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# *MUCUNA PRURIENS* (*VAR. UTILIS*) FODDER AS DRY SEASON FEED SUPPLEMENT FOR WEST AFRICAN DWARF GOATS

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## ABSTRACT

The nutritive attributes of *Mucuna pruriens* fodder (MPF) were evaluated with West African Dwarf (WAD)goats by feeding MPF as supplement to *Panicum maximum* grass (PMG) at different ratios of 0:100 (feeding of PMG as sole diet), 10:90, 20:80 and 30:70. The study lasted for 56 days in which feed intake, weight gain, nutrient digestibility and hematological indices were investigated using a completely randomized experimental design. Results indicated that crude protein content of the fodder ranged from 9.63% in the vines to 26.25% in the leaves. The total dry matter (DM), organic matter (OM) and crude protein intakes differed ($p<0.05$) among the diets. Total DM and OM intakes decreased ($p<0.05$) with increasing supplementation levels of MPF. Total OM intakes were 47.54, 103.52, 99.04 and 87.91g/day for 0, 10, 20 and 30% supplementation levels, respectively. Total dry matter intake of 52.30g/day was least at the control and was highest ($p<0.05$) (123.44g/day) at 10% inclusion level of MPF. The haematological indices though declined ($p<0.05$) slightly from 10% supplementation, were still within the range recommended for goats. The mean values of 24.21% of packed cell volume and 8.25g/dl for haemoglobin in the 10% supplemented group did not differ from the control group. It was concluded, based on weight gain and hematological data that WAD goats could tolerate inclusion of *Mucuna pruriens* fodder up to 10% as a short term dry season feeding strategy for WAD goats in the derived savanna zone of Nigeria.

**Keywords:** *Haematological, Mucuna pruriens, WAD goats, Feed intake, Digestibility*

## INTRODUCTION

According to RIM (1992) there are 6 million herds of goats in Nigeria. Goats in the tropics are hardy, highly prolific and could subsist on a wide range of browse and roughage diets (Silanikove, 2000). Forages are the most reliable, cheap and sustainable means of goat production in the derived savannah zone of Nigeria. *Mucuna pruriens* is a legume that has not been fully exploited as ruminant livestock feed resource in the derived savanna zone of Nigeria (Iyayi and Egharevba, 1998), despite the fact that the plant is common and widely distributed in the tropics and subtropics. The forage yield could be as high as 19t/ha with a seed yield of about 3.85t/ha in Nigeria (Emenalom and Udedibe, 1998). The seeds have been successfully incorporated into the diet of monogastrics (Iyayi and Egharevba, 1998; Emenalom and Udedibie, 1998, Emiola *et al*., 2003) and are also consumed by humans in some parts of the world, including Nigeria (Diallo and Berhe, 2003). The use of *Mucuna pruriens* foliage in ruminant feeding was probably limited because of its low palatability (Matenga *et al.*, 2003) and generally high concentrations of toxic and anti-nutritional factors (Liener, 1994). Trypsin inhibitors, phytates, cyanogenic glycosides, tannins and 3, 4 dehydroxyphenylalanine (L-Dopa) were among the anti-nutritional factors that have been identified in *M. pruriens* (Ravindra and

Ravindra, 1988). The concentration of these anti-nutritional factors were influenced by climatic and ecological conditions (Emenalom and Udedibie, 1998).

Blood parameters were important indicators of health status in animals and have been an indispensable tool in the diagnosis, treatment and prognosis of many toxic chemicals in feeds (Gilboa *et al*., 2000; Nazifi and Vesal, 2003). Although, *M. pruriens*' overwhelming role in cropping system is well recognized, it is however regarded as an underutilized forage in livestock feeding. The objective of this study was to evaluate the potential of *Mucuna pruriens* fodder as a dry season feed supplement in a crop-livestock farming system in the derived savanna zone of Nigeria.

## MATERIALS AND METHODS

### Experimental site

The experiment was carried out at the Teaching and Research Farm of Ladoke Akintola University of Technology, Ogbomoso. The site is located within the belt of the derived savanna ecological zones. It is on latitude $8^0$ 26'N and longitude $4^0$ 29'E. Average annual rainfall is 1173mm and usually occurs between June and October with a marked dry season from the beginning of December to late March. The wet season can be divided into main-wet (April to August) and minor- wet (September to November). The top soil (0-15cm) is sandy loam, with a pH of 6.7 ($H_20$), 0.69% organic carbon, 2.94% total nitrogen and 37.0ppm available phosphorus (Jagtap, 1995). The site has been under continuous cultivation for about five years and dominated by gamba grass and wild sunflower.

### Source of test ingredients

A land of about $200m^2$ was ploughed, harrowed and divided into five plots during 2018/ 2019 and 2019/2020 cropping seasons. Each plot measured 8 x 24 m with a footpath of 1.5 m between plots. Each plot constituted a replicate. The seeds were procured from the International Institute of Tropical Agriculture (IITA), Ibadan, Nigeria. The seeds were hand drilled into the soil at a spacing of 1x1m and seed rate of 6kg/ha assuming 90% viability, as recommended by Humphrey (1980). The plots were weeded twice manually until the plot was covered up by mucuna forage. No fertilizer or inoculums were applied.

The harvested herbage was shade-dried, chopped manually to between 2-5cm lengths, bagged and stored in a dry place until dry season when it was offered as supplement to West African Dwarf (WAD) goats. *Panicum maximum* forage was harvested from an existing plot after it was cut back to allow regrowth.

### Experimental animals, diets and management

Sixteen WAD goats of average weight 8-10 kg were acquired from the neighbourhood. They were quarantined for two weeks during which the sick ones were treated with oxytetracyline, iron dextrin, piperazine (dewormer) and multivitamins intramuscularly at 1 ml/10kg body weight. They were also given ivermectin against ectoparasites and endoparasites. The animals were offered cassava peels, corn grits and *Panicum maximum* during the two weeks of adjustment period. Water was offered *ad libitum*. They were gradually exposed to the experimental diets thereafter. The sixteen animals were balanced for weight and assigned to the four experimental diets with 4 animals in each treatment groups, each animal represents a replicate. *Panicum maximum* basal diet was supplemented at 4% of their body weight with shade-dried *Mucuna pruriens* fodder at 0, 10, 20 and 30% level during the experimental period of 56 days.

### Data collection

***Feed intake*:** This was estimated by the difference between the quantity of feed offered and feed refusals by each animal for 56 days.

***Live Weight gain*:** The weight of the animals was taken before the commencement of the study and fortnightly till the end of the study with measuring scale. The difference between the initial weight and final weights of the individual animals during the experimental period was estimated as the weight gain.

***Nutrient Digestibility*:** Two animals from each treatment group were put in individual metabolic cages modified for easy collection of faeces and urine. They were allowed to acclimatize for seven days in the metabolic cage. During the experimental period of fourteen days, feed offered and left over were weighed. The collected and weighed fresh faecal samples were bulked for each of the animal; air dried, milled to pass through 0.5mm sieve and kept in air tight containers till analysis. The nutrient digestibility coefficient was estimated as:

$$= \frac{\text{Nutrient in feed – nutrient in faeces}}{\text{Nutrient in feed}} \times 100\%$$

***Haematological study:*** Blood samples were collected at the beginning and at the end of the experimental period from the jugular vein of each animal using sterilized needles and syringe. The blood samples were stored in ethylene-diamine tetra acetic acid (EDTA) bottles to prevent coagulation. The blood samples were analyzed using Haemato–analyzer (B1110) for packed cell volume, mean corpuscular volume, mean corpuscular haemoglobin, mean corpuscular haemoglobin concentration and haemoglobin.

**Chemical analysis**

Sub-samples of forage and faecal samples were air-dried and analyzed for chemical composition, using the methods of AOAC (1990). Air-dried samples of vine and leaf of Mucuna pruriens were bulked and milled through 1.0mm sieve for laboratory analyses. Crude protein was analyzed by the Kjeldahl method and neutral detergent fibre according to Van Soest *et al*. (1991). Ash was obtained by placing samples in a muffle furnace at $600^0$C for 18h. Analyses of forage samples for phytate was carried out by the method of Maga (1983), while oxalate was analyzed using the method of Fassset (1966). Extractable tannin was quantified according to the method of Price *et al.* (1978). Mineral analysis was by wet digestion of samples in $HNO_3$/ $HClO_3$ and the concentrations of the elements, Mg, Ca and P were read in an atomic absorption spectrophotometer (Bulk Scientific model 200a, East Norwalk, USA)

**Experimental Design and Statistical analysis**

The experimental design was completely randomized design. The collected data were analyzed using one-way analysis of completely randomized design with animals as replicates using General Linear Model (GLM) procedures of (SAS, 2002). Means were separated assuming a probability level of 0.05 using Duncan Multiple Range Test of the same package.

## RESULTS

**Chemical composition and antinutrients of Panicum maximum and Mucuna pruriens**

The chemical composition of the leaves is shown in Table I. The crude protein (CP) content of the leaves were 25g/kg and 262g/kg and neutral detergent fibre of 691g/kg and 552g/kg for *P. maximum* and *M. pruriens* respectively. The *P. maximum* contained higher values of crude fibre (CF), lignin, phosphorus, phytic acid, oxalate and tannin than *M. pruriens*. The phytic acid levels were 12.6 and 0.8g/kg and oxalic acid contents were 13.7 and 0.6g/kg for *P .maximum* and *M. pruriens*, respectively.

**Table 1: Nutrient composition and anti-nutrients (g/kg) of *P. maximum* and *M. pruriens* fodder offered to West African Dwarf goats during the experimental period**

| Composition (g/kg) | *P. maximum* | *M. pruriens* |
|---|---|---|
| Organic matter | 908 | 943 |
| Crude protein | 25 | 262 |
| Neutral detergent fibre | 691 | 552 |
| Acid detergent fibre | 368 | 399 |
| Lignin | 396 | 138 |
| Magnesium | 39 | 5.7 |
| Calcium | 3.3 | 7.4 |
| Phosphorus | 7.3 | 3.7 |
| Antinutrients | | |
| Phytic acid | 12.6 | 0.8 |
| Oxalate | 13.7 | 0.6 |
| Tannin | 0.8 | 0.5 |

**Growth and Digestibility study**

Table 2 shows that the dry matter intake (DMI) of *Panicum maximum* by the WAD goats increased with supplementation up to 10% and then declined. The DMI of *Mucuna pruriens* fodder decreased ($P<0.05$) with increasing levels of supplementation. However, the total DMI followed a similar trend as in DMI of the basal forage. Live weight gain of the animals increased progressively with increasing inclusion of mucuna forage, but not beyond 10%. The dry matter digestibility was highest at 10% level of supplementation and the least value was obtained with the control. Similar trend was observed for organic matter digestibility and crude protein digestibility. The *Panicum maximum* sole diet had poor DMI, live weight gain, organic matter digestibility, and crude fibre digestibility values when compared to the others which were supplemented with *Mucuna pruriens*.

**Haematological study**

The results of haematological indices of WAD goats fed *M. pruriens* at different levels of supplementation are presented in Table 3. All the values for the haematological parameters were within the standard values for West African dwarf goats. There were however significant differences ($P<0.05$) among the experimental diets at the different supplementation levels for packed cell volume (PCV), haemoglobin (Hb) and mean cell volume (MCV) while mean corpuscular haemoglobin concentration (MCHC) and mean corpuscular haemoglobin (MCH) were not significant. The treatment mean value of 24.21% for PCV at 10% supplementation was lower than 26.67% for the control group (0%). Similar pattern was observed for MCV, Hb, and MCHC. This implied a decrease with increasing supplementation levels of mucuna fodder. Thus continuous feeding of *Mucuna pruriens* could decrease these parameters and cause adverse effect on the health status of the animal. The supplementation level should be at 10%.

**Table 2: Feed intake and nutrient digestibility of the West African Dwarf goats fed *Panicum maximum* basal diet supplemented at four levels of *Mucuna pruriens* (var utilis) fodder**

| Intake | Supplementation levels of *Mucuna pruriens* fodder | | | | |
|---|---|---|---|---|---|
| | **0%** | **10%** | **20%** | **30%** | **SEM** |
| Dry matter intake ($g/W^{0.75}$) | | | | | |
| *Panicum maximum* | $52.36^{d}$ | $82.71^{a}$ | $80.56^{b}$ | $73.51^{c}$ | 0.09 |
| *Mucuna pruriens* | - | $40.73^{a}$ | $35.41^{b}$ | $26.95^{c}$ | 0.06 |
| Total | $52.36^{d}$ | $123.44^{a}$ | $115.97^{bc}$ | $99.46^{b}$ | 3.54 |
| Organic matter intake ($g/W^{0.75}$) | | | | | |
| *Panicum maximum* | $47.54^{d}$ | $75.10^{a}$ | $65.85^{b}$ | $55.70^{c}$ | 5.9 |
| *Mucuna pruriens* | - | $38.42^{a}$ | $34.19^{b}$ | $32.21^{b}$ | 7.63 |
| *Total* | $47.54^{d}$ | $103.52^{a}$ | $99.04^{b}$ | $87.91^{c}$ | 13.65 |
| Live weight gain (g/day) | $9.01^{c}$ | $13.36^{a}$ | $10.59^{b}$ | $10.23^{b}$ | 1.31 |
| Feed conversion ratio | 5.81 | 9.24 | 10.95 | 9.72 | 0.70 |
| Nutrient digestibility coefficient | | | | | |
| Organic matter (%) | $34.6^{c}$ | $46.0^{a}$ | $36.0^{b}$ | $32.3^{c}$ | 1.20 |
| Dry matter (%) | $38.1^{c}$ | $48.4^{a}$ | $47.1^{b}$ | $45.6^{b}$ | 2.50 |
| Crude fibre (%) | $43.9^{d}$ | $52.3^{a}$ | $51.7^{b}$ | $45.7^{c}$ | 2.21 |

$^{a,b,c,d}$: Means in a row with same superscripts did not differ (P>0.05); SEM= Standard Error of Means

**Table 3: Effect of levels of fresh *Mucuna pruriens* fodder supplementation on the hematological indices of West African dwarf goats**

| Parameters | Supplementation levels of *Mucuna pruriens fodder* | | | | | |
|---|---|---|---|---|---|---|
| | **0%** | **10%** | **20%** | **30%** | **SEM** | **Normal Range** |
| PCV (%) | $26.67^{a}$ | $24.21^{a}$ | $21.80^{b}$ | $19.25^{b}$ | 1.80 | 21-35[#] |
| Hb (g/dl) | $8.88^{a}$ | $8.25^{a}$ | $7.20^{b}$ | $6.80^{b}$ | 0.60 | 7-15[#] |
| MCV (fl) | $53.33^{a}$ | $49.69^{a}$ | $43.60^{b}$ | $36.50^{c}$ | 3.63 | 50-68[*] |
| MCH (Pg) | 18.11 | 16.59 | 14.40 | 13.50 | 1.23 | 8.0-12.0[*] |
| MCHC (%) | 33.31 | 32.39 | 31.96 | 30.39 | 0.15 | 32-34.6[#] |

$^{abc:}$ Means in a row with same superscripts did not differ (P>0.05); SEM= Standard Error of Means; [#]- Daramola *et al*. (2005); Shittu *et al*., (2016)

## DISCUSSION

The crude protein (CP) content in the fodder of *Mucuna pruriens* was 262 g/kg DM. The higher CP content of *Mucuna pruriens* fodder relative to the grass (*Panicum maximum)* agreed with the reports of Larbi *et al*. (1996) and Adejoh *et al*. (2012). The difference was simply due to the morphological characteristics of the two forages. It further confirmed that the two forages could complement each other in the diets of ruminants. The mean CP content of 262 g/kg DM of *M. pruriens* is consistent with the reported value of Ibrahim *et al.* (2018). This level of CP was also higher than the critical level of 70g/kg DM, below which the feed intake of the animal was, depressed (Minson, 1980). The concentration of the anti-nutrients in the supplement was generally low. The tannin value of < 1% in the forages was lower than 2.05% reported for *G. sepium* (Ahn *et al.*, 1989). This tannin level was much lower than the level of 5% at which goats may reject feed (Cooper and Owen- Smith, 1985). Tannin at this level protects labile plant proteins in the rumen and consequently increased the supply of high-quality protein into the duodenum (Bunglavan and Dutta, 2013). The phytic acid and oxalate contents were also low. The phytic value was lower than the range values of 3.47 and 3.24% reported for some browse legumes in Nigeria (Bamikole *et al.,* 2004), while the oxalate content was lower than 28.79 mg/100g reported by Amira *et al*. (2014). However, due to microbial fermentation in the rumen, ruminants, including goats, could consume considerable amounts of plant with high oxalate content without adverse effects (Yisehak *et al.,* 2016). The levels of the antinutrients investigated and found in *M. pruriens* in this study were unlikely to have any negative effect on ruminant livestock.

A significant increase in the intake of the basal diet (PMG) with (MPF) supplementation in this study indicate an additive effect of the supplement on the basal diet. Smith *et al.* (1995) reported a similar additive effect when sheep were fed a basal diet of *P. maximum* supplemented with fresh and wilted leaf of *Gliricidia sepium.* Akinlade *et al*. (2002) obtained a similar result when *Stylosanthes guianensis* was the supplement for *P. maximum* basal diet in goats. The increased total dry matter intake with increasing levels of supplementation agreed with the reports of Ademosun *et al*. (1988) and Ash (1990) that supplementation of hays with *Leucaena leucocephala*, *Gliricidia sepium* and *Sesbania sesban* fodder increased total dry matter intake when fed to goats. Thus, supplementation of *Mucuna pruriens* at 10% could be recommended as there were decreases in DMI, live weight gain and nutrient digestibility at above 10%. Dietary fibre supplementation had been shown to enhance intake by increasing nitrogen supply to the rumen microbes (Van Soest, 1982). Thus, it was most likely that the observed improvement in the fibre and dry matter digestibility up to 10% inclusion may have been due to availability of nitrogen for efficient fermentation in the rumen. Similar trend was observed in haematological profiles of the WAD goats. The relatively low packed cell volume, mean corpuscular haemoglobin and mean corpuscular volume recorded among animals exposed to 20 and 30% supplementation with *Mucuna pruriens* leaf indicated possible anaemia. It was thus possible that the *Mucuna pruriens* fodder contained some bioactive agents, which inhibited the synthesis of erythropoeitin, implicated as the primary regulator of red blood cell production (Polenakovic and Sikole, 1996). There was no adverse effect on the haematological indices at 10% supplementation.

## CONCLUSION

The CP value of M. *pruriens* was sufficiently high to warrant utilization and inclusion as a protein supplement to poor quality diets during the dry season and the level of tannin was unlikely to have any adverse effect on the use of *Mucuna pruriens* as dry season supplement for goats. However, the possible presence of some bioactive gents in it could limit their utilization at 20% supplementation and above. Hence not more than 10% level of *Mucuna pruriens* fodder, inclusion could serve as protein feed supplement for a short period of time when poor quality basal diet was offered or remain the only available feed in the natural pasture.

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