	22.32^{bc}	5.28^{cd}	62.87^{cd}	44.26^{c}	526.90^{c}	8.96^{ab}
LTGNS × X	20.44	27.02^{a}	6.58^{bc}	78.37^{bc}	55.55^{b}	661.33^{b}	8.84^{ab}
ULGNS × X	15.17	20.82^{c}	5.65^{c}	67.24^{c}	42.99^{c}	511.81^{c}	7.64^{a}
UGNS × G	18.60	27.30^{a}	8.71^{a}	103.64^{a}	65.79^{a}	783.20^{a}	7.68^{a}
UTGNS × G	17.76	24.95^{ab}	7.19^{b}	85.56^{b}	51.76^{bc}	616.15^{bc}	7.18^{a}
LTGNS × G	19.43	24.18^{b}	4.75^{cd}	56.51^{cd}	47.85^{bc}	569.65^{bc}	10.57^{b}
ULGNS × G	21.72	26.47^{ab}	4.76^{cd}	56.63^{cd}	53.04^{bc}	631.43^{bc}	13.43^{c}
SEM	1.13^{NS}	1.19	0.63	7.50	4.63	55.17	1.18

^{abcd} Mean values with different superscript on same column are significantly ($P<0.05$) different, UGNS: untreated groundnut shells, UTGNS: urea treated groundnut shells, LTGNS: lime treated groundnut shells, ULGNS: urea-lime treated groundnut shells, ADWG: average daily weight gain, TFI: total feed intake, ADFI: average daily feed intake, FCR: feed conversion ratio, SEM: standard error of means

Elam *et al*. (2003) also expressed that enzyme supplementation have shown to improve FCR and ADWG of feedlot cattle.

Concerning the chemical effect, non-significant effect ($P>0.05$) was recorded in FW, weight gain (WG) and average daily weight gain (ADWG) while other parameters were significantly ($P<0.05$) different. Higher ($P<0.05$) values (62.12 and 739.49 kg) were recorded in the group receiving the UGNS for total feed intake (TFI) and ADFI respectively. Significantly ($P<0.05$) higher feed intake recorded in the group of *Yankasa* rams fed UGNS may be a reflection of greater palatability and lower retention time of the ration in

the rumen aided by highly fermentable concentrates that postulates increased intake (Jiwuba *et al*., 2016). It was reported that untreated groundnut shell increased the intake of *Yankasa* rams which was in consistence with the present findings (Millam *et al*., 2017). Yulistiani *et al*. (2015) studied chemical treatment of crop residues and documented that when crop residues are treated with urea and fed to sheep, it did not increase feed intake. Meanwhile, Sarnklong *et al*. (2010) and Abdel Hameed *et al*. (2013) reported that chemical treatment of groundnut shells increased feed intake when fed to sheep, which contradicts the results of this study. The least (P<0.05) FCR (8.07) was observed in the group receiving the UTGNS. This improvement indicates that rams receiving rations containing UTGNS were more efficient in converting feed to live weight gain better than the animals fed other rations. The observed result for FCR in UTGNS was consistence with the findings of Nayawo *et al*. (2017) that increased FCR in *Yankasa* rams fed 60% urea treated rice straw.

Significant (P<0.05) influence was observed on the overall parameters measured for the interaction of both chemical treatment and enzymes supplementation. Higher significant (P<0.05) values were seen in the group of animals receiving xylanase-LTGNS (27.02 kg) and glucanase-UGNS (27.30 kg) for FW. The group of rams receiving glucanase-UGNS recorded the higher values significantly (P<0.05) for WG, (8.71 kg) and ADWG, (103.64 g). Significant (P<0.05) increase in the weight gain observed with the group of rams receiving glucanase-UGNS in the present study may be as a result of the differences in the levels of concentrates used in the ration formulation (Azizi *et al*., 2017; Yahya *et al*., 2020). Similarly, the increased in weight gain also corresponds with the increase in feed intake of rams in same group, since the body weight changes of animals greatly depends on optimising feed intake (Jiwuba *et al*., 2016; Azizi *et al*., 2017). The improvement in body weight might also be attributed to the degradation of fibre content, NDF (Sujani and Seresinhe, 2015). Beauchemin *et al.* (2003) and Millam *et al*. (2020) reported that feed substances especially ones that undergo chemical treatment especially with exogenous enzyme supplementation could perform better than those without when feed intake and weight gain are considered. These reports was in conflict with the result on WG obtained in this study.

The group of rams receiving glucanase-UGNS also recorded higher values significantly (P<0.05) for TFI (65.79 kg) and ADFI (783.20 g). The observed increase in the feed intake could be explained as the high crude fibre in the ration which limits energy access and the non-structural polysaccharides present within the cell wall, when in contacts with water, forms a gel that reduces passage time and absorption of nutrients and thus, increases feed consumption to compensate and meet nutritional demands (Anuradha and Roy, 2015). Likewise, the increase in the intake of the untreated group may be due to increased palatability of the ration due to soluble sugars released by post-ingestive enzyme effect, such as increased digestion rate or extent of degradation resulting from increased hydrolytic activity in the rumen to reduce gut fill and enhance feed intake (Alsersy *et al*., 2015; Salem *et al*., 2015). Bhasker *et al*. (2013), Torres *et al*. (2013) and Almaraz *et al*. (2016) reported that the supplementation of exogenous enzyme in the ration of sheep failed to improve the feed intake, which was does not concur with the present study. In another study, Sujani and Seresinhe (2015) and Beauchemin *et al*. (2019) reported significant changes in the intake of sheep when fibrolytic enzymes was supplemented with grasses.

The group of rams receiving xylanase-ULGNS (7.64), glucanase-UGNS (7.68) and glucanase-UTGNS-glucanase (7.18) were observed to have the least (P<0.05) FCR compared to other treatments. Though, the group of rams receiving xylanase-ULGNS, glucanase-UGNS and glucanase-UTGNS are statistically same for FCR, there was a relatively least significant improvement in the group of rams receiving glucanase-UTGNS. This might be attributed to the supplementation of enzyme along with urea treatment which was effective in the supplying a better feed utilization and it is an indication of better meat production. Meanwhile, Miller *et al*. (2008) and Almaraz *et al*. (2016) reported no significant differences in growth performance with enzyme supplementation, which was in conflict with the results of this study. Some factors which influence FCR among others includes, breed, age, sex of animals as well as nutrition and environment (Jiwuba *et al*., 2016).

CONCLUSION

The study revealed that untreated groundnut shells along with glucanase supplementation in rations of *Yankasa* rams improve weight gain and feed intake. Urea treatment of groundnut shells along with glucanase supplementation relatively improve feed efficiency. Therefore, it can be concluded that either untreated or urea treated groundnut shells with glucanase supplementation could improve the growth performance of yearling *Yankasa* rams when weight gain, feed intake and feed efficiency are considered.

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