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# NUTRIENT UTILIZATION AND RUMEN MICROBIAL POPULATION OF WEST AFRICAN DWARF SHEEP FED *PANICUM MAXIMUM* SUPPLEMENTED WITH *TITHONIA DIVERSIFOLIA, MERREMIA AEGYPTIA* AND *CHROMOLAENA ODORATA*.

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## ABSTRACT

Voluntary feed intake and digestibility of trees and shrubs (browse plants) by ruminant may be limited due to direct or indirect effects of their secondary compounds on rumen microbial activities. This study was carried out to investigate nutrient content of selected browse plants (*Tithonia diversifolia, Merremia aegyptia* and *Chromolaena odorata*) and their effect as feed supplement on nutrient utilization and rumen microbial population of West African dwarf (WAd) Sheep. Twenty-four (24) WAd sheep weighing 15±1kg were divided in a Completely Randomized Design into four groups (6 sheep per group) and were fed basal diet of *P. maximum* supplemented with the selected browse plants, along with fixed quantity of concentrate diet for a period of 84 days. The last group had no browse plant supplementation. Fourteen (14) days were used for digestibility studies. Apparent Nitrogen absorbed was calculated. Results showed that *M. aegyptia* (21.97%) had highest (P<0.05) crude protein (CP) content while *P. maximum* (9.00%) had least value. *T. diversifolia* (34.53%) contained highest (P<0.05) value of Acid detergent lignin (ADL) among all the browse plants investigated while *M. aegyptia* (11.29%) had low (P<0.05) value. However, *P. maximum* (9.51%) had the lowest ADL content. Animals that consumed *M. aegyptia*as supplement had highest (P<0.05) intake of DM and CP. Low (P<0.05) quantity (DM: 91.09 g/day and CP: 76.70 g/day) of *C. odorata* was consumed by animals as supplement, despite this, the total CP intake of the animals offered this browse supplements were better (P<0.05) than those given grass alone. *T. diversifolia* consumption enhanced microbial proliferation as revealed by the increase in the rumen microbial population 4 hours post feeding. There is a reduction in the rumen microbial population of animals fed *C. odorata* supplement. This observation revealed that *C. odorata* leaves do not support microbial proliferation in the rumen. The result of this study therefore revealed that all browse plants investigated could be used as supplement to grass and other low quality feedstuffs especially during the dry season.

**Key words:** Rumen microbial population, Sheep, Browse plant supplement.

## INTRODUCTION

Ruminants have a major role in balanced agricultural system as converters of low quality feeds to highly desired protein food of high biological value for the benefit of man (Ademosun, 1973). Gastrointestinal tracts of ruminant species are colonized by a diversity of microorganisms and the use of fibrous feedstuff by ruminants depends on the metabolic activities of anaerobic microbes in the rumen and the large intestine (Herrero *et al.*, 2008). Ruminants are animals that can digest and utilize cellulose and hemicelluloses. They feed on a variety of edible plants; they use Non-Protein Nitrogen (NPN) to synthesize most of the amino acid required. (Demment *et al.*, 1986).Browse has been defined as leaves, shoots and sprouts including tender twigs and stems of woody plants, which are cropped to a varying extent by

domestic animals (Devendra and Burns, 1983). Browse plants are commonly utilized in the wild by small-holder livestock farmers for feeding small ruminants (Uwechue, 1990; Okoli *et al.*, 2003). They are generally high in protein, particularly during dry season (Lascano *et al.*, 2003), but their feeding value is often limited owing to their high content of secondary metabolite such as tannins, due to direct or indirect effects of secondary compounds on rumen microbial activities (Aschfalk *et al*., 2002). The objective of this study therefore, is to determine nutrient content of selected shrubs (*Tithonia diversifolia, Merremia aegyptia* and *Chromolaena odorata*) and to evaluate their effect as supplement on nutrient utilization and rumen microbial population of West African dwarf sheep fed a basal diet of *Panicum maximum*.

## MATERIALS AND METHOD

The experiment was carried out at the small ruminant unit of teaching and research farm directorate of University farm, Federal University of Agriculture, Abeokuta, Ogun State, which is located in the tropical semi humid zone of Nigeria within $7^o$10'N and $3^o$ 2'E. The area has an average rainfall of 1100mm, a mean ambient temperature of about $34^0$C and average relative humidity of 82% (Google earth, 2011). The experiment was carried out between December, 2012 and April, 2013.

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Twenty four (24) West African dwarf sheep aged 15 to 24 months with weight ranging between 14 and 16 kg were divided into four groups of six animals per dietary group in a completely randomized design (CRD). Experimental diets and water were offered *ad libitum* at 7.30 am every day for 84 days. Fourteen (14) days were used for digestibility studies during which the animals were transferred to metabolic cages for total collection of feaces and urine. On the last day of the experiment, rumen content was collected via suction tube into different bottles before feed and 4 hours post feeding, for microbial analysis (Galyean, 1989; Hobson, 1965; Hungate, 1969).

Experimental diets consist of a basal diet of *Panicum maximum* (harvested just before flowering stage) and concentrate diet (100g/animal/day) with or without browse (*Tithonia diversifolia, Merremia aegyptia* and *Chromolaena odorata*) supplementation. The browse plants were air-dried for 24 hours before feeding. Concentrate diet contained Maize-13%, Wheat offal-54%, Palm kernel cake-20%, Ground nut cake-7%, Oyster shell-4% and salt-2%. Apparent nitrogen absorbed was calculated as nitrogen in feed minus nitrogen in faeces. Chemical composition of feed, faeces and urine were determined according to the method of AOAC (2000). Data from parameters were subjected to one way analysis of variance (ANOVA) using SAS (1999) procedure. Mean significance was compared using Duncan's Multiple Range Test (Duncan, 1955)

## RESULT

In Table 1, dry matter (DM) contents of wilted browse plants (As fed) ranged from 42.67% in *P. maximum* to 29.57% in *C. odorata* while residual DM ranged from 88.96% in *T. diversifolia* to 87.89% in *M. aegyptia*. Crude protein (CP) value of *M. aegyptia* (21.97%) was highest ($p<0.05$) and *P. maximum* had least CP value (9.00%). *P. maximum* (64.16%) had highest value of Neutral detergent fibre (NDF), while *C. odorata* had least value (52.16%).

**Table 1: Proximate composition (% DM) of *Tithonia diversifolia, Merremia aegyptia, Chromolaena odorata* and *Panicum maximum***

| Parameter | *T. diversifolia* | *M.aegyptia* | *C. odorata* | *P.maximum* | SEM |
|---|---|---|---|---|---|
| Dry matter (As fed) | 34.06$^{b}$ | 39.52$^{a}$ | 29.57$^{c}$ | 42.67$^{a}$ | 1.60 |
| Dry matter (Residual) | 88.96$^{a}$ | 87.89$^{b}$ | 88.79$^{a}$ | 88.39$^{ab}$ | 0.15 |
| Crude protein | 19.77b | 21.97a | 18.66c | 9.00d | 1.50 |
| Neutral detergent fibre | 55.48$^{b}$ | 55.61$^{b}$ | 52.16$^{c}$ | 64.16$^{a}$ | 1.47 |
| Acid detergent fibre | 45.79$^{a}$ | 38.30$^{d}$ | 44.18$^{b}$ | 39.80$^{c}$ | 0.74 |
| Acid detergent lignin | 34.53$^{a}$ | 11.29$^{c}$ | 15.55$^{b}$ | 9.51$^{d}$ | 1.24 |

$^{a,b,c}$Means along the same row with different superscript are significantly different ($p<0.05$). SEM = Standard error of means

Table 2 revealed that total DM intake was highest ($p<0.05$) in animals fed *M. aegyptia* (1010.71gday$^{-1}$) as supplement while lowest values were recorded in animals fed *C. odorata* (596.81 gday$^{-1}$) as supplement.

**Table 2: Dry Matter and Crude Protein Intake and apparent digestibility of WAD sheep fed *Tithoniadiversifolia, Merremiaaegyptia, Chromolaenaodorata*and *Panicum maximum***

| Parameter | *T. diversifolia* + *P.maximum* | *M. aegyptia* + *P. maximum* | *C. odorata* + *P. maximum* | *P.maximum* only | SEM |
|---|---|---|---|---|---|
| **Intake (g day$^{-1}$)** | | | | | |
| **Dry matter** | | | | | |
| Concentrate | 186.50 | 186.50 | 186.50 | 186.50 | 0.00 |
| Grass | 323.83$^{b}$ | 335.90$^{b}$ | 319.23$^{b}$ | 444.61$^{a}$ | 13.56 |
| Browse | 345.57$^{b}$ | 488.35$^{a}$ | 91.09$^{c}$ | 0.00$^{d}$ | 50.40 |
| **Total** | **855.90b** | **1010.75a** | **596.81d** | **631.07c** | **43.89** |
| **Crude Protein (gday$^{-1}$ DM)** | | | | | |
| Concentrate | 30.64 | 30.64 | 30.64 | 30.64 | 0.00 |
| Grass | 30.02b | 31.14b | 29.60b | 41.22a | 1.26 |
| Browse | 45.65b | 61.68a | 16.47c | 0.00d | 6.23 |
| **Total** | **106.31b** | **123.45a** | **76.70c** | **71.85d** | **5.49** |
| **Apparent Digestibility (%)** | | | | | |
| Dry matter | 78.54$^{ab}$ | 81.14$^{a}$ | 76.98$^{b}$ | 75.81$^{b}$ | 0.76 |
| Crude protein | 81.43$^{ab}$ | 86.05$^{a}$ | 79.58$^{b}$ | 76.14$^{b}$ | 1.26 |

$^{a,b,c}$Means along the same row with different superscript are significantly different ($p<0.05$). SEM = Standard error of means

The quantity of DM from individual browse plant consumed by experimental animals varied ($p<0.05$) while similar ($p>0.05$) amount of DM from grass were consumed by all animals fed browse supplement. DM consumption from *C. odorata* (91.09 $gday^{-1}$) was relatively small ($p<0.05$) compared to other browses. CP consumption from the various browse plants followed similar trend with DM intake. Total CP intake was also highest in animals fed *M. aegyptia* (123.35 $gday^{-1}$) supplement while animals on grass alone had least ($p<0.05$) total CP intake. DM and CP digestibility of animals on the various treatments follow similar trend. Highest ($p<0.05$) digestibility values were recorded for animals on *M. aegyptia* supplemented diet.Table 3 showed that nitrogen output of animals was not affected by the various treatment diets while apparntnitrogen absorbed followed the same trend with CP content of browse and CP intake by animals. The rumen microbial count of sheep fed *T. Diversifolia* supplement and those on grass alone increased 4 hours post-feeding while that of *C.odorata*reduced drastically.

**Table 3**: **Rumen microbial population and nitrogen retained by WAD sheep fed *Tithoniadiversifolia, Merremiaaegyptia, Chromolaenaodorata*and *Panicum maximum***

| Parameter | *T. diversifolia + P. maximum* | *M. aegyptia +P. maximum* | *C. odorata + P. maximum* | *P. maximum* only | SEM |
|---|---|---|---|---|---|
| Nitrogen intake($g\ d^{-1}$) | $17.01^{b}$ | $19.74^{a}$ | $12.27^{c}$ | $11.50^{d}$ | 0.88 |
| Faecal Nitrogen output ($g\ d^{-1}$) | 7.14 | 7.01 | 5.56 | 6.70 | 0.30 |
| Apparent $N_2$ absorbed ($gd^{-1}$) | $9.87^{b}$ | $12.64^{a}$ | $6.71^{c}$ | $4.60^{d}$ | 0.83 |
| MCB 1 (cfu/mol) | $11.30^{a}$ | $6.50^{b}$ | $14.10^{a}$ | $5.70^{b}$ | 0.99 |
| MCB 2 (cfu/mol) | $12.73^{a}$ | $6.35^{c}$ | $9.70^{b}$ | $8.60^{bc}$ | 0.70 |

$^{a,b,c}$Means along the same row with different superscript are significantly different ($p<0.05$). SEM = Standard error of means. MCB1=Microbial count before feeding. MCB2=Microbial count 4 hours after feeding

## DISCUSSION

Crude Protein content of the various browse plants used in this study exceeded the minimum protein requirement of 7% for ruminants recommended by ARC (1985). The CP value recorded for *M. aegyptia* (21.97%) is higher than the value of 15.3% reported by Aschfalk *et al*. (2002) for *M. tridenata* and 19.62% recorded by Isah *et al*. (2013) for *M. aegyptia*.Variability in nutrient content of browses and grasses could be attributed to many factors such as species differences, plant parts, season of the year, harvesting regime, location, soil type and age of plant at harvest (Norton, 1994). The CP intake of animals fed the various browse foliage followed similar trend with the CP content of the browse foliage, this is in consonance with the observation of McDonalds *et al*. (2002) that ruminant animals showed higher nitrogen intake with feed that is high in CP. Very low ($P<0.05$) quantity (DM: 91.09 g/day and CP: 76.70 g/day) of *C. odorata* was consumed by animals as supplement, despite this, the total CP intake of the animals offered this browse supplements were better ($P<0.05$) than those given grass alone. Intake of browse foliage might be limited by their lignin content as observed from the result of the nutrient content of the browse plants. Furthermore, *M. aegyptia* was implicated for low content of antinutritional factors such as Saponins and steroids and absence of phenols (Yusuf *et al.,* 2013), while *C.* odorata and *T. diversifolia* were implicated for tannin and Saponins (Fasuyi and Ibitoye, 2011, Igboh, *et al.*, 2009, Anyaso, *et al.*, 2011, Essiet and Akpan, 2013).

The trend observed in digestibility of CP by animals is similar to that observed in intake and CP content of the browse supplement. The lignin content of the browse foliage might be responsible for this observation. High apparent nitrogen absorbed by animals fed *M. aegyptia* supplement (12.64 g $day^{-1}$) might be due to higher CP intake (123.35 g $day^{-1}$) and low lignin content (11.29%). Brooker *et al.*, (1995) had earlier reported that when feed is high in soluble plant protein, nitrogen metabolism occurs mainly in the rumen. Reduction in microbial population of animals fed *C. odorata* 4 hours post feeding might be due to the presence of antimicrobial factors which may hinder the proliferation of rumen microbes (Igboh, *et al.*, 2009, Anyaso, *et al.,* 2011) and this also affected intake and digestibility by animals fed browse plant. Also, the pungent smell of the plant when fresh might discourage palatability. However, appreciable quantities of nitrogen consumed by the animals fed browse supplements were absorbed compared to animals fed grass alone**.** *M. aegyptia* supplemented diet had little impact on microbial population of animals, but might probably contain anti-nutritional factor such as condensed tannin (Yusuf *et al.,* 2013). From the result of this study, supplementation with selected browse plants significantly affect intake, digestibility, nitrogen absorption and microbial proliferation and hence the population of the rumen microbesin WAD sheep.

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