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The Effects of Sawdust/poultry Litter and *Brachiaria ruziziensis* Silages on the Performance of West Africa Dwarf Goats

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ABSTRACT

This study was carried out in order to determine the effect of three test rations comprising *Brachiaria ruziziensis* grass silage and sawdust/poultry litter silage which replaced some conventional feed ingredients (wheat offal, soya bean cake and maize offal) at varying levels in the diets of goats. Twelve young West African dwarf does with mean ages and weights of 6±0.17 months and 4.2±0.44 kg, respectively, randomly divided into three groups of four replicates were used for the study which lasted for forty-five days. The animals were fed three test rations with sawdust/poultry litter silage replacing 50% (Diet 1), 25% (Diet 2) and 0% (Diet 3 or Control. In addition, all groups received *Brachiaria ruziziensis* grass silage at 5% inclusion level. Parameters measured include Production attributes, Haematology and serum biochemistry. Results showed that the haematological and serum biochemical parameters showed no significant differences ($p>0.05$) among groups. However, significant differences ($p>0.05$) existed in the production attributes with respect to mean final gain, mean daily gain, mean daily intake, mean total feed intake and apparent protein digestibility, feed conversion efficiency, but not in their rumen motility. Cost of production was significantly ($p<0.05$) lowest in diet 1 compared to diets 2 and 3, respectively. It was observed that sawdust/poultry litter silage was most beneficial at 25% inclusion level as animals fed this diet had significantly higher weight gain and better feed conversion efficiency compared to those of 50% and Control groups.

Key words: Diets, haematology, production attribute, serum biochemistry, inclusion level

INTRODUCTION

The importance of goats in the livestock industry cannot be over-emphasized as they play a vital role in the socio-economic structure of the rural poor (Pal *et al.*, 2011).

Meat goat production is gaining an increasing economic importance as well as the generation of interest, particularly so as small ruminant production in the Tropics has been noted to have high potentials for optimum profit making (Koc and Ceylan, 2009). More so, people in the rural population depend on these animals for meat and milk production (Kioumarsi *et al.*, 2008; Ajala *et al.*, 2008; Norris *et al.*, 2011). Small ruminants have been noted to play important role in animal protein production since they have the ability to convert the vegetation of marginal ecosystems to useful products (Banerjee *et al.*, 2009). There is also a generation of interest, especially in ecological and vegetation control in some parts of the world using small ruminants (Coffey, 2006).

However, a greater percentage of goat population is found within the developing countries where they are faced with problems of diseases (Munir *et al.*, 2008; Al-Qudah *et al.*, 2008). In the rural Africa, ruminants are faced with poor nutrition (Ravhuhali *et al.*, 2011), and this occurs because during the dry season, animals suffer periods of starvation as a result of scarcity and reduction in the nutrient content of forages (Nwaigwe *et al.*, 2007). At such periods, most available ruminant feedstuffs become fibrous and have low digestibility, leading to poor livestock production (Mubi *et al.*, 2008; Asaolu *et al.*, 2011).

Consequently, this study reports on the effect of conversion and use of waste materials, such as sawdust and poultry litter, for the production of ruminant feed, replacing some expensive conventional feed materials.

MATERIALS AND METHODS

The experiment was carried out in the Department of Animal Health and Production, Faculty of Vet Medicine, University of Nigeria Nsukka and was completed in August, 2010.

Experiment design: A total of twelve West African dwarfs does used for the study were purchased from Orie-Orba, a local market near the University. The means of their ages and weights were 6±0.17 months and 4.2±0.44 kg, respectively. They were sheltered in a climatic house in the above department, where they went through an equilibration period of two weeks, during which the animals were vaccinated against botulism, dewormed and treated with antibiotics to prevent secondary bacterial infection. At the end of the equilibration period, the twelve animals were randomly divided into three groups and each group was replicated four times. Each group represented the inclusion level of sawdust/poultry litter silage (SPLS) in the ration; Group 1 (50%), Group 2 (25%) and Group 3 (0% or the Control group).

Grass silage preparation: The materials used for silage preparation include sawdust, dry poultry litter, *Brachiaria ruziziensis* grass and maize offal. Fifty kilograms of *B. ruziziensis* was obtained from the Faculty of Agriculture Demonstration Farm of the University. The grasses were wilted for 24 h, chopped manually (6-12 cm) and compressed into impervious polyethene bags to expel as much air as possible. The bags were tightly closed with twine, after which a Bunsen slit was made at the base of the bags. The grass was then ensiled in a trench silo and covered with earth for a period of 21 days (Nwaigwe *et al.*, 2007).

Preparation of sawdust/poultry litter silage (SPLS): Fifty kilogram of sawdust used for the work was sourced from Nsukka Wood market from woods which the millers confirmed to be free of chemical wood preservatives. The sawdust was mixed with 50 kg of previously dried poultry litter, which was collected from intensively reared laying birds in the Faculty of Veterinary Medicine Farm. The sawdust and poultry litter were mixed in the ratio of 1:1 with 25 L of water while 20 kg of fresh poultry litter was added to the mixture to form starter inoculant for fermentation. This mixture was divided into two in order to accommodate specific quantities of maize offal (43 and 56% in diets I and 2, respectively). Prior to ensiling portions of the mixture were removed for the pH and chemical analysis. The bags were ensiled as in grass silage above.

Experimental diets: Diets 1 and 2 were formulated such that SPLS replaced some fractions of the conventional feed ingredients (wheat offal and Soya bean cake) at 50, 25% inclusion levels while Diet 3 was formulated as a normal concentrate feed using Soya bean and wheat offal, without the inclusion of SPLS (0%). *B. ruziziensis* grass silage was added to the three diets at 5% inclusion level. The diets and ingredients were analysed for proximate fractions using the method of AOAC (1990).

Digestibility studies: The trial lasted for a period of fourteen days during which the three groups were given their respective diets and water *ad lib* for the first five days so as to remove residues of the previous feed completely and also to determine their maximum daily feed consumption. Based on this determination, the animals were then fed the test diets at the level of 90% of *ad lib* (0.4 kg/head/day) each day between 8.00 and 9.00 am daily after which they were tethered for grazing. The animals were housed in individual metabolism cages with facilities for separate collection of faeces and urine. The animals were weighed at the beginning and end of the study. Samples of faeces were collected each morning just before feeding while 10% of the daily faecal output from each group was collected and preserved with 10% formalin for chemical analyses. Samples of the individual feed ingredients were also analysed in the laboratory so as to determine their proximate fractions.

Haematology and serum biochemistry: A total of 10 mL of blood was collected through the external jugular vein of the goats for analyses and 7 mL of the blood samples was deposited in plastic tubes without anticoagulant which was allowed to cloth within a few hours of collection to produce serum used for biochemical analysis. The remaining 3 mL was put into plastic tubes containing EDTA for haematological studies. Enumeration of total erythrocytes and total leukocytes were determined with the aid of Neubaur counting chamber (Haemocytometer) (Coles, 1986). Serum Glutamate Pyruvate Transaminase (SGPT), Serum glutamate oxaloacetate transaminase (SGPT) and Alkaline phosphatase (ALP) were analysed spectrophotometrically by using commercially available diagnostic kits (RANDOX® Test kits).

Rumen motility: The ruminal movements which were recorded per minute were obtained by gently pushing finger tips against the left rumen wall between the last rib and the hip joint, around the sub-lumbar fossa (Kinne, 2005).

Statistical analysis and calculations: Data collected from the study were analyzed using a computer package SPSS Version 10.0 in a Complete randomized block design (CRD) while the means were separated using Duncan's Multiple Range Test (DMRT) at $p \leq 0.05$ (Steel and Torrie, 1980). Dry Matter Intake (DMI) was determined using the following equation: DMI ($g \cdot day^{-1}$) = % DM/100×feed intake. Dry matter digestibility (DMD) (%) was calculated as: 100×DM intake (g)–DM output (g)•DM–1 intake (g).

RESULTS

The percentage composition of the ingredients used for compounding both the experimental and control diets is shown in Table 1. All the rations contained *B. ruziziensis* silage at 5% inclusion level, whereas their crude protein levels ranged from 14.77% (diet 2) to 15.75% (control). SPLS was added to the rations at the level of 50, 25 and 0% which served as the control. The fecal crude protein also ranged from 5.04% in the control to 6.25% in diet 1.

Table 2 shows the Crude protein, pH and dry matter contents of SPLS and *B. ruziziensis* grass. pH After ensiling, the crude protein content of the unfermented SPLS increased from 16.50 to 20.50% while the pH, decreased from 5.6 to 3.8. This occurred as a result of the activity of microbes present on the silage mass.

The production attributes in Table 3 revealed the effects of the treatments on the parameters measured. The mean final weight gain, means weight gain and mean total feed intake (kg $head^{-1}$)

Table 1: Percentage composition of experimental diets

	Inclusion level		
Ingredients	50 (%)	25 (%)	0% (control)
B.ruziziensis	5.00	5.00	5.00
Maize offal	31.00	48.00	60.00
SPLS	50.00	25.00	0.00
Wheat offal	10.00	16.00	29.00
Soya bean cake	4.00	4.00	4.00
Bone meal	1.00	1.00	1.00
Premix	0.50	0.50	0.50
Salt	0.50	0.50	0.50
Total	100.00	100.00	100.00
Dry matter (%)	88.80	87.90	88.45
Crude protein (%)	15.24	14.77	15.75
Faecal crude protein (%)	6.25	5.61	5.04

Composition of premix (Real agromixTM) per Kg: Vit.A-3200000 IU, Vit.D3-640000IU, Vit.E-2000IU, Vit.K-800 mg, B1-600 mg, B2-1600 mg, Pyridoxin-600 mg, Niacin-6200 mg, Vit.B12-4 mg, Panthothenic acid-2000 mg, Folic acid-200 mg, Biotin-8 mg, Cholin chloride-80 mg, Manganese-32 g, Zinc-20 g, Copper-2 g, Iron-8 g, Iodine-0.46 g, Selenium-80 mg, Cobalt-80 mg. CP: Crude protein

Table 2: Crude protein, dry matter content and pH of materials

Ingredient	CP (%)	DM (%)	pH
SPLS (unfermented)	16.50	88.61	5.6
SPLS (fermented)	20.50	87.88	3.8
Dry poultry litter	27.40	88.20	
B. ruziziensis grass	6.00	87.50	

SPLS: Sawdust /poultry litter silage; CP: crude protein; DM: dry matter

Table 3: Production attributes

	Inclusion level (%)		
Parameter	50	25	0
Mean (initial) weight (kg)	4.20±0.10	4.50±0.03	3.90±0.07
Mean (final) weight (kg)	6.28±0.10^{ab}	7.04±0.20^{a}	5.35±0.11^{b}
Mean weight gain (kg)	2.08±0.07^{a}	2.54±.010^{a}	1.45±0.04^{b}
Mean daily gain (kg)	0.07±0.01^{a}	0.09±0.01^{b}	0.64±0.01^{a}
Mean daily intake (kg/head)	0.86±0.02^{a}	0.90±0.01^{a}	0.70±0.08^{b}
Mean total feed intake (kg/head)	2.91±0.31^{a}	3.03±0.35^{a}	2.11±0.22^{b}
Cost of feed /kg gain(N)	14.65±0.20^{a}	22.40±0.14^{b}	35.06±0.20^{c}
Feed conversion efficiency (gain/feed)	0.71^{a}	0.84^{b}	0.69^{a}
Apparent protein digestibility	0.59^{a}	0.78^{b}	0.62^{a}
Mean rumen motility/min	3.00±0.0^{a}	3.03±0.05^{a}	2.52±0.02^{a}

Means with similar superscript across a row are not significant at $p \leq 0.05$

were all significantly high in groups 1 and 2 compared to the control. Group 2 had significantly higher mean daily gain, feed conversion efficiency and apparent protein digestibility and also significantly lowest cost of production compared to either group 1 or control. The mean rumen motility/minute was not significant within groups; though the values obtained for groups 1 and 2 were slightly higher compared to the control.

Table 4: Haematological and serum biochemical parameters

	Level of replacement (%)		
Parameter	50	5	0
PCV (%)	26±1.20[a]	28±0.41[a]	26±2.10[a]
Total RBC (x10^6 μL^{-1})	12.05±0.79[a]	11.70±0.71[a]	10.40±0.55[a]
Total WBC (x10^3 μL^{-1})	14.3±0.44[a]	13.70±0.81[a]	13.01 ±0.77[a]
Hb g/100 mL	9.50±0.04[a]	9.45±0.00[a]	9.47±0.04[a]
Leucocytes			
Lymphocytes (%)	52±0.20[a]	57±0.55[a]	56±0.00[a]
Neutrophils (%)	45±0.00[a]	40±0.20[a]	41±0.20[a]
Eosinophils (%)	2±0.00[a]	2±0.00[a]	2±0.00[a]
Basophils (%)	0	0	0
Monocytes (%)	1±0.00[a]	1±0.00[a]	1±0.00[a]
SGOT (IU L^{-1})	25.0±0.44[a].	26.4±0.24[a]	28.20±0.22[a]
ALP (IU L^{-1})	1.7±0.00[a]	1.5±0.05[a]	1.7±0.01[a]
SGPT (IU L^{-1})	24±0.02[a]	22±0.01[a]	26 ±0.02[a]

Means with similar superscript across a row are not significant

In Table 4, the haematological (PCV, RBC, WBC, Hb and the leucocytes) as well as the serum biochemical parameters (SGOT, ALP and SGPT) examined, showed no significant differences among various groups, despite the fact that some groups had higher values than others.

DISCUSSION

From the results, the mean final weight gain of animals fed 25% (Group 2) of SPLS inclusion level in the diet significantly differed ($p<0.05$) from the control (Group 3) and not group 1, even though the mean weight gain of animals in group 2 were higher. A similar trend was also noted in the mean daily gain as well as in the food conversion efficiency of the groups while the mean daily feed intake of Groups 1 and 2, were significantly higher compared to the control which also had the lowest value (Table 2).

This suggested that the animals in groups 1 and 2 had better digestibility and feed conversion efficiency compared to the control, despite the fact that the control diet had the highest crude protein level of 15.75%, compared to diets 1 (15.24%) and 2 (14.77%) (Table 1). This is in agreement with the observations of McDonald *et al*. (2002) who reported on a relationship between intake, food conversion efficiency and weight gain.

Reece (2004) indicated that food intake does not depend on the nutrient composition of feed alone, but other factors such as palatability, food texture, taste mechanism, etc., may also be involved.

The mean rumen motility was higher in groups 1 and 2 compared to the control, though this was not statistically significant ($p>0.05$). This suggested that the inclusion of sawdust as a component of SPLS in diets 1 and 2 improved the dietary level of effective fibre, which can also improve rumen motility and rumination. It has also been reported that when feeds are low in effective fiber, this can affect both rumen motility as well as the passage of the digesta out of the rumen (Aydin *et al*., 1999). Although, it is equally important to note that the three major characteristics of a feed source that contribute to its effectiveness at stimulating rumination are: chemical composition (fiber level), functional specific gravity and particle size (Van Soest, 1994).

Apparent protein digestibility among the groups showed that diet 2 (0.78) was significantly higher ($p<0.05$) compared to either diet 1 (0.62) or 3 (0.59), even though diets 1 and 3 had slightly higher crude protein levels than diet 2 (Table 3).This may also have a relationship with both intake and feed conversion efficiency. According to Reece (2004), protein digestion and availability in ruminants do not depend only on the quantity of protein fed but also on the activities of the rumen microbes in forming microbial proteins, in addition to the availability of by-pass protein for peptic digestion.

The groups differed significantly in their cost of feed/kg, hence diet 1 had significantly the lowest cost of production was followed by diet 2 which was also significantly lower compared to the control ($p<0.050$. This could be attributed to high cost of the conventional feed materials (e.g., Soya bean cake, maize, wheat offal, etc.) used in formulating the control diet (Table 3).

The haematological and serum biochemical parameters showed no statistical significant differences among groups in the parameters examined. The values obtained on PCV of the groups showed that the animals in group two had higher values (28±0.41) ($p>0.05$) compared to either groups one 26±1.20 (Table 4). More so, the values of RBC, WBC, haemoglobin and leucocytic counts were all insignificant ($p>0.05$) within groups and were within the range of values recorded for the West African dwarf goats by Daramola *et al.* (2005). The serum enzymes (SGOT, SGPT and ALP) also showed no significant difference ($p>0.05$) within groups, though the SGOT and SGPT values of the control group was higher than in the other groups, just like the ALP of group one (Table 4). Consequently, these findings suggested that the treatments did not have toxic effects on the animals since they were all within the range of values documented by Daramola *et al.* (2005) Ikhimioya and Imasuen (2007).

Other workers also reported the peculiar characteristics of the West African dwarf goats as being able to have the tendency for Compensatory accelerated production of blood cells which is understood to be a protective mechanism (Dargie and Allonby, 1975; Kahn and Line, 2005).

CONCLUSION

This study has shown that ensiled sawdust and poultry litter can be used for compounding ruminant rations particularly at the levels used in this work without observable detrimental effects. More so, the use of SPLS at 25% level of replacement was quite beneficial especially with respect to intake, digestibility, weight gain and feed conversion efficiency when compared to the other groups (Control and 50%). It was also cheaper than the control diet (0% replacement).

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