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Nutritive Value of *Panicum maximum* Ensiled with Two Cultivars of *Lablab purpureus* (*Lablab purpureus L).* by West African Dwarf Ram

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Abstract: Silage making is an effective way of preservation both the quantity and quality of forages over hay making which is of paramount importance in sheep production. Supplementing *Lablab purpureus* (*L. purpureus*) improves the quality of *Panicum maximum* (*P. maximum*) in (*P. maximum*)/*Lablab purpureus* mixtures silages when used as basal diet. Information on *P. maximum* with *L. purpureus* mixtures as silage is scanty. The potential of *Panicum maximum* ensiled with two cultivars of *Lablab purpureus* (Highworth and Rongai) as dry season feed was therefore investigated. Silage characteristics were determined. Twenty-one West African dwarf rams were allotted to seven treatments on varying proportions of *P. maximum* ensiled with *L. purpureus*: 100% *P. maximum* (1), 75% *P. maximum*+25% Highworth (2), 50% *P. maximum*+50% Highworth (3), 25% *P. maximum*+75% Highworth (4) (75% *P. maximum* and 25% Rongai (5), 50% *P. maximum* and 50% Rongai (6) (25% *Panicum maximum*+75% Rongai (7) mixtures at 5% body weight for 98 days to assess Feed Intake (FI), Body Weight Gain (BWG), Dry Matter Digestibility (DMD) and nitrogen retention. Colour of silages was olive green with pleasant odour, firm texture, normal temperature (23-25°C) and pH range of 4.1-4.5. Least CP value was observed in diet 1 (9.0%) and highest in diet 4 (16.8%). Highest neutral detergent fibre, acid detergent fibre, acid detergent lignin were 56.1, 39.4 and 9.4%, respectively observed for diet 1. The least FI (573.87g) and BWG (23.81g) occurred in rams fed A while the highest FI (715.47g) and BWG (47.62g) was reported for rams fed G and D, respectively. Least DMD (40.4%) was obtained from rams fed E while highest (56.9%) was for rams fed G and percent retention differed significantly among treatment such that rams fed B had the least (30.7%) while those fed G had the highest (56.7%). 100% *Panicum maximum* diet had the least FI and WG while animals fed 25% *Panicum maximum* with 75% Rongai had the highest FI. Rams fed 25% Highworth had the least nitrogen retention while those fed 75% Rongai had the highest nitrogen retention. Better feed intake, nutrient digestibility, nitrogen utilization and growth rates of rams could be achieved when 25% *Panicum maximum* basal diets are supplemented with either of the two cultivars of lablab (Highworth or Rongai) at 75%. Rams placed on 25% *Panicum maximum* with 75% lablab performed better followed by those fed 50% *Panicum maximum* with 50% lablab. Similarly rams placed on 75% *Panicum maximum* with 25% *Lablab purpureus* performed better than those on sole *Panicum maximum*. 25% *Panicum maximum* ensiled with 75% lablab was thereby recommended.

Key words: Nutritive value, digestibility, silage quality, WAD ram

INTRODUCTION

Poor nutrition affects ruminant productivity in Nigeria, due to the fact that during the dry months of the year, forages are scarce and are of low nutritional quality. Sheep and goats provide a significant proportion of meat consumed in Nigeria (RIM (Resource Inventory and management Studies), 1992). Their productivity is however limited by scarcity and fluctuating quality of year round forages supply (Ajayi *et al*., 2005). Furthermore, most available ruminant feeds during dry season have been described as fibrous, resulting in low digestibility and poor livestock production (Richard *et al*., 1994). Protein supplementation of grass diets with forage legumes is essential to achieve high productivity in the animals. Forage legumes are known to have an important role in the nutrition of ruminants in terms of providing energy, protein, minerals element for chewing and ruminant (Ahmad *et al*., 2000; Ranibar, 2007). This protein supplementation affects voluntary feed intake and digestibility positively. The use of forage legumes such as lablab as feed supplements has been shown to enhance intake of poor quality forages, improve growth rates and increase production efficiency in ruminants (Orden *et al*., 2000). Feed intake increases as digestibility of energy increases and as crude protein content of the feed increases.

Based on the available information on the use of herbaceous legumes in sheep nutrition, these legumes can be grown for stall feeding, grazing or preserved as hay or silage for use during the dry season when there is scarcity of graze-able materials. A forage legume that can be grown is *Lablab purpureus* cvs Highworth and

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Rongai. Lablab is one of the major leguminous forages and a valuable feed resource for ruminant production. It can be grazed by both small and large ruminant and also be fed as fresh foliage, hay or silage (Muhammad *et al*., 2004). Babayemi (2009) described silage making as a means of supplementing feed for ruminants in the dry season. Grasses can be ensiled with legumes. *Panicum maximum* a grass which grows naturally and as improved pasture but with a challenge of rapid decline in crude protein and soluble carbohydrate can be upgraded while ensiled with a forage legume. Muhammad *et al*. (2008) reported the use of lablab in the improvement of silage quality of Columbus grass. The present study was conducted to evaluate the utilization of *Panicum maximum* ensiled with *Lablab purpureus* cvs Highworth and Rongai by West African dwarf rams.

MATERIALS AND METHODS

Experimental sites: The experiment was carried out at the teaching and research farm of the University of Ibadan in January 2011. The location was 7°27^{1}N and 3°45^{1}E at an altitude of 200-300 m above sea level. The average annual rainfall was about 1250 mm with a mean temperature of 25-29°.

Twenty one West African dwarf rams, average age of eight months old and 14.17kg-15.50kg live-weight were used for the feeding trial for 98 days. The animals were confined for one month adaptation period. During this period they were treated against external and internal parasite infections. They were also vaccinated against Peste de Petis Ruminante (PPR). During this time, they were fed *Panicum maximum* and cassava peels *ad libitum* as well as vitamin and mineral supplement in form of salt-licks. The rams were weighed and randomly divided into seven treatment groups of three animals per treatment in a completely randomized design. The animals were balanced for weight such that the initial weights were not statistically different. The rams were housed in individual pens which were cleaned and washed thoroughly with warm disinfectant to remove dirts and obnoxious odour prevailing in the house. The floor was spread with wood shavings at 5cm depth to enhance the removal of urine and faeces. The animals were placed on prophylactic treatment through the administration of antibiotics (long acting). Animals were also treated against endoparasites and ectoparasites using 10% of Levamisol and diazintol respectively. Feeders and drinking trough were placed in the pens for free access to feed and fresh water daily. Feed were offered at approximately 5% of their body weight. Voluntary feed intakes were estimated as the difference between feed offered and feed refusal. The animals were weighed prior to feeding to minimize error due to "fill" in the morning on a weekly basis to calculate average weight gain. Weight changes were determined weekly before the morning feeding.

Silage production: The grass and legume was harvested every 6 weeks from the established pasture. Guinea grass and legume (*Lablab purpureus cvs* Highworth and Rongai) were sun dried for two hours. Later the grass and legume were chopped into small sizes of 5cm lengths compressed, compacted and sealed air-tight in an anaerobic condition. The harvested grasses and legumes were weighed in order to determine the expected amount for silage making in such a way that sole grass and grass/legume mixtures were combined and fed as silage.

Digestibility and nitrogen balance: Three rams were used per treatment for digestibility and nitrogen balance study. There was an adjustment period of a week to the cage environment after which collection of urine and faeces was done for 7 days. The quantity of feed offered and refusals as well as faecal output from each ram were determined. Nitrogen loss from the urine by volatilization was prevented by adding 10 ml of 10% tetraoxosulphate IV oxide (H_2SO_4) into the container for collecting the urine sample (Chen and Hutton, 1992). Daily collections of faeces and urine were separately bulked and 10% sub-sample of each was taken. Faecal samples were oven dried at 105°C for 24 hour. The urine samples were stored in a deep freezer (-20°C) until required for analysis.

Chemical analysis: Ground samples of grass, legumes and faeces were analyzed for nitrogen by the Micro-Kjeldahl method. Dry matter, crude fibre, ether extract and ash were determined according to AOAC (1990) method. All samples were analyzed in duplicate. Acid detergent fiber, acid detergent lignin and neutral detergent fiber were determined according to Van Soest and Robertson (1985).

Statistical analysis: Data obtained were subjected to one way analysis of variance (ANOVA) using SAS (1987). Mean separation was done with Duncan (1955) Multiple F- test.

RESULTS

Chemical composition of ensiled *Panicum maximum*, *Panicum maximum* with *Lablab purpureus* cvs Highworth and Rongai mixtures are shown in Table 1. Dry matter content ranged between 33.1% in *Panicum maximum* with 25% Highworth-46.4% in sole *Panicum maximum*. Crude protein content ranged between lowest (9.0%) in sole *Panicum maximum*-highest value (16.8%) in *Panicum maximum* with 75% Highworth. NDF value ranged from lowest (44.7%) in *Panicum*

Table 1: Chemical composition of the ensiled *Panicum maximum* with *Lablab purpureus* mixture fed to WAD ram

	DM	CP	CF	EE	ASH	NDF	ADF	ADL	HEMI	CELL
T1	46.39^{a}	9.01^{d}	33.08^{b}	8.15^{d}	10.01^{b}	56.16^{abc}	39.42^{a}	9.42^{ab}	12.59^{ab}	27.99^{ab}
T2	33.10^{e}	15.13^{c}	36.15^{b}	9.05^{cd}	11.33^{ab}	44.73^{cd}	37.41^{abc}	8.61^{bc}	5.31^{b}	30.81^{a}
T3	36.26^{de}	16.78^{b}	37.07^{b}	10.35^{a}	12.00^{ab}	48.58^{bc}	38.75^{ab}	8.73^{bc}	9.83^{ab}	30.02^{a}
T4	41.47^{bc}	15.15^{c}	36.33^{b}	9.16^{bcd}	12.01^{ab}	54.36^{ab}	36.71^{abc}	9.15^{ab}	17.65^{a}	27.56^{ab}
T5	35.62^{de}	15.16^{c}	35.51^{b}	10.11^{ab}	11.01^{ab}	52.98^{ab}	37.61^{abc}	8.25^{bc}	15.37^{a}	29.36^{a}
T6	39.80^{cd}	15.16^{c}	46.05^{a}	8.80^{cd}	12.97^{a}	50.01^{ax}	37.53^{abc}	8.61^{bc}	18.63^{a}	28.92^{a}
T7	43.49^{abc}	16.51^{c}	36.17^{b}	9.56^{abc}	12.00^{ab}	53.60^{ab}	34.53^{bc}	7.80^{c}	19.10^{ab}	26.75^{a}
SEM	1.36	0.45	6.32	0.33	0.81	2.20	1.35	0.37	2.83	1.61

^{A,b,c,d,e}means with different superscript along the same column are significantly different (p<0.05)

Table 2: Performance characteristics of West African dwarf sheep Fed ensiled *Panicum maximum* and *Lablab purpureus* mixture

Parameter	T1	T2	T3	T4	T5	T6	T7	SEM
Initial body weight (Kg)	14.17	15.00	15.33	14.50	15.50	15.33	15.00	0.68
Final Body weight (Kg)	16.17^{b}	17.33^{ab}	18.83^{a}	18.50^{a}	17.83^{ab}	18.83^{a}	18.92^{a}	0.64
Body weight gain (Kg)	2.00^{b}	2.33^{ab}	3.50^{ab}	4.00^{a}	2.33^{ab}	3.50^{ab}	3.92^{a}	0.60
Daily weight gain (g/day)	23.81^{b}	27.78^{ab}	41.67^{ab}	47.62^{a}	27.78^{ab}	41.67^{ab}	46.63^{a}	6.63
Dry matter intake (g/day)	573.87^{c}	658.15^{ab}	673.11^{ab}	700.11^{a}	626.25^{bc}	683.62^{ab}	715.47^{a}	23.26
Feed conversion ratio	24.10^{c}	24.42^{c}	17.77^{b}	15.82^{a}	24.66^{c}	18.11^{b}	16.05^{a}	3.56

^{a,b,c}means with similar superscripts along the same row are not significantly different (p<0.05)

Table 3: Apparent digestibilities (%) of West African Dwarf Sheep fed *P. maximum* ensiled with *Lablab purpureus* mixtures

Apparent digestibility (%)	T1	T2	T3	T4	T5	T6	T7	SEM
Dry matter	41.4^{b}	41.9^{c}	42.6^{c}	56.7^{a}	40.4^{c}	42.6^{c}	56.9^{a}	0.74
Crude protein	70.0^{c}	70.9^{c}	71.3^{c}	78.3^{a}	70.7^{c}	71.3^{c}	78.3	0.37
Neutral detergent fibre	80.5^{a}	73.4^{b}	76.2^{c}	79.6^{a}	73.1^{b}	76.7^{ab}	79.7^{a}	1.23
Acid detergent lignin	24.9^{c}	16.4^{c}	16.6^{c}	28.6^{bc}	18.3^{c}	17.8^{ab}	28.8^{bc}	3.85
Ether extract	27.6^{c}	56.8^{b}	66.1^{a}	61.3^{ab}	57.9b	60.7^{ab}	64.0^{ab}	2.26
ASH	33.0^{bc}	43.7	44.3^{ab}	51.3^{a}	44.7^{ab}	44.1^{ab}	51.7^{a}	3.68
Crude fibre	90.4^{ab}	84.9^{b}	82.7^{ab}	87.6^{ab}	85.4^{ab}	84.5^{b}	82.8^{b}	1.71
Acid detergent fibre	72.4^{a}	62.9^{b}	77.7^{a}	72.2^{a}	63.^{b}	70.7^{a}	72.2^{a}	1.86
Hemicellulose	91.60^{a}	85.62^{b}	83.00^{c}	91.36^{a}	85.43^{b}	88.19^{a}	93.14^{a}	2.78
Cellulose	89.93^{ab}	88.39^{bc}	94.50^{a}	81.87^{d}	76.46^{e}	89.93^{ab}	84.52^{cd}	1.65

^{a,b,c}means on the same row with the same superscripts are not significantly different (p>0.05)

maximum with lablab cv Highworth-highest (56.2%) in *Panicum maximum*. There were variations also in ADF, the highest value 39.4% was obtained for *Panicum maximum*, lowest value (34.5%) was in *Panicum maximum* with 50% Rongai. *Panicum maximum* with 75% Rongai had the lowest (7.8%) ADL value and the highest (9.4%) was recorded for *Panicum maximum*. Ether extract also varied, it ranged from 8.2% in *Panicum maximum* and 10.4% in *Panicum maximum* with 50% Highworth. The value of ash content was lowest in *Panicum maximum* and highest 12.9% in *Panicum maximum* with 50% Rongai. Generally, *Panicum maximum* being grass was highest in NDF, ADF and ADL but least for CP, EE and ash contents when compared to *Panicum maximum* with *Lablab purpureus* mixtures.

The performance characteristics of West African dwarf (WAD) rams fed a basal diet of *P. maximum* supplemented with a forage legume using two cultivars are depicted in Table 2. The performance characteristics of the rams placed on the treatments differed significantly (p<0.05). The DM intakes of the rams ranged from lowest (573.87g/day) in diet 1 to highest (715.47g/day) in diet 7. The DM intakes varied significantly between treatment 1 and other 6 treatment. The intakes of rams fed diet 2 and 5 were not significantly different, intakes of rams fed diets 3 and 6 were significantly similar also intakes of rams fed diets 4 and 7 were significantly similar. The Daily Weight Gain (DWG g/day) differed (p<0.05) significantly and Body Weight Gain (kg) differed (p<0.05) significantly and follow similar trend as DM intakes. The Feed Conversion Ratio (FCR) of the rams fed diets 4 (15.82) and 7 (16.05) were the lowest, FCR for rams fed diets 3 (17.77) and 6 (18.11), FCR for rams fed diets 2 (24.42) and 5 (24.66) and FCR for rams fed diets 1 (24.10).

The apparent digestibility of WAD rams fed *Panicum maximum* with *Lablab purpureus* mixtures is presented in Table 3. The DM values differed (p<0.05) significantly among the treatments. Rams Placed on diet 1 had 41.4% value for DM digestibility. Among the rams fed the supplemented diets (diet 2-7), the DM digestibility ranged from (40.4% for rams placed on diet 5 and 41.1% for rams placed on diet 2)-56.7% for rams fed diet 4 and 56.9% fed rams fed diet 7). The CP digestibility also differed (p<0.05) significantly among treatment. Rams placed on diet 1 had the lowest (70.01%) CP digestibility value while rams placed on diet 4 (78.3%)

Table 4: Nitrogen utilization of WAD ram fed *Panicum maximum* ensiled with two cultivars of *Lablab purpureus*

Parameters	T1	T2	T3	T4	T5	T6	T7	SEM
N. Intake	6.95^{c}	12.51^{b}	11.47^{b}	13.75^{a}	11.42^{b}	11.51^{b}	14.10^{a}	0.38
N. Excretiong/day								
Faecal N	2.52^{e}	6.80^{a}	5.80^{b}	4.34^{c}	4.34^{c}	4.24^{c}	3.33^{d}	0.25
Urinary N	2.00^{abS}	1.90^{ab}	1.82^{b}	2.10^{ab}	3.43^{a}	2.30^{ab}	2.74^{ab}	0.46
Total	4.52	8.70	7.62	6.44	7.77	6.54	6.07	
N. Retained	2.43^{c}	3.81^{bc}	3.85^{c}	7.36^{a}	3.64^{bc}	4.97^{b}	8.03^{c}	0.52
N. Retention%	34.91^{cd}	30.67^{d}	33.74^{cd}	53.26^{ab}	31.75^{d}	43.60^{bc}	56.76^{a}	3.36

^{a,b,c,d}means on the same row with the same superscripts are not significantly different (p>0.05)

and on diet 7 (78.3%) had the highest CP digestibility values. The NDF digestibility values differed significantly (p<0.05) among the treatments, the values ranged from lowest (73.1%) for rams placed on diet 5-highest (80.0%) for rams placed on diet 1. The ADL digestibility values and the ADF digestibility values also differed significantly (p<0.05). The ADL digestibility values ranged from the least (16.4%) for rams fed diet 2 to highest (28.8%) for rams fed diet 7 and (28.6%) for rams fed diet 4. The ADF digestibility values follow the same trend as ADL digestibility. The Hemi-cellulose digestibility values differed significantly (p<0.05), the values ranged from the least (83.0%) for rams fed diet 3 to the highest (93.1%) for rams fed diet 7.

Table 4 reveals the nitrogen utilization of WAD sheep fed *P. maximum* and *L. Purpureus* mixtures. The mean values obtained differed (p<0.05) significantly among the treatments. The least value of nitrogen intake and nitrogen balance was observed in sheep fed diet 1 while the least percent retention (30.7) was observed in sheep fed diet 2 which was not statistically different from percent retention (34.9) obtained for animals fed diet 1.The highest nitrogen intake, nitrogen balance and percent retention was observed in sheep fed diet 7 while the next higher value for nitrogen intake, balance and percent retention was observed for sheep fed diet 4. Among the sheep supplemented with lablab, nitrogen intake ranged from 11.47g/day (diet 3)-14.10 g/day (diet 7). The percent nitrogen ranged from 30.7% (diet 2)-56.8% (diet 7).

DISCUSSION

Some of the determinants of suitable forage species for use as a silage material include high yield per unit area, nutritional quality at ensiling and quality of the resultant silage (Kallah *et al*., 1997). The treatments evaluated did manifest a defined trend for Dry Matter (DM) as fed. Apart from the dietary treatment 1, the other treatments with increasing levels of inclusion of lablab irrespective of the cultivar had increasing percent of DM.

The Crude Protein (CP) content of the prepared silage was outstanding. The CP of the *Panicum maximum* obtained in this study compared well with values reported in literature (Babayemi, 2009). The CP of the *Panicum maximum* obtained in the present study is higher than the critical value of 7.7% or 70g/kg recommended for small ruminants (National Research Council, 1981) and very close to the minimum requirement of 10-12% recommended by ARC (1985) for ruminants. Increase in the level of lablab (25, 50 and 75%) incorporated in the silages resulted to increase in the percent CP, CF, EE and ash in all the treatments examined. This perhaps suggests the need for inclusion of higher levels of legume to capture the optimum legume requirement for inclusion in *P. maximum* silages at soft dough stage of maturity. The higher CP, the lower the fibre and the lower the DM recorded in this study also reflected that they were still young at cutting for ensiling (Bamikole *et al*., 2004). On the other hand, older grasses are low in CP but high in fibre and DM (Babayemi and Bamikole, 2006b).

While the increasing trend observed in CP is in agreement with report from (Babayemi *et al*., 2006). However, Titterton and Maasdorp (1997) recommended 40% inclusion of legumes in grass-legume silage. In mixed *Panicum maximum*-legume silage, *Panicum maximum* provides the fermentable carbohydrate while the legumes improve the protein of the silages. The level of CP in the sole *Panicum maximum* is above the minimum requirement for ruminants (Minson, 1976).

The NDF values obtained for the grass and forage legumes are within the range of 24-61 reported for tropical forages (Topps, 1992). While, silages prepared with lablab and *Panicum maximum*, in addition, lablab contributed more to the content of EE in the silage prepared. This could perhaps mean that lablab is higher in some components of nutritive value relative to others. While crude protein values realize for sole silages compare with data reported by Kallah *et al*. (1997), higher values were obtained from the legume fortified silages.

The higher total dry matter intake DMI for the legume supplemented diets (diets 2-7) compared with the *Panicum maximum* diet only (diet 1) in this study could be due to the higher crude protein content and low NDF and ADF contents of the legumes. The DMI for the 25% Highworth and Rongai supplemented diets (diets 2 and 5) were significantly similar, were higher than DMI for diet 1. The DMI for the 50% Highworth and Rongai supplemented diets (diets 3 and 6) were significantly similar and were higher than DMI for supplementary diets (diets 2 and 5). The DMI for the 75% Highworth and

Rongai supplemented diets (diets 4 and 7) were significantly similar and were higher than DMI for supplementary diets (diets 3 and 6). The same trend follows for DWG. It is a known fact that the high CP content of a feed stimulates more feed intake (Oldham and Alderham, 1980). The similarity of the DMI of the legumes supplemented diets 2 and 5, 3 and 6, 4 and 7, Could be ascribed to the comparable values of the CP contents of the legumes.

Low DMI reported for *Panicum maximum* could be linked to the high NDF content of the grass. A feed high in NDF usually has low voluntary intake as it occupies a large volume in the rumen. NDF concentration is used as an index of gut fill to predict voluntary feed intake (Mupangwa *et al*., 2000). Supplementation of a basal diet of grass or crop residue with legume usually increases DMI of the animals. This conforms to earlier findings (Mtenga and Shoo, 1990; Ifut, 1992).

Apparent nutrient digestibility (DCP, DADL, DEE, DASH) of rams fed the *Lablab purpureus* supplemented diets were significantly ($p<0.05$) higher than those on *Panicum maximum* diet only, probably because they consumed higher levels of crude protein occasioned by the higher concentration of crude protein in the legumes. The nitrogen retained or balance and retention values were the best in animals placed on treatments 4 and 7 however, the highest value obtained in these two treatments is in agreement with the assertion that nitrogen retention increased with protein supplementation (Mupangwa *et al*., 2000).

Conclusion: Improved dry matter intake, nutrient digestibility, nitrogen utilization and growth rates of rams could be achieved when *Panicum maximum* basal diets are supplemented with either of the two cultivars Highworth or Rongai at 25:75 of *Lablab purpureus*. Rams placed on 25% *Panicum maximum* with 75% lablab performed better followed by those fed 50% *Panicum maximum* with 50% lablab. Similarly rams placed on 75% *Panicum maximum* with 25% *Lablab purpureus* performed better than those on sole *Panicum maximum*.

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