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Performance of West African dwarf goats fed *Panicum maximum* and concentrate diets supplemented with Lablab (*Lablab purpureus*), Leucaena (*Leucaena leucocephala*) and Gliricidia (*Gliricidia sepium*) foliage.

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Abstract

Performance of Sixteen West African dwarf (WAD) goats were evaluated by feeding varying proportions of Lablab purpureus (LP) and Panicum maximum (PM) based diets. The study lasted for 105 days during which Leucaena leucocephala (LL) with Panicum maximum (PM) were fed at ratio 25:75 (T_1), Gliricidia sepium (GS) and PM at ratio 25:75 (T_2) and Lablab purpureus (LP) with PM were fed at ratio 25:75 (T_3) and 50:50 (T_4) respectively. Concentrate (13 % CP) was given to the animals at 1 % body weight. The animals were arranged in a completely randomized design. Parameters such as feed intake, growth rate, digestibility and nitrogen balance were monitored. The DM intake (g/kg$W^{0.75}$/day) was not significant among the treatment means. Animals placed on 50 % lablab had better dry matter than goats in other treatments. Treatment 3 and 4 had highest values 115.71 and 121.87 respectively than the control, Treatment $_1$. The crude protein intake (g/kg$W^{0.75}$/day) was highest in treatment 4 (23.97) and lowest in treatment 3 (20.57). The liveweight gain (g/day) was highest in animals fed with leucaena and those on 50% lablab. The digestibility of DM, CP, ADF, ADL and NDF were generally higher than the control and best in the 50 % lablab supplementation. The N balance (g/kg$W^{0.75}$/day) and retention were also highest in 50 % lablab and lowest in 25 % Gliricidia supplemented diet. Result indicated that feeding lablab at 50 % supplementation with Panicum maximum-diets could lead to improve feed intake, weight gain, digestibility and nitrogen utilization in WAD goats.

Keywords:*Lablab purpureus, Leucaena leucocephala, Gliricidia sepium*, digestibility, WAD goats.

Introduction

The insufficiency of year round grazeable forages for livestock, owing to seasonal changes is a major constraint to livestock production in Nigeria. The seasonal forage supply stems from uneven distribution of annual rainfall in most parts of the tropics, which explains the alternating abundance, and scarcity of grazeable forage. This poses serious forage management and animal feeding difficulties during the dry season in Nigeria, when available forage materials could no longer provide the minimum protein and energy requirements to grazing animals (Obioha and Ndukwe, 1976). The feed resources that are in ample supply to provide the bulk of ruminant feeds in the humid tropics include biomass from grasslands and crop residues. These are incapable

of sustaining most animals throughout the dry season. Adegbola (1985) reported that ruminants could not meet their maintenance needs on grass alone. Therefore, there is the need for legume forages that improve livestock nutrition during this period

Lablab purpureus (LP) is one of the under-utilized legume forages that can tolerate the dry season period. Ogundipe *et.al,* (2003) reported that LP remains green far into the dry season, easy to cultivate, very rich in nutrients and is rapidly gaining acceptance by peasant and commercial livestock farmers. Lablab is a dual-purpose legume with high biomass yield, which makes it suitable for ruminant feeding systems. Adu, *et.al,* (1991) stated that it is a legume that thrives well in the dry season between November and February in Northern Nigeria. It is drought resistant and usually sown after the normal cropping season, thereby acting as a buffer crop for ruminant feeding during the dry season. Ayoub (1986) reported a dry matter yield and N-content of 5.4t/ha and 2.53% respectively when grown as monoculture crop.

Several workers have investigated the supplementary effects of lablab in the diets of ruminants. NRC (1976) reported that the legume would supply minerals such as P, Ca, K, Mn and Fe requirements of beef cattle. It has been used as a protein supplement for Tswana sheep and goats (Aganga and Autlwetse, 2000) at 40% level of inclusion to enhance productivity and in Matebele goat breed (Ndlovu and Sibanda, 1996). The feeding value has not been evaluated in West African Dwarf goats. This study was therefore designed to investigate the effects of *Lablab purpureus* on the performance of WAD goats.

Materials and methods

The study was conducted at the sheep and goat unit of the Institute of Agricultural Research and Training, Moor Plantation, Ibadan, Nigeria (Latitude 7°15¹ to 7°30¹N and Longitude 3°45¹ to 4°0¹E). The area has a tropical humid climate with mean annual rainfall of 1415 mm and the average daily temperature between 28°C to 35°C.

Lablab purpureus seeds were obtained from the International Livestock Research Institute (ILRI), Ibadan, Nigeria. The cultivar used was the Highworth black. The seeds were soaked in hot water for 5 minutes to break the hard seed coat and then air dried before planting in June 2002 using 1 m x 1 m spacing.

Sixteen WAD goats comprising 8 bucks and 8 does, aged between 5 and 7 months old were used for the feeding trial. The average liveweight was 7.77±0.49 kg. They were purchased from villages about 30 km from the study area. On arrival at the farm, the goats were given prophylactic treatments, which consisted of intramuscular application of long acting antibiotics at the dosage of 1 ml/10 kg body weight of the animals. They were injected with levamisole at 1 ml/10 kg body weight to control endoparasite and dipped in asuntol solution against ectoparasites. Individual pens were cleaned and disinfected with Morigard disinfectant before the arrival of the animals. Each pen had its floor covered with wood shavings of about 5 cm layers, which was replaced every two weeks as bedding materials. The animals were adapted for 21 days and were fed grass and cassava peels during the period . The experimental diets were introduced after 21 days adaptation period as follows:

Treatment 1: (25 % *Leucaena* + 75 % *Panicum maximum*)
Treatment 2: (25 % *Gliricidia* + 75 % *Panicum maximum)*
Treatment 3: (25 % *Lablab* + 75 % *Panicum maximum)*
Treatment 4: (50 % *Lablab* + 50 % *Panicum maximum).*

The leaves of P. *maximum* and those of legume trees (leucaena and gliricidia) were collected from the research farm. The *P. maximum* was harvested at the pre–anthesis from the

established pasture of the farm. The grass was sun dried for three days as hay and chopped to 5 cm pieces for the feeding trial, which commenced in August 2003. Leaves of leucaena, gliricidia and lablab were harvested and air-dried for about six hours prior to feeding.

Based on body weights and sex, the animals were divided into four groups of four per treatment and were randomly allocated to the experimental diets in a completely randomized design. Each goat was housed individually in separate pens with provision for feeding and water troughs. Wood shavings were provided as bedding material. The forages were offered at 08:00 h and concentrate at 15:00 h. The composition of the concentrate include 10 % maize, 50 % maize offal, 25 % dried brewers grain, 17 % soybean meal, 4 % bone meal, 0.5 % common salt and 0.5 % vitamin premix. The concentrate was offered at 1 % body weight. The concentrate was fed to take care of any imbalance in nutrient intake that may arise due to the use of the forages. Provision was made for daily feed allowance of 10 % above the previous day's consumption. Fresh water was made available all the time. Daily voluntary intake was estimated by differences in the feed offered and the remnants collected. The goats were weighed weekly before the morning feeding to ascertain the weight changes.

Digestibility and Nitrogen balance

Three goats were used per treatment for digestibility and nitrogen balance studies. Each goat was kept in an individual metabolism cage designed for separate collection of urine and faeces for 7 days after one-week adjustment to the cage. The quantity of feed offered, feed residue, faeces and urine from each goat were determined. Nitrogen loss from the urine by volatilization was prevented by introducing 10 ml of 10 % H_2SO_4 into the urine sample (Chen and Gomez, 1992). Daily collections of faeces and urine were separately bulked and a 10 % sub sample of each was taken. Faecal samples were oven dried at 70°C for 48 hours. Urine samples were stored in a deep freezer until required for analysis

Blood collection

In the last week of the feeding trial, goats were bled through the jugular vein puncture and 5 ml of blood was collected into EDTA bottle for haematological analysis.

Chemical analysis

Dried samples were milled with Thompson hammer mill using 2 mm sieve. Samples were analysed for nitrogen by the Micro-kjeldahl method. Dry matter, crude fiber, ether extract and ash were determined according to the Official Methods of Analysis (A.O.A.C 1990). Samples were analysed in duplicate. Nitrogen free extract was obtained by calculation while Acid detergent fiber, neutral detergent fiber and acid detergent lignin were determined (Van Soest and Robertson, 1985). Mineral analyses of iron, magnesium and calcium were read with atomic absorption spectrophotometer after ashing of samples in a muffle furnace at 550°C. Sodium and potassium were analysed using the flame photometer and phosphorus by spectrophotometer (Spectronic 20).

Packed cell volume (PCV), haemoglobin (Hb) concentration, red blood cell (RBC) and white blood cell (WBC) were determined as described (Jain, 1986). The energy value was determined from Pauzenga equation (1985): 37 x % Protein + 81.8 x % Fat + 35.5 x % NFE (Nitrogen free extract). Oxalate was determined by the method of Beutler *et al.*, (1980) and phytate by the method of Maga (1983).

Statistical analysis

Data obtained were subjected to the analysis of variance according to the method of Steel and Torrie (1980). Significant treatment means were compared using the Duncan (Duncan, 1955) Multiple Range F-Test. Regression analysis was used to estimate the growth rate.

Results

Table 1 shows the chemical composition of the diets fed to WAD goats. *Panicum maximum* had the lowest CP content (7.20 %) but contained the highest amount of NDF and ADF. The lowest values for NDF and ADF were in the Leucaena. The ADL value ranged between 8.67 to 11.66 % being the lowest in *Gliricidia sepium*. The ash content ranged between 8.05 to 11.25 %. The sodium level was highest in leucaena and lowest in the grass. The same trend occurred in the calcium level. Potassium level was highest in the grass but lowest in gliricidia. The Fe in the forage legume ranged between 153.07 to 161.40 ppm with Leucaena possessing the highest value. Lablab was the least in oxalate and phytin, these compounds were however, highest in leucaena.

Table 1: *Proximate composition (g/100gDM) of Panicum maximum, forage legumes and concentrate diets fed to WAD goats*

Composition	*Panicum. maximum.*	*Leucaena leucocephala*	*Lablab purpureus*	*Gliricidia sepium*	Concentrate
Dry matter	71.29	63.14	48.81	54.62	84.27
Crude protein	7.20	22.40	14.06	19.38	16.22
NDF	73.39	38.76	51.44	46.15	28.17
ADF	36.95	27.14	32.57	29.95	46.25
ADL	8.71	11.66	9.53	8.67	3.14
Ash	11.25	8.05	9.47	9.73	14.38
Ether Extract	3.07	3.53	2.83	2.30	18.62
NFE	25.18	43.55	42.39	39.74	34.18
Mineral composition					
Sodium (%)	0.01	0.23	0.17	0.20	0.13
Calcium (%)	0.21	0.27	0.23	0.22	0.68
Potassium (%)	1.99	1.86	1.52	1.50	2.10
Iron (ppm)	153.07	161.40	156.29	159.02	174.59
Anti-nutritional factor					
Oxalate (mg/100g)	-	0.66	0.52	0.54	-
Phytate (mg/g)	-	26.80	20.20	24.30	-

The performance characteristics of the goats are shown in Table 2. The goats placed on all the dietary treatments consumed an average of 443 g of grass. The highest ($P<0.05$) consumption of grass and legume was recorded for animals on 50 % lablab and 50 % *P. maximum*. Significant differences did not occur ($P>0.05$) for crude protein, NDF and ADL intake (g/ $kgW^{0.75}$/day) among the treatment means.

Table 3 presents the apparent digestibility of the nutrients by the goats. Significant differences did not occur ($P>0.05$) among the treatments in the DM, CP, NDF and ADF digestibility except for ADL and energy. Animals on Treatment 4 had highest apparent dry matter, crude protein, ether extract and ash digestibility.

Table 4 shows that significant ($P<0.05$) differences occurred among the treatment means for goats in N utilization. Animals on diets supplemented with lablab had an encouraging N utilization when compared with those on treatments 1 and 2. The least and highest N balance were observed for the animals on treatments 2 and 4 respectively. The N retained

by goats was outstanding (P<0.05) in the lablab-supplemented diets than others.

The value of the concentration of haemoglobin by animals on treatment 4 was highest (P>0.05) than the rest treated animals (Table 5). The value of WBC for goats placed on treatment 3 was highest (P>0.05). The same trend was observed in the RBC concentration.

Animal on treatment 1 had the least PCV (P>0.05) when compared to other treatment means. Regression equations of weekly mean body weight (kg) of the animals with age (week) are presented on Table 6. In all cases, the regression was significant (P<0.05), which implies that the rates of growth were affected by treatments. Animals on treatment 1 had the fastest growth rate (56.0 g/d) and followed by animals on treatment 4 (50.0 g/d).

Table 2: *Performance characteristics of WAD goats fed Panicum maximum, forage legumes and concentrate diets.*

Parameters	T1 75% *P.max.* + 25% leucaena	T2 75% *P.max.* + 25% gliricidia	T3 75% *P.max* + 25% lablab	T4 50% *P.max.* + 50% lablab	SEM
Intake (g DM/day)					
Grass	439.01	425.88	449.10	456.60	
Leucaena	89.70	-	-	-	
Gliricidia	-	76.78	-	-	
Lablab	-	-	90.20	177.0	
Concentrate	70.04	70.04	70.04	70.04	
Total	611.26[a]	604.84[a]	615.56[a]	704.39[b]	3.64
Nutrient Intake (g/kgW $^{0.75}$/day)					
Dry matter	111.54	112.84	115.71	121.87	15.11
Crude protein	22.38	20.72	20.57	23.97	1.50
NDF intake	85.50	83.00	88.72	97.03	5.64
ADF intake	56.92	55.71	58.62	64.51	3.08
ADL intake	19.06	17.65	18.78	21.24	1.14
Initial liveweight (kg)	7.00	7.55	7.10	7.51	
Final liveweight (kg)	11.65	11.33	11.18	12.20	
Weight gain (g/day)	56.00	46.00	47.0	50.00	2.22

[a,b,c]Means on the same row with the same superscripts are not significantly different (P>0.05)

Table 3: *Apparent digestibilities (%) of WAD goats fed Panicum maximum, forage legumes and concentrate diets.*

Apparent digestibility (%)	T1 75% *P.max.* + 25% leucaena	T2 75% *P.max.* + 25% gliricidia	T3 75% *P.max* + 25% lablab	T4 50% *P.max.* + 50% lablab	SEM
Dry matter	59.74	64.88	67.72	71.87	2.81
Crude protein	73.57	70.95	68.47	74.13	1.49
NDF	79.56	79.12	77.48	79.93	5.49
ADF	67.41	73.65	67.29	69.38	6.75
ADL	33.45^{b}	37.98^{ab}	50.13^{b}	45.47^{ab}	2.79
Ether extract	86.84^{b}	89.29^{ab}	96.73^{a}	95.27^{a}	1.80
Ash	50.56	56.45	58.94	66.93	3.72
Energy concentration (MJ/kgDM) [x]					
Digestible energy	21.40^{a}	19.58^{b}	20.45^{ab}	20.15^{ab}	0.35
Metabolizable energy	17.12	15.66	16.32	16.12	0.96

[a,b,c]Means on the same row with the same superscripts are not significantly different (P>0.05)
x = Determined by Pauzenga (1985) equation

Table 4 : *Nitrogen utilization of WAD goats fed Panicum maximum , forage legumes and concentrate diets*

Parameters	T1 75% *P.max.* + 25% leucaena	T2 75% *P.max.* + 25% gliricidia	T3 75% *P.max* + 25% lablab	T4 50% *P.max.* + 50% lablab	SEM
Nitrogen intake (g/day)[y]	2.08	2.44	2.27	2.48	0.13
Nitrogen excretion (g/day)					
Faecal	1.03	1.22	1.07	1.14	0.25
Urinary	0.66^{b}	0.14^{c}	0.22^{c}	0.88^{a}	0.04
Total	1.09^{b}	1.36^{a}	1.09^{b}	1.22^{b}	0.04
Nitrogen balance ($g/kgW^{0.75}$/day)	0.99^{b}	0.88^{ab}	1.18^{ab}	1.26^{a}	0.08
Nitrogen retained (%)	47.60^{a}	39.29^{b}	51.98^{a}	50.81^{a}	1.22

a,b,c = Means on the same row with the same superscripts are not significant different (P>0.05)
y = N intake by measurement during metabolic trial.

Table 5: *Haematology of the WAD goats fed Panicum macximum ,forage legumes and concentrate diets*

	T1	T2	T3	T4	
Parameters	75% *P.max.* + 25% leucaena	75% *P.max.* + 25% gliricidia	75% *P.max* + 25% lablab	50% *P.max.* + 50% lablab	**SEM**
Haemoglobin (g/dl)	6.89	8.51	8.50	8.77	0.79
White blood cell x 10^3 ul	22.15	20.89	25.59	23.46	1.76
Red blood cell x 10^6 ul	12.98	11.15	17.14	17.26	2.14
PCV (%)	20.53	25.40	24.67	23.49	1.32

Table 6: *Regression equations of mean weekly body weight (kilogram) with age (week) of animals fed Panicum maximum, forage legumes and concentrate diets*

Treatment	Regression equation	R^2
1	7.00 + 0.056x	0.96
2	7.55 + 0.046x	0.99
3	7.11 + 0.047x	0.98
4	7.51 + 0.050x	0.98

Discussion

The crude protein of lablab was consistent with previously reported value (Makembe and Ndlovu, 1996). The CP values obtained in *Panicum maximum*, leucaena and gliricidia are comparable to values reported in literature (Aye and Adeyeye, 2002; Aye, 2002; Arigbede *et. al.*, 2002). The NDF and ADF in lablab were lower when compared with the values of 57.90 % and 46.60 % reported in other studies (Makembe and Ndlovu, 1996; Ndlovu and Sibanda, 1996). A lower amount of the fiber component in lablab was possible as the legume was harvested at about 12 week regrowth. However, the NDF of leucaena in this study was similar to value reported elsewhere (Larbi *et. al.*, 1997). Also values obtained for Gliricidia was higher than the value reported (Larbi *et. al.*, 1997). The values of the nutrients obtained in the present study could be reasonable since the result may largely depend on the age of the forage. The values of phytin and oxalate obtained for the browse plants fell below the range of 82.03 to 292.91 mg/g for phytin and 0.33 to 2.06 mg/ 100mg respectively (Onwuka, 1996). These values, which were below the normal connotes that some essential minerals required by the animals from the forages could easily be made available. The major economic importance of phytic acid is its ability to complex certain mineral elements such as Ca, Mg, Fe and Zn (Nelson *et. al.*, 1968) thereby rendering them metabolically unavailable. Similarly, Fasset (1966) and Oke (1969) suggested that Mg metabolism may be impaired by oxalic acid if freely present in the forage. The major minerals appeared adequate for ruminant animals based

on the recommendations (ARC, 1980; Suttle, 1983; Fettman *et al.*, 1984)

There was higher dry matter intake in diets supplemented with lablab than the control diets. This could be as a result of the succulent nature of the lablab coupled with its endowed higher CP. High dry matter intake had also been reported in lablab than sitratro and stylo with cassia hays as basal diet (Mupangwa *et. al.*, 2000). In the present study, supplementation of *Panicum maximum* with increasing levels of lablab increased the DM intake of the goats. This result is in agreement with the findings of Umuna *et al.*,(1995) and Oldham and Alderman (1980); Smith *et al* (1995a) and Adejumo (1987). The higher CP, NDF and ADL intakes by the goats consuming equal amounts of lablab and Guinea grass were encouraging, suggesting that lablab is palatable.

The digestibility values were fairly high in all the treatments. The apparent digestibility of the animals, particularly those placed on treatment 3 is in agreement as reported (Mupangwa *et. al.*, 2000). The highest value of dry matter digestibility of the studied goats on 50 % lablab plus 50 % Guinea grass might be due to the increased crude protein intake. The high intake resulting to higher protein digestibility may be connected with the nature of the forage. Small ruminants preferred sweet or sour plant and generally reject bitter plants (Krueger *et al.*, 1974). High crude protein in the diets has been considered an important factor that enables high intake of the feed. Oldham and Alderman (1980) established that sometimes *ad libitum* intake by the animals is increased by an increased in crude protein content of the diet. The ME intake in the lablab supplemented animals was above the daily maintenance requirement of 2.32 MJ/ME for confined goats with liveweight of 10 kg (Steele, 1996). The nitrogen balance and retention values were the best in animals placed on treatments 3 and 4. However, the highest value obtained in treatment 4 is in agreement with the assertion that nitrogen retention increased with protein supplementation (Mupangwa *et al.*, 2000). The Hb content in treatment 1 was the lowest when compared to the mean values obtained for goats on treatment 2, 3 and 4. This value is below the normal physiological range of Hb for goats (Oscar, 1971). The high phytin level in the leucaena which has the ability to bind some minerals including iron (Nelson *et al.*, 1968) may be responsible for the low Hb obtained for the goats on treatment 1. The values of the WBC, RBC and PCV obtained for the goats on remaining treatments were within the physiological range (RBC: 8.0 – 18.0x10^{6}ul, WBC: 4.0 – 13.0x10^{3}ul, Hb: 8.0 – 14.0g/dl, PCV: 19.0 – 38.0%) (Oscar 1971).

Conclusion

Lablab purpureus, when used as supplement to *Panicum maximum*-based diet improved the dry matter intake, nutrient digestibility, nitrogen utilization and growth rates of goats. The haematological studies showed that the lablab was not detrimental to animal health and therefore, could be used up to 50% inclusion with *P. maximum* in goat diets. Since lablab is drought resistant and therefore available to the peak of the dry season, it could reliably be used for goat feeding as supplement to the low quality grass that are available during the dry season and thereby increasing the productivity of the animal throughout the season.

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