



**NITROGEN BALANCE AND APPARENT NUTRIENT
DIGESTIBILITY OF WEST AFRICAN DWARF SHEEP FED
CULTIVATED *PENNISETUM PURPUREUM* AND
*CALOPOGONIUM MUCUNOIDES***

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ABSTRACT

This study was designed to investigate the nitrogen balance and nutrient digestibility of Pennisetum purpureum and Calopogonium mucunoides harvest at different ages after planting in West African Dwarf (WAD) sheep. Nine WAD sheep were used for the study in a completely randomized design with 3 treatments replicated 3 times with 1 ram per replicated. Basal concentrate was also fed to the rams as supplement. Pennisetum purpureum and Calopogonium mucunoides were cultivated and harvest at 8, 10 and 12 weeks after planting, air dried to reduce the moisture content before being fed to the animals during the digestibility trials in the ratio of 70% Pennisetum purpureum and 30% Calopogonium mucunoides and tagged as T₁, T₂ and T₃ respectively. The animals were assigned an individual metabolic cage fitted with facilities for separate collection of faeces and urine. Data collected were subjected to analysis of variance using the General linear model (GLM) procedure of SAS 2001. From the result, Pennisetum pupureum, Calapogonium mucunoides supplemented with concentrates had similar effect on nitrogen intake, urine nitrogen, nitrogen balance and nitrogen retention, but however, influenced faecal nitrogen of the WAD rams. The study revealed significant effect of Pennisetum purpureum, Calopogonium mucunoides and concentrate on all parameters investigated. Dry matter intake was higher in T₃ than in T₂ and T₁ groups. It can be concluded that feeding rams with 70% Pennisetum pupureum, + 30% Calopogonium mucunoides and concentrate at early stage of harvest enhances nitrogen retention and apparent nutrient digestibility of West African Dwarf sheep.

Keywords: Silage crops, pastures, pasture legumes, ruminant nutrition, range management

INTRODUCTION

Small ruminants occupy important economic and ecological niches in agricultural systems throughout the developing countries (Devendra 2005). Sheep and goats constitute a good source of family income and livelihood, assets and agricultural resources for small holder farmers (Iyayi and Tona 2004, Shittu *et al.*, 2008; Salem-Ben and Smith 2008). In Nigeria, sheep and goats contribute about 35% of the total animal meat production (Maigadi 2001). This ranks small ruminants as the second most important suppliers of meat protein to the population after cattle (Maigadi 2001).

Pennisetum purpureum is one of the most valuable forage and silage crops in its native Africa and throughout the wet tropics. It is an important

forage and pasture grass especially for cattle and it is also cut for hay and fermented for silage (FAO 2013). This grass is also planted as hedgerows for erosion protection and forage production in the alley cropping system of agroforestry (Langeland *et al.*, 2008). *Pennisetum purpureum* is also used as a windbreak in horticultural crops and orchards and lines of these plants are used to mark boundaries between plots and properties (FAO 2013; Tropical Forages 2013).

Like many other legume forages, the nutritive potential of *Calopogonium mucunoides* lies in its protein content (Evitayani *et al.*, 2004). However, a rather wide range of protein contents has been reported, from 5% to 24%, depending on the material eaten (full browse or leaves), position on the plant (the top of the plant is more nutritious)

and stage of maturity (Cook *et al.*, 2005; Evitayani *et al.*, 2004). Calopo is seldom grazed alone and mostly used in mixed pastures with other grasses and/or legumes. *In vitro* digestibility of *Calopogonium mucunoides* leaves ranges from 58 to 66% depending on the age of regrowth and level of hairiness. High densities of epidermal hairs (34 hairs per mm²) are associated with lower *in vitro* dry matter digestibility (Cook *et al.*, 2005; Pizarro 2001).

The main objective of this study is to investigate the digestibility and nitrogen balance of West African Dwarf sheep fed *Pennisetum purpureum* and *Calopogonium mucunoides* harvest at different ages of growth.

MATERIALS AND METHODS

Experimental Site

The research was conducted at the Pasture Land of the Teaching and Research Farms, University of Uyo Annex, Uyo, Akwa Ibom State. Uyo is located on latitude 4° 59' and 5° 04'N and longitude 7° 53' and 8° 00'E, with an elevation of about 60.9 m above sea level. Uyo has a bi-modal rainfall pattern with mean annual rainfall of 2190 mm and mean relative humidity of 81%. The average maximum and minimum temperatures are 31°C and 18°C, respectively (Tadross *et al.*, 2005).

Land Preparation and Planting of Pasture

The total land area used for this study was 6000 cm². The site was ploughed manually then demarcated into eighteen plots, each 300 x 270 cm² in a Randomized Complete Block Design (RBCD). After land preparation, the plots were irrigated to field capacity. *Pennisetum purpureum* and *Calopogonium mucunoides* were obtained from the University of Uyo Teaching and Experimental Farm, Use Offot. The plants were treated with Chlorofos, 125mls per 10 litres of water against ants, termites, stem borers and other insects. *Pennisetum purpureum* and *Calopogonium mucunoides* were planted manually at a spacing of 50 × 40cm and 30×20cm respectively using cuttings with four nodes and each plot had eighty (80) stands. Two nodes/vines were placed into the ground and above the ground

at an angle of 30 – 45°. All plots were irrigated manually with water pipes during the 12 weeks of the experiment. The irrigation period was designed to supplement rainfall to maintain field capacity. Organic poultry manure of 1kg/plot was applied to the forages. Weeding was done manually immediately after the weeds starts to grow.

Processing of Ingredient

The plants were harvested at eighth, tenth and twelfth weeks respectively. They were air dried to reduce the moisture content before being fed to the animals during the digestibility trials.

Experimental Animal

Nine (9) West African Dwarf (WAD) Rams, aged between 11 months – 2 years with a mean body weight of 35kg were sourced from flocks of the Department of Animal Science, Faculty of Agriculture, University of Uyo, Uyo. The rams were fed *Pennisetum purpureum* and *Calopogonium mucunoides* with a fixed quantity of concentrates.

Experimental Diet

The animals were fed fixed quantity of 300g concentrates along with varying levels of the experimental diet. The diet consisted of wheat offal, palm kernel cake, *Pennisetum purpureum*, *Calopogonium mucunoides*, bone meal, vitamin premix and table salt. Feeding trial lasted for 3 weeks and was preceded by one-week acclimatization. The animals were weighed before the commencement of the feeding. They were divided into 3 groups with 3 replicates, and 1 sheep per replicate in a Completely Randomized Design (CRD). The experimental diets were fed in two installments per day at 08:00 h and 16:00 h respectively. Each animal received 1.3 kg of each of the experimental diet for 21 days. The mixture of elephant grass and calopo diets were:

T₁ = 70% *Pennisetum purpureum* and 30% *Calopogonium mucunoides* (At 8 week of harvest)

T₂ = 70% *Pennisetum purpureum* and 30% *Calopogonium mucunoides* (At 10 week of harvest)

T₃ = 70% *Pennisetum purpureum* and 30% *Calopogonium mucunoides* (At 12 week of harvest).

Table 1: Composition of Experimental Concentrate for West African Dwarf (WAD) Rams.

Ingredients	Composition (%)
Wheat offal	60.0
Palm kernel cake	36.0
Bone meal	3.0
Ruminant premix	0.5
Table salt	0.5
Total	100
Calculated analysis	
ME(Kcal/kg)	2004
Crude protein (%)	14.76
Crude fibre (%)	10.5

*Premix composition/kg: vitamin A, 7,000,000mg; vit D3, 700,000mg; Mn 50,000mg; Fe 50,000mg; zn, 50,000mg; Cu 10,000mg; I 400mg; Co 100mg; Se 100mg

Digestibility and Nitrogen Balance Trials

The animals were assigned an individual metabolic cage fitted with facilities for separate collection of faeces and urine. The quantity of feed offered, leftovers, faeces and urine were determined for the last 3 days, after the 7 days of adjustment to the cages. Ten percent of the faeces and urine collected daily for the last 3-days period were bulked. Nitrogen loss from urine and bacteria growth infestation were prevented by introducing a drop of 0.1N H₂SO₄ into the urine collecting bucket placed under metabolic cages for daily urine output. At the end of the 3days collection period, 10% of urine taken from each replicate was sub sampled and stored pending nitrogen determination (Rego *et al.*, 2010).

The apparent nutrient digestibility of the experimental diet was determined during the last two weeks of the experimental period. Faeces and urine were collected for digestibility study. The

quantity of feeds consumed and faeces excreted daily during the last 3days period were weighed and dry in a forced draught oven at 80°C for 24 hours to a constant weight before storing in a cellophane bag till required for analysis.

Statistical Analysis

Data collected were subjected to analysis of variance using the General linear model (GLM) procedure of SAS (2001) significant differences observed among replicates means were separated using the Duncan's multiple range test of same software

RESULTS AND DISCUSSION

Nitrogen Balance of WAD rams fed forages of *Pennisetum pupureum*, *Calapogonium mucunoides* and concentrates

Results obtained on nitrogen balance of WAD rams fed *Pennisetum pupureum*,

Calopogonium mucunoides and concentrates are presented in Table 2. From the result, WAD rams fed *Pennisetum purpureum*, *Calopogonium mucunoides* supplemented with concentrates had similar nitrogen intake, urine nitrogen, nitrogen balance and nitrogen retention, but however, influenced faecal nitrogen of the WAD rams. WAD

rams on T₁ diets had significantly lower while higher faecal nitrogen was observed in T₃ group. The result obtained for faecal nitrogen in this study agrees with the report of Ajayi *et al.* (2005). Other parameters were not significantly affected by age at harvest of *Pennisetum purpureum*, *Calopogonium mucunoides* and concentrate fed to the WAD rams.

Table 2: Nitrogen Balance of West African Dwarf Sheep (Rams) fed *Pennisetum purpureum*, *Calopogonium mucunoides* and concentrates

Parameters	T ₁	T ₂	T ₃	SEM
Nitrogen Intake	23.49	23.16	25.47	0.89
Faecal Nitrogen (g/day)	3.50 ^b	4.07 ^{ab}	4.87 ^a	0.34
Urine Nitrogen (g/day)	1.19	0.91	0.85	1.34
Nitrogen Balance (g/day)	18.79	18.18	19.75	1.14
Nitrogen Retention (%)	79.84	78.37	77.49	0.02

^{abc} means within the same row with different superscripts are significantly different (P> 0.05), SEM = Standard error mean; T₁ = *Pennisetum purpureum* and *Calopogonium mucunoides* harvested at 8 weeks, T₂ = *Pennisetum purpureum* and *Calopogonium mucunoides* harvested at 10 weeks, T₃ = *Pennisetum purpureum* and *Calopogonium mucunoides* harvested at 12 weeks.

CONCLUSION

The result obtained on nitrogen balance and digestibility percentage parameters of WAD rams fed T₁ diets containing *Pennisetum purpureum*, *Calopogonium mucunoides* and concentrates, showed better result when compared with T₂ and T₃ harvested at weeks 10 and 12 of age respectively. It can be concluded that

feeding rams with 70% *Pennisetum purpureum*, + 30% *Calopogonium mucunoides* and concentrate at early stage of harvest enhances nitrogen retention and apparent nutrient digestibility of West African Dwarf sheep.

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