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PERFORMANCE OF WEST AFRICAN DWARF RAMS FED UNTREATED AND ALKALI TREATED BUSH FOGGAGE

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Abstract

A seventy (70) day feeding study was conducted to assess the nutritive value of untreated and alkali treated bush foggage (Panicum maximum standing hay) in West African Dwarf rams diets. Silage of bush foggage treated with lye, calcium hydroxide and urea solutions were prepared and allowed to stand for thirty (30) days. Four diets were prepared as follow; A (untreated-bush foggage), B: (Lye-treated bush foggage), C: (1% Calcium hydroxide-treated bush foggage) and D: (5% Urea-treated bush foggage) Twenty West African Dwarf rams that weighed 24.40 ±1.02 kg and aged 24-30 months were selected from the flock of small ruminant unit of the Teaching and Research farm, Federal University of Technology, Akure. The rams were divided into four groups of five (5) rams per group and fed the diets for 70 days in a Completely Randomized Design experiment. Chemical composition of untreated and alkali treated bush foggage diets revealed that all nutrients determined were significantly (P<0.05) influenced by the treatment except cellulose and energy. Dry matter ranged from 73.52 (diet C) to 84.08 % (diet A) while crude proteins of diets B, C and D were improved due to alkali treatment and fermentation. The highest crude protein (12.86 %) was obtained in urea treated bush foggage. The least energy content (15.32 KJ/100g DM) was obtained in untreated bush foggage. The fibre fraction decreased with alkali treatment and fermentation when compared to value obtained in the untreated bush foggage. The results of nutrients intake revealed significant (P<0.05) influence by the treatment, dry matter intake ranged from 523.30 to 723 g/day. Crude protein intake increased with alkali treated bush foggage, the rams fed diet D had the highest crude protein intake. Apparent digestibility coefficient of nutrients was significantly (P<0.05) influenced by the treatment, the rams fed diet D digested their feed better compared to other rams. Rams fed urea-treated bush foggage had the highest nitrogen balance (11.35g/day), weight gain (16.43 g/day) and converted their feed (44.04) to flesh better compared to rams fed untreated bush foggage. The results indicated that alkali treatment improved the nutritive value of poor quality bush foggage and could therefore support the small ruminants' performance.

Key words:- *Alkali solution, bush foggage, nitrogen balance, performance, rams*

Introduction

The most complex and limiting production factor for tropical and semi-tropical cattle, sheep and goats are those concerning nutrition, feed cost and supplies. In most developing countries such as Nigeria, the availability and supplies of feed for livestock production have been the greatest constraints to the expansion of the industry (Adewumi 1992)**.** The feed energy for ruminant animals is provided mainly by natural pastures which are generally unable to meet nutrients requirement for production.

The seasonality of production of most pasture species and inadequate supplies of grasses also limit the productive capacity of resident herds. While nutrient contents may be optimum during the wet season (Babayemi *et al.,* 2000), most pasture species become fibrous and less nutritive during the dry season, therefore making the nutrients of the so called poor quality grass hay unavailable and nonnutritive for animal consumption (Fajemisin *et al.,* 2014).

Feeding cost also accounts for approximately 65% of the total cost of intensive animal production **(**Akpodiete and Inoni, (2000)**,** especially when grains, notably the cereal grains are used in mixed feeds for livestock feeding. This cost has made nutritional requirement at reasonable cost more difficult to achieve especially with the lack of improvement in crop yields. In both North and South, particularly the former where the vast majority of Nigeria livestock are reared, sheep and goats live on these coarse, poor and nonnutritive grasses and shrubs during the dry season (Babayemi *et al.,* 2000)**.** During the period of feed scarcity and dry season, the animals undergo malnutrition, often near starvation level and have to make use of body reserves to subsist resulting in seasonal loss in weight, haggard conformation, slow rate of growth and low milk yield that have to be made up in the coming raining season.

The improved performance of these rams can only be achieved through improvement in their feeding and

management. It is imperative therefore, to find new and cheaper sources of feed supply by improving the feeding value of existing poor quality cellulosic grasses and roughages from farm wastes and increasing the number of readily acceptable feeding ingredients. High efficient utilization of poor-quality roughages could be achieved in sheep, goats and cattle by application of simple treatments and or supplementation (Fadiyimu *et al.,* 2010).

However, chemical treatment through the use of alkali has been shown to improve digestibility of poor-quality roughages appreciably (Adebowale *et al.,* 1991) and increase voluntary intake (Nakashima and Orskov, 1990). Therefore, the purpose of this study is to evaluate the performance of WAD rams fed untreated and alkali treated bush foggage (*Panicum maximum* standing hay).

Materials and Methods

Experimental Site

The experiment was conducted at the Teaching and Research Farm and Nutrition laboratory of the Department of Animal Production and Health, Federal University of Technology, Akure, Nigeria. The area is located in the rainforest zone of Nigeria between latitude 7^0 18'N and longitude 5^0 10'E with 1500mm to 2378mm annual rainfall.

Materials Collection and Processing

Harvesting of Bush Foggage (*panicum Maximum* Standing Hay) and Procurement of Silage Plastic Drums

Bush foggage (standing hay of *Panicum maximum*) was harvested at 5 months old at the Teaching and Research Farm of the Federal University of Technology, Akure, air-dried for 24 hours and chopped manually with cutlass into small bits (3-6cm) for silage preparation. The plastic drums (120 litre capacity) and polythene sheets were procured at Oba Adesida market Akure.

Alkali Solutions Preparation

Lye solution was prepared by dissolving saw-dust ash collected from nearby sawmill industry in Akure City, Ondo State, Nigeria in a ratio of two parts of saw-dust ash to three parts of water (w/w). The mixture was thoroughly stirred and allowed to settle overnight and decanted. The 5% Urea solution was prepared by dissolving five (5) kilogram urea fertilizer in 100 litres of water (w/v) and one percent calcium hydroxide [1% $Ca(OH)_2$] solution was prepared by dissolving one gram of calcium hydroxide in 100 litres of water (w/v).

Silage Preparation

The lye-solution-treated bush foggage was prepared by packing the grass into a jute bag and soaking the bag and its content in the decanted lye solution until properly soaked. The bag was then removed, squeezed off most of the excess solution and the content was transferred into silage plastic drums (120 litre capacity) lined with polythene sheets. The materials were properly compressed in order to exclude as much air space as possible, covered with polythene sheets and pressed down with about 15cm of earth and allowed to ensile for thirty (30) days. The diets C and D were prepared in a similar manner as the diet B except that one percent calcium hydroxide [1% $Ca(OH)_2$] and five percent urea (5% Urea) solutions were used in place of lye solution. Four diets made of untreated and alkali treated bush foggage were prepared as follow:

Treatment A: Bush foggage (Control diet)
Treatment B**:** Lye solution treated bush foggage
Treatment C**:** 1% Calcium hydroxide solution treated bush foggage
Treatment D: 5% Urea solution treated bush foggage.

Animal Procurement and Management

Twenty (20) West African Dwarf rams with initial mean live weight of 24.40 ±1.02 kg and of between 12-15 months old were selected from the flock of the Teaching and Research Farm, Federal University of Technology, Akure Ondo State, Nigeria. The rams were dewormed and routinely treated against ecto and endoparasite. The rams were randomly divided into four groups (five rams per group) allotted to the test diets in a Completely Randomized Design and the feeding trial lasted for seventy (70) days excluding thirty days of adaptation.

The rams were offered the untreated and alkali treated bush foggage at rate of 3.5% per body weight in their individual pens. Rams were fed thrice daily at 8.00hr and 12.00hr and 17.00hr every day. Fresh water was made available and *ad libitum* everyday. Every morning 50g of each diet (in duplicate) was taken after thorough mixing as representative samples, dried and kept for proximate analysis. Remnants of the feeds were collected, weighed and deducted from the feed offered to determine the feed intake per day per ram. Rams were weighed weekly to determine changes in live weight gain.

During the last two weeks of the experimental period, rams were transferred into metabolic cages to determine faecal and urine output. Each ram was placed in the modified cages to facilitate total and separate collection of faeces and urine (Akinsoyinu, 1974).

Faecal and Urine Samples Collection

Data on faeces and urine output were collected for seven days. Ten (10%) percent of aliquot samples of

faeces and urine were retained for chemical analysis. Samples of the collected faeces were bulked and milled with a laboratory Christy and Morris Hammer milling machine, stored in air-tight sample bottles. The urine samples were kept in plastic bottles containing 2-3mls of concentrated sulphuric acid (H_2SO_4) to forestall microbial contamination and stored in cold refrigerator (-5°C) in the laboratory till required for chemical analysis.

Chemical Analysis

The chemical compositions of feeds (diets) and faecal samples were determined by standard methods of AOAC (2000). Neutral Detergent Fibre (NDF), Acid Detergent Fibre (ADF) and Acid Detergent Lignin (ADL) were determined using methods of Van-Soest *et al.* (1991). Hemicellulose and cellulose were determined by calculation.

Experimental Design, Calculation and Statistical Analysis

Experimental layout was a Completely Randomized Design. Gross energy was calculated using method of Ekenayake *et al* (1999). Data were analyzed using the General linear model of SAS (1995) and significant treatment differences between means were compared using Duncan's (1955) multiple range and multiple F-tests.

Results and Discussion

The chemical composition of the lye, 1% $Ca(OH)_2$ and 5% urea solutions treated bush foggage on dry matter basis are presented in Table 1. The results of chemical composition of untreated and alkali treated bush foggage revealed that the diets were significantly ($P<0.05$) influenced by alkali treatment and fermentation with the exception of cellulose and gross energy.

The dry matter ranged between 73.52 (diet C) and 84.08% (diet A), the high dry matter content of diet A might be attributed to low moisture content, coarse texture and lignifications. The crude protein (5.24%) of the untreated bush foggage diet was significantly ($P<0.05$) lower compared to [CP] observed in the alkali treated foggage diets and was also compared to the value reported by Fajemisin *et al,* (2014) when West African Dwarf goats were fed *Panicum maximum* supplemented with ensiled ammoniated *Cajanus cajan* haulms. The lower CP of the untreated bush foggage diet could be as a consequence of the age and the time of harvest which was at the mid-period of dry season in Nigeria. The high CF contents might be an indicator of poor quality of the bush foggage (standing hay of *Panicum maximum*). The gross energy ranged between 15.32 (diet A) and 15.79 KJ/100gDM (diet D), this observation might be attributed to improved soluble carbohydrate contents in the alkali treated bush foggage.

Table 1: Chemical composition of untreated and alkali treated bush foggage diets fed to West African Dwarf rams

Parameters	Diets				SEM
	A	B	C	D	
Dry matter	84.08^{a}	75.33^{b}	73.52^{b}	74.67^{b}	1.37
Crude protein	5.24^{d}	8.16^{c}	10.78^{b}	12.86^{a}	0.90
Crude fibre	34.73^{a}	25.32^{b}	19.45^{c}	17.55^{c}	2.07
Ash	11.70^{a}	7.90^{b}	7.75^{b}	7.46^{b}	0.54
Ether extract	1.90^{a}	1.50^{ab}	1.40^{b}	1.56^{ab}	0.08
Nitrogen free extract	47.43^{c}	57.12^{b}	60.62^{a}	60.57^{a}	1.68
Neutral Detergent Fibre	63.56^{a}	57.45^{b}	54.87^{bc}	52.63^{c}	1.31
Acid Detergent Fibre	50.81^{a}	44.76^{b}	43.95^{b}	42.79^{c}	0.95
Acid Detergent Lignin	31.45^{a}	27.61^{ab}	27.34a^{b}	26.67^{b}	0.78
Hemicelulose	12.75^{a}	12.69^{a}	10.92^{b}	9.84^{b}	0.41
Cellulose	19.36	17.15	16.61	16.12	0.70
Gross energy (KJ/100g DM)	15.32	15.70	15.70	15.79	0.44

abcd=Means within the same row but with different superscripts are significantly($P<0.05$) different

The treatment effect on the crude fibre was significant ($P<0.05$) but the observed reduced CF content in treatments B, C and D could be due to the breakdown of fibre bonds during ensiling (Adewumi 1992) or alkali effect of lye, 1% $Ca(OH)_2$ and 5% urea solutions as delignifying agents on the bonds that linked the cellulose units together. The high values of DM (84.08%), CF (34.73%), NDF (63.56%), ADF (50.81%), hemicelluloses (12.75%) and lignin (31.45%) in the untreated bush foggage diet were indications of complete lignifications with its resultant effects on the reduction of other nutrients present in the bush foggage.

The obtained result of nutrients intake in Table 2 showed that the nutrient intake was improved by alkali treatment, fermentation, improved protein quality and reduced crude fibre contents of diets B, C and D. The improvement of nutrients intake might be due to chemical changes as a result of fermentation (Nakashima and Orskov, 1990), delignification and production of butyric acid smell with golden brown colour (McDonald *et al.,* 1995) that increased acceptability, palatability and feed intake by the rams.

Table 2: Daily nutrient intake (g/day) of the West African Dwarf rams fed untreated and alkali-treated bushfoggage diets

Parameters	Diets				SEM
	A	B	C	D	
Dry matter	523.30^{c}	689.87^{b}	680.27^{b}	723.65^{a}	23.38
Crude protein	27.42^{d}	56.29^{c}	73.33^{b}	93.06^{a}	7.29
Crude fibre	181.74^{a}	174.68^{b}	132.31^{c}	127.00^{d}	7.39
Ether extract	9.94^{ab}	10.35^{ab}	9.52^{c}	11.29^{a}	0.28
Ash	61.23^{a}	54.34^{b}	52.72^{b}	53.98^{b}	1.51
Nitrogen free extract	248.20^{c}	414.75^{b}	412.38^{b}	438.31^{a}	22.91
Neutral detergent fibre	332.61^{c}	396.33^{a}	373.26^{b}	388.09^{a}	7.61
Acid detergent fibre	265.89^{b}	308.79^{a}	298.98^{a}	309.64^{a}	5.64
Acid detergent lignin	164.58^{b}	180.06^{a}	185.99^{a}	192.99^{a}	4.04
Hemicellulose	66.72^{c}	87.54^{a}	74.29^{b}	71.21^{b}	2.39
Cellulose	101.31^{d}	118.31^{a}	112.99^{b}	116.65^{a}	2.04
Energy KJ	80.16^{b}	108.31^{a}	106.80^{a}	114.26^{a}	4.16

a,b,c,d=Means within the same row but with different superscripts are significantly($P<0.05$) different.

The dry matter intake ranged from 523.30 (diet A) to 723.65 g/day while the least crude protein (27.42 g/day) intake was obtained in rams fed diet A. The significant ($P<0.05$) differences in crude protein (CP) intake was probably due to delignification of crude fibre that led to release of the nutrients locked up in the cell walls of the ensiled bush foggage (Akin, 1988). The low protein intake (27.42g/day) observed in this study agreed with values reported by Adebowale (1985a) when small ruminants were fed straws treated with palm bunch ash, cocoa pod ash and sodium hydroxide solutions.

The least intake of ether extract (9.52g/day) by rams fed diet C might be due to the effect of saponification action of calcium hydroxide on the lipid contents of the bush foggage. However, it has been generally demonstrated that calcium hydroxide, ammonium and sodium hydroxide (saw-dust ash solution) treatment improved voluntary intake (Zorilla-Rio *et al.,* 1989; Adewumi, 1992).

The performance of WAD rams fed untreated bush foggage and alkali treated bush foggage in Table 3 indicated that there were significant ($P<0.05$) differences in the observed apparent digestibility coefficient of all the nutrients. The values increased with alkali treated bush foggage compared to the values of digested contents of untreated bush foggage. This was supported by Kerley *et al.* (1985) that reported improved ADF, NDF and cellulose digestibility for lambs fed diets containing about 72% treated wheat straw than for lambs fed untreated straw. Adebowale (1985b) also reported that when sheep and goats were fed ash and sodium hydroxide-treated maize straw, the apparent digestibility coefficient of nutrients (CP and CF) was increased significantly.

Table 3: Nutrient digestibility(g/100g) of the West African Dwarf rams fed untreated and alkali-treated bush foggage diets

Nutrients	Diets				SEM
	A	B	C	D	
Dry matter	53.59^{c}	63.76^{b}	66.56^{b}	76.87^{a}	2.54
Crude protein	55.76^{d}	61.95^{c}	67.84^{b}	73.21^{a}	1.98
Crude fibre	56.24^{c}	61.33^{b}	75.58^{a}	75.76^{a}	2.62
Ether extract	55.67^{b}	63.67^{ab}	70.21^{a}	72.45^{a}	2.34
Nitrogen free extract	56.22^{c}	63.67^{b}	66.12^{b}	71.56^{a}	1.72
Neutral detergent fibre	50.27^{d}	62.51^{b}	60.14^{c}	68.91^{a}	2.03
Acid detergent fibre	58.95^{b}	68.37^{a}	68.34^{a}	70.14^{a}	1.37
Acid detergent lignin	55.48^{c}	63.96^{b}	64.82^{b}	69.35^{a}	1.52
Hemicellulose	54.57^{c}	62.61^{b}	61.79^{b}	66.43^{a}	1.36
Cellulose	57.34^{c}	66.23^{b}	67.66^{ab}	69.58^{a}	1.47
Energy	58.43^{c}	65.19^{b}	68.45^{a}	68.94^{a}	1.32

a, b, c, d = Means within the same row but with different superscripts are significantly(P<0.05) different

The daily weight gain of rams fed lye, calcium hydroxide and urea solutions treated bush foggage increased (P<0.05) significantly compared to the rams fed untreated bush foggage (Table 4). Mirgain (1987) also reported significant (P<0.05) increased average daily weight gain of goats fed sodium hydroxide treated desert grass. The nitrogen voluntary intake of rams fed alkali treated bush foggage improved significantly (P<0.05), while the nitrogen balance values ranged from 3.85 (diet A) to 11.35 g/day (diet D). Similar observation was reported by Zorrilla-Rio *et al.* (1989) for sheep fed ammoniated straw.

The feed to gain ratio of the rams fed untreated and alkali treated bush foggage differed significantly (P<0.05). The values obtained decreased with the treatments, the values ranged between 44.04 and 89.30 however, the rams fed diet D (44.04) converted their feed to flesh better compared to the rams fed untreated bush foggage. The obtained results in respect of nutrients intake, weight gain and nitrogen balance revealed that alkali solution could improve the nutritive value of poor quality bush foggage (*Panicum maximum)* and make available the nutrients in the bush foggage to support small ruminants' growth and production.

Table 4: Nitrogen utilization, weight gain and feed to gain ratioof the West African Dwarf rams fed untreated and alkali-treated bush foggage diets

Nutrients	Diets				SEM
	A	B	C	D	
Nitrogen intake (g/day)	4.39^{c}	9.01^{b}	11.73^{ab}	14.89^{a}	1.24
Faecal nitrogen (g/day)	0.38^{c}	1.86^{b}	1.77^{b}	2.65^{a}	0.25
Urinary nitrogen (g/day)	0.16^{d}	0.79^{c}	0.98^{a}	0.89^{b}	0.10
Nitrogen balance (g/day)	3.85^{d}	6.56^{c}	8.98^{b}	11.35^{a}	0.85
Initial liveweight (kg)	24.40	24.39	24.41	24.40	0.34
Final liveweight (kg)	24.81	25.13	25.24	25.55	0.31
Weight gain (kg)	0.41^{b}	0.74^{ab}	0.83^{ab}	1.15^{a}	0.10
Daily weight gain(g/day)	5.86^{c}	10.57^{b}	11.86^{b}	16.43^{a}	1.89
Feed gain ratio	89.30^{a}	65.27^{b}	57.36^{c}	44.04^{d}	4.97

a,b,c,d=Means within the same row with different superscripts are significantly(P<0.05) different

Conclusion

The cheaper the feed source without sacrificing the quality, the better the return to the farmer. It was concluded that lye, calcium hydroxide and urea solutions to some extent enhanced the quality of the fibrous grass hay (bush foggage), improved supply of adequate required protein and energy that supported the weight gain and feed to gain ratio of the rams.

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