# EFFECTS OF FEEDING *Panicum maximum* SUPPLEMENTED WITH LEGUME PELLETS ON THE RUMEN FERMENTATION CHARACTERISTICS OF WEST AFRICAN DWARF SHEEP

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## ABSTRACT

*The study evaluated the effects of supplementation of legume pellets on the rumen fermentation parameters of West African dwarf (WAD) sheep fed Panicum maximum. Twenty WAD rams with average body weight of 12.43 ± 0.5 kg were allocated to four dietary treatments: sole Panicum maximum, P. maximum supplemented with Lablab purpureus pellets, P. maximum supplemented with* Calopogonium mucunoides pellets *and P. maximum supplemented with Mucuna pruriens pellets arranged in a Completely Randomized Design. Panicum maximum was offered to the animals ad libitum and legume pellets were fed at 5 % of their body weight. The feeding trial lasted 12 weeks. Rumen pH, ammonia nitrogen ($NH_3$-N) and total volatile fatty acid were determined, and analyzed using one-way analysis of variance. At 6 hours post feeding, $NH_3$-N concentration in rams supplemented with* C. mucunoides *pellets were significantly ($P<0.05$) lower than others. Rams supplemented with L. purpureus pellets had the lowest ($P<0.05$) rumen pH (6.99) at 0 hour and at 6 hours post feeding (6.54). Moreso, supplementing rams with L. purpureus pellets increased the $NH_3$-N and reduced the rumen pH which can improve the activity of micro-organisms in the rumen. As such, supplementation with forage pellets during dry season, will serve as reliable source of feed for ruminants.*

Keywords: Ammonia, legume pellets, *Panicum maximum*, rumen pH, volatile fatty acids

## INTRODUCTION

The forage plants decline rapidly in quantity and quality during dry season (Ajayi, 2007). During this period, the animals are faced with reduced feed intake, loss of weight and this led to their poor performance. To alleviate this problem, it becomes imperative to conserve and process forages during period of abundance for use during the period of scarcity. They can be stored as hay or silage and fed to animals as conserved feed. The rumen which is an essential fermentation vat in ruminants, is capable of preparing end products particularly volatile fatty acids and microbial proteins as major energy and protein for ruminants hosts. It also provides an anaerobic environment, constant temperature and pH to the microorganisms for digestion (Yusuf, *et al* 2008). The products of microbial fermentation, mainly volatile fatty acids (VFA) and microbial protein, are available for absorption in the small intestine while the gases (carbon dioxide and methane) are eructated (Bayat and Shingfield, 2012). Tropical forages are rich in fibre and lignin which reduces the fermentation rate, microbial mass and production of VFA in the rumen of the animals (Ebtehag *et al*., 2016). The fibre contents can be reduced by processing forages into pellets (Oyaniran *et al*., 2018) and this will increase the fermentation rate. Hence, this study investigated the rumen pH, ammonia nitrogen and VFA of West African dwarf sheep fed *Panicum maximum* supplemented with legume pellets.

## MATERIALS AND METHODS

The experiment was carried out at the Directorate of University Farms, Federal University of Agriculture, Abeokuta (FUNAAB), Nigeria on latitude 7° 13’ 49.46" N and longitude 3° 25’ 11.98" E. *Lablab purpureus*, *Calopogonium mucunoides* and *Mucuna pruriens* leaves were harvested at 12 weeks and dried. The dried legumes were milled and pelletized using a 6 mm die size to produce pelletized legume forages of average length of 40 mm. Cassava flour was used as binder (proportion of 1 kg of cassava flour to 100 kg of the milled sample) with addition of water to moisten. The pellets

were warm and moist, when they came out of the mill. They were then air dried to harden up so as to hold their forms. The experimental diets were Sole *Panicum maximum*, *P. maximum* supplemented with *L. purpureus* pellets, *P. maximum* supplemented with *C. mucunoides* pellets, *P. maximum* supplemented with *M. pruriens* pellets. A total number of twenty (20) West African dwarf (WAD) rams with average body weight of 12.43 ± 0.5 kg were used for the experiment. The animals were weighed and randomized into four treatment groups of five animals per treatment each balancing for body weight. A basal diet

of fresh *Panicum maximum* grass was fed daily to the animals. The grass was harvested at 6 weeks of re-growth, wilted, chopped and offered to the animal's *ad libitum* daily. The legume pellets were fed as supplements to the animals at 5 % of their body weight. At the end of feeding trial, ruminal fluid samples were collected before morning feeding and six hours post feeding using oesophageal tube for the determination of rumen pH, ammonia nitrogen and volatile fatty acids. Sub- samples of the grass and legume pellets were oven dried at 65 $^{o}$C to constant weight. Proximate composition were determined according to AOAC (2000). Fibre fractions: neutral detergent fibre (NDF), acid detergent fibre (ADF), acid detergent lignin (ADL) were analysed according to the procedure of Van Soest *et al.* (1991). Tannin contents were determined using the Vanillin-HCl method as described by Price and Butler (1977). Saponin contents were determined according to the method of Obdoni and Ochuko (2001). The pH of the rumen fluids were measured immediately after collection with the use of pH meter (Hanna instruments, pH 211, microprocessor pH meter, K012818, Portugal). Thirty (30) ml of rumen fluid was taken and filtered through four layers of cheese cloth for the determination of rumen ammonia nitrogen (Lanyansunya *et al*., 2007) and volatile fatty acids were determined according to the procedure of Siedlecka *et al*. (2008). All data obtained were arranged in a completely randomized design and subjected to one-way analysis of variance (ANOVA). Significant means were separated using Duncan's Multiple Range Test of SAS (2000).

**RESULT AND DISCUSSION**

Table 1 shows the chemical composition of *P. maximum* and herbaceous forage legume pellets. The crude protein content in this study ranged from 94.5 gkg$^{-1}$ in *P. maximum* to 126.0 g kg$^{-1}$ in *Mucuna puriens* pellets. The crude protein content of the legume pellets was higher than the minimum recommended range of 7.0 - 8.0 % for efficient functioning of rumen microorganisms (Van Soest, 1994). *Calopogonium mucunoides* pellets had the highest (P<0.05) NDF content while *L. purpureus* pellet had the least value. The fibre contents of samples in this study were below 60-65 % suggested as the critical limit above which efficiency of utilization of tropical forages by ruminants would be impaired (Muia, 2000). Tannin content was highest (P<0.05) in *Mucuna pruriens* pellets (0.0042 %) while *C. mucunoides* pellet (0.0018 %) had the lowest (P<0.05) value. Tannin content recorded in this study were lower than 2-5 % sheep and cattle can tolerate (Diagayete and Hugg, 1981). Babayemi *et al*. (2004) reported that higher level of saponin in feed is known to deter the activities of bacteria in the rumen.

**Table 1**: Chemical composition (g $kg^{-1}$) of *P. maximum* and herbaceous forage legume pellets

| | Treatment | | | | | |
|---|---|---|---|---|---|---|
| Parameters (g $kg^{-1}$) | *Panicum maximum* | *Lablab purpureus* | *Calopogonium mucunoides* | *Mucuna pruriens* | SEM | P-value |
| Dry matter | 256.00[d] | 855.20[c] | 902.07[b] | 915.23[a] | 1.13 | <.0001 |
| Crude protein | 94.50[d] | 120.80[b] | 105.00[c] | 126.00[a] | 3.79 | <.0001 |
| Ether extract | 40.00[c] | 50.00[b] | 50.00[b] | 70.00[a] | 3.30 | <.0001 |
| Ash | 120.00[a] | 95.00[b] | 70.00[c] | 70.00[c] | 6.26 | <.0001 |
| Neutral detergent fibre | 560.00[b] | 480.00[d] | 580.00[a] | 500.00[c] | 12.43 | <.0001 |
| Acid detergent fibre | 360.00[a] | 240.00[c] | 300.00[b] | 300.00[b] | 12.79 | <.0001 |
| Acid detergent lignin | 140.00[a] | 60.00[d] | 100.00[b] | 80.00[c] | 8.92 | <.0001 |
| Tannin (%) | ND | 0.0025[b] | 0.0018[c] | 0.0042[a] | 3.51 | <.0001 |
| Saponin (%) | ND | 5.00[c] | 5.50[b] | 6.00[a] | 0.15 | 0.0002 |

[a, b, c] means on the same row with different superscripts are significantly different (P<0.05). ND: Not determined. SEM: Standard error of mean

Table 2 shows the rumen parameters of West African dwarf rams fed *P. maximum* supplemented with herbaceous forage legume pellets. Rams supplement with *M. pruriens* pellets had the highest (P<0.05) rumen pH (6.91) while rams that were supplemented with *L. purpureus* pellets (6.51) had the lowest (P<0.05) rumen pH. The high ruminal pH in rams before feeding could be due to effect of low soluble carbohydrate in the rumen of the animals at that time. However, the rumen pH of the animals was reduced at 6 hours post feeding and this could be as a result of high VFA and rapid fermentation at 6 hours post feeding. Highest ruminal pH in rams fed *M. pruriens* pellet supplemented diet at 6 hours post feeding could be the effect of high tannin content which increases saliva and it serves as buffering capacity in the rumen (Yusuf *et al*., 2017). Volatile fatty acids usually accumulate in the rumen if its rate of production exceeds the clearance rate which may lower the rumen pH and cause the metabolic disturbance (Yusuf *et al*., 2013). Low VFA in the rumen of rams supplemented with *C. mucunoides* pellets, could be attributed to high fibre in the feed. At 6 hours post feeding, the VFA in the animals was higher compared before feeding except for rams supplemented with *M. pruriens* pellet. This could be due to high tannin content in the feed and this in line with the reports of Getachew and Makkar (2002) that lower production of VFAs could be due to the elevated content of tannin. The rumen pH of the rams after feeding fell within the range 6.00-7.00 required for optimal microbial digestion of fibre and protein in the rumen (Firkins, 1996). Low $NH_3$-N in rams supplemented with *C. mucunoides* pellets could be due to low crude protein content and VFA because metabolism of the ammonia requires a considerable and commensurate amount of energy (Oba and Allen, 2003). The concentration of $NH_3$-N in the rumen depends on the protein content in the feeds fed to the animals (Ranjah, 1980). The ruminal $NH_3$-N concentration of the rams were sufficient for maximizing rumen microbial synthesis since it lies within the range of 2 and 5 mg/100ml reported as minimum rumen fluid.

**Table 2**: Rumen Parameters of West African dwarf rams fed *P. maximum* supplemented with herbaceous forage legume pellets

| Parameters % | Dietary treatment | | | | SEM | P-value |
|---|---|---|---|---|---|---|
| | *P. Maximum* | *Lablab purpureus* + *P. maximum* | *Calopogonium mucunoides* + *P. maximum* | *Mucuna pruriens* + *P. maximum* | | |
| pH | | | | | | |
| Before feeding (0 hour) | 7.18[b] | 6.99[c] | 7.36[a] | 7.22[b] | 0.04 | 0.0002 |
| Post feeding (6 hours) | 6.78[ab] | 6.54[b] | 6.71[ab] | 6.91[a] | 0.05 | 0.0003 |
| Total VFA | | | | | | |
| Before feeding (0 hour) | 1.21 | 1.23 | 1.14 | 1.40[a] | 0.04 | 0.0569 |
| Post feeding (6 hours) | 1.22 | 1.31 | 1.16 | 1.22 | 0.03 | 0.0354 |
| Ammonia N | | | | | | |
| Before feeding (0 hour) | 28.07 | 34.02 | 27.56 | 34.02 | 1.51 | 0.2530 |
| Post feeding (6 hours) | 36.57[a] | 39.12[a] | 19.32[b] | 34.02[a] | 2.60 | 0.2325 |

[a, b, c] means on the same row with different superscripts are significantly different (P<0.05), SEM = standard error of means.

## CONCLUSIONS

From the results of this study, it can be concluded that rams supplemented *Lablab purpureus* pellets had highest ruminal ammonia nitrogen and the lowest rumen pH. The rumen pH of the rams were reduced at 6 hours post feeding.

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