Nigerian J. Anim. Sci. 2017 (1):223 - 231

Growth Performance, Nutrient Digestibility and Nitrogen Retention in Female Rabbits Fed *Sorghum Almum: Lablab Purpureus* Forage Mixtures

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Target audience: Farmers, Forage agronomists, Extension agents and Animal Scientists.

Abstract

A study was conducted to determine the effect of varying inclusion levels of Sorghum almum and Lablab purpureus mixtures on growth performance, nutrient digestibility and nitrogen retention in female rabbits. A total of 20 female rabbits of different cross breeds with initial live weight range of 450g-500g were fed rations with inclusion levels of 100%Sorghum almum (SA), 75:25%Sorghum almum-Lablab (SL), 50:50% Sorghum almum-Lablab (SL) 25:75% Sorghum almum-Lablab (SL) and 100%Lablab (LL), respectively in a completely randomized design (CRD). The rabbits were allotted into 5 dietary treatments with 4 rabbits per treatment which served as replicates. The result shows that final live weight, dry matter intake and feed conversion ratio were significantly (P<0.05) influenced by the treatments. Female rabbits supplemented with 50:50%SL and 25:75%SL had higher (P<0.05) final weight gain (1665.73g vs. 1617.36g) and average daily weight gain (19.62g vs.18.96g) than the others. The highest feed intake (95.75g/d) was recorded in rabbits fed 50:50% Sorghum almum-Lablab (SL) forage mixture. The least feed conversion ratio (3.83) was recorded in the 75:25%SL inclusion levels of Sorghum almum and Lablab (SL) in the diets. There were significant effects (P<0.05) on nutrient digestibility, nitrogen retention and nitrogen absorbed by the female rabbits among the treatments. From the study carried out, it was concluded that Sorghum almum: Lablab forage mixture of 50:50%SL in the feed of female rabbits would be optimum for improved productive performance. However, further research could be carried out to ascertain the effect of Sorghum almum: Lablab forage mixtures on

Key words: *Sorghum almum*, Dolichos lablab, feed, mixture, Nigeria, rabbit

Description of Problem

The poor economic condition in many tropical countries coupled with associated increase in the shortage of quality animal protein has turned attention to rabbit production (1). One reason for the shortage of animal protein in the diets of most Nigerians is inadequate supply and exorbitant cost of conventional feed ingredients, leading to high cost of meat and animal products such as beef, mutton, goat meat, poultry eggs and milk (2). Akinmutimi and Ezea (3) stated that conventional feeds account for about 70% of the total cost of rabbit production making them expensive to most small-scale farmers. Rabbits have been recommended as having the best productive advantages to bridge the protein deficiency gap (4). Similarly, (5) reported that increased rabbit production is one sure way of meeting the animal protein requirements of the populace. The advantages of keeping rabbits include but not limited to the following: Rabbits have small body size, short gestation period, high reproductive potential, rapid growth rate, being pseudo ruminant, rabbit have the ability to utilize forages compared to beef, chicken and mutton (6). Also rabbits are 2.5 and 4 times more efficient in extracting protein from forages than sheep and beef cattle, respectively (7). Rabbit require minimal initial capital outlay and can be easily sold when small amount of money is needed to meet the immediate need of the family (8).

Rabbit production is an effective means of converting green forages and by-products into high quality protein for human consumption (9). Green forages form the bulk of rabbit ration. The availability of these greens which are scarce during dry season last between October and April in most parts of Northern Nigeria (10). The potential of forages as feed for rabbit is of particular significance because of their availability and ability of rabbits to effectively digest leaf protein (11). The development of high quality forage-based diets with simple supplements is a priority research area in developing countries (12).

Two natural feed resources on which feeding system can be based in Nigeria are *Lablab purpureus* and *Sorghum almum*. These forages can be produced in almost all ecological zones in Nigeria. *Lablab purpureus* produces high quality conserved feed (4t DM/ha and 120gCP/kgDM) (10). *Sorghum almum* makes a good quality coarse hay and silage (7). Studies have also shown that rabbits can utilize 50 g of concentrate with forage grasses or legumes and still grow at a rate of 5-13 g/day (3). It is of a great importance that feeding rabbits with diets containing higher dietary fiber levels not only provides nutrient substances, but also has the function of maintaining micro-ecological balance of gut, promoting digestive system development and consequently improving the productive performance (3). This study was undertaken to evaluate the growth performance of female rabbits fed *Lablab purpureus and Sorghum almum* forage mixtures in Northern Guinea savannah of Nigeria.

Materials and Methods

Experimental site

The experiment was conducted at the Rabbitary Unit of the Teaching and Research Farm of the Department of Animal Science, Ahmadu Bello University, Zaria, Nigeria. It is located within the Northern Guinea Savannah zone of Nigeria: Latitude $11^0$9'45"N and longitude $7^0$38'8"E at an altitude of 610m above sea level. The climate of the study area is characterized by discrete wet and dry seasons. The mean annual rainfall vary from 617 -1365mm with an average of 1041mm between July and September (13). The location has about 4-8 months of dry season with maximum and minimum temperature 33 and 15.2^0c, respectively. It has an ambient temperature ranging between 22°C and 24°C (13).

Experimental diets, Animals and management

The experimental diets consisted of five (5) diets with different inclusion levels of *Lablab purpureus and Sorghum almum* mixtures (100SA; 75:25%SL; 50: 50% SL; 25: 75% SL and 100% LL, respectively. The composition of the concentrate diet is presented in Table 1.

Twenty female rabbits of six weeks old (450-500g) were purchased from Samaru market in Zaria, Kaduna State. The rabbits were mixed breeds (Dutch, Carlifornian white and Newzealand white). The rabbits were prophylactically treated against internal and external parasites immediately after arrival. All animals received 0.1ml/Kg body weight of Ivermectin (10ml) injection and 0.1mg/Kg body weight of Tetranor (Oxytetracycline Dehydrate, 20% weight/volume injectable solution). They were housed in a long three tier wire cages, consisting of 12 hutches (3 hutches in each column and 4 across the row). Each row had a collection tray under it for the collection of faeces and urine. Each hutch had a feeding and water pot. The floor of the house was made of a hard concrete for easier and proper cleaning. The rabbit house was cleaned prior to their arrival and the place was disinfected. The rabbits were allowed to adjust for 14 days; they were fed concentrate diet containing no inclusion levels of *Lablab purpureus* or *Sorghum almum*. The rabbits were grouped into 4 in a completely randomized design with

Table 1: Ingredient composition of the concentrate diet

Ingredients	Amount (%)
Maize bran	40.00
Maize Offal	17.00
Groundnut Cake	16.00
Rice offal	15.00
Soya Cake	8.00
Oil Sludge	0.50
Limestone	0.50
Bone meal	2.50
Salt	0.25
Vitamin Premix	0.25
Total	100
Cost/25Kg Diet (₦)	1258.25
Calculated Analysis	
%CP	16.71
ME (Kcal/Kg)	2616.81
%EE	4.69
%CF	10.14
%Ca	0.92
Available P%	0.46
Ca:P ratio	2.01

*A Vitamin mineral premix provides per kg diet: Vitamin A, 13.340 iu, vitamin D_3 2680 iu, vitamin E_{10}iu, vitamin K, 2.68 iu, Calcium pentothenate, 10.68mg, Vitamin B_{12} 0.022mg; Folic acid, 0.668mg; Choline chloride 400mg; hlortetracyS Line, 26-28mg; Manganese, 133.34mg; Iron, 66.68mg; Zinc, 53.34mg; Copper, 3.2mg; Iodine, 1.86mg; Cobalt, 0.268mg; Selenium, 0.108mg.

each rabbit serving as a replicate. The initial weights of the rabbits were taken at the beginning of the experiment and at weekly interval thereafter; feed given was weighed daily and leftover feed was weighed to determine the feed intake. Weight gained, feed consumed, feed conversion ratio (FCR), feed cost (Ɛ) and feed cost/kg gain (Ɛ) were calculated.

At the end of the feeding trial of eight (8) weeks, nutrient digestibility study was conducted on the 9th week. The rabbits were caged individually for faecal and urine collection. A known weight of the experimental diet was supplied daily and fresh drinking water was given ad libitum. Total daily faecal droppings and urine output were collected for five days. Urine samples were collected in small plastic bottles containing 10ml of 10% dilutes H_2SO_4 to minimize nitrogen loss. The faecal samples were weighed and oven-dried daily for a period of five days. The dried faecal samples were bulked according to treatments, sub-sampled and kept in dry polythene bags before analysis. The urine samples were also bulked according to treatments, sub-sampled and kept in plastic bottles before analysis. Percentage digestibility was calculated using the formula:

$$\text{Digestibility (\%)} = \frac{\text{Nutrient intake - Nutrient in faeces}}{\text{Nutrient intake}} \times 100$$

Chemical Analysis

Milled samples of the *Lablab purpureus and Sorghum almum* forages of the experimental diets were taken to the Biochemistry Laboratory, Department of Animal Science, Ahmadu Bello University, Zaria for proximate analysis. This was determined according to the A.O.A.C (14) procedure. The following parameters were determined:% Dry matter (DM),% Crude protein (CP),Crude fibre (CF),% Ether extract (EE), % Ash and % Nitrogen-free extract (NFE). NFE was calculated as NFE=100-(%CP+%CF+%EE+%Ash).

Statistical Analysis

All data collected on feed intake, nutrient digestibility, growth performance and nitrogen retention were subjected to statistical analysis of variances (ANOVA) using (15) procedure. Significantly different means were compared using Tukey's HSD Test.

Results and Discussion

Table 2 shows the proximate composition of the experimental diets. Lablab forage had 4% and 9% higher dry matter compared to Sorghum almum and the concentrate diet. Also, lablab forage had higher crude protein (18%) compared to Sorghum almum. This result agreed with the findings of Amodu *et al*. (10) who suggested that lablab forage is a quality material for livestock feeding in Nigeria. However, *Sorghum almum* had over 70% higher crude fibre compared to lablab forage. Gu *et al*. (3) suggested that fibre level of forage grasses aids in good physiological functioning of the digestive tracts and productive performance in rabbits. The soluble carbohydrate content of the lablab forage and concentrate diet was almost similar compared to that of *Sorghum almum*.

Table 2 : Proximate composition of the Experimental diet, Lablab forage and Columbus grass

Parameters (%)	Diet	Lablab forage	*S almum*
Dry matter	86.75	94.10	90.33
Organic matter	80.37	86.99	83.40
Crude protein	16.69	18.02	11.11
Crude fibre	9.05	8.61	29.00
Ether extract	4.96	5.83	5.55
Ash	6.38	7.11	6.93
Nitrogen free extract	56.47	60.13	45.79

Growth performance of female rabbits fed varying inclusion levels of Sorghum Almum: Lablab mixture

Results of growth performance of female rabbits fed varying inclusion levels of Sorghum almum: Lablab mixture is presented in Table 3. Initial weight and feed conversion ratio (FCR) of the rabbits were similar (P>0.05) across the treatments. Generally, there was increasing trend in the results across the treatments. However, beyond 50% inclusion levels of both lablab and sorghum almum, most of the parameters decreased (P<0.05), except in the average daily weigh gain. The highest final and total weight gains were recorded in the 50:50%SL and 25:75%SL treatments. Bello (11) suggested that rabbits can potentially utilize green forages to meet their daily requirements. According to Aduku and Olukosi (16), rabbits meet their energy requirements from the consumption of both concentrate and forage diets. The results obtained in this study agreed with these authors.

Table 3. Effect of varying inclusion levels of *Sorghum almum*: Lablab mixture on growth performance of female rabbits

	Inclusion level of *Sorghum almum*: Lablab mixture (%)					
Parameters	100%SA	75:25%SL	50:50%SL	25:75%SL	100%LL	SEM
Initial weight (g)	546.97	550.00	567.22	555.33	554.45	12.41^{NS}
Final weight (g)	1360.70^{c}	1510.57^{b}	1665.73^{a}	1617.36^{a}	1495.44^{b}	30.23
TWG (g)	813.73^{c}	960.57^{b}	1098.51^{a}	1062.03^{a}	940.99^{b}	28.87
ADWG (g/d)	14.53^{b}	17.15^{a}	19.62^{a}	18.96^{a}	16.80^{a}	1.59
ADFI (g/d)	63.75^{d}	65.75^{d}	95.75^{a}	92.50^{b}	72.50^{c}	1.31
FCR (gADFI/gain)	4.39	3.83	4.88	4.88	4.32	2.22^{NS}
Mortality (%)	0.00	1.00	1.00	0.00	1.00	1.55^{NS}

^{abc} Means with different superscripts within a row differed significantly (P<0.05), SEM = Standard Error of Means, ADWG = Average Daily Weight Gain, ADFI = Average Daily Feed Intake, FCR = Feed Conversion Ratio, NS = Not Significant; SA = *Sorghum almum*; SL = *Sorghum almum* : Lablab Mixture; LL = Lablab. TWG= Total weight gain

Nutrient digestibility of female rabbits fed varying inclusion levels of *Sorghum almum*: Lablab mixture

Results of the nutrient digestibility of female rabbits fed varying inclusion levels of *Sorghum almum*: Lablab mixture is presented in Table 4. It could be deduced that treatment with 75:25%SL on the average had the best nutrient digested among the parameters analyzed except for ash and nitrogen free extract compared to other treatments

This support FAO (17) report that silage made from a mixture of Lablab and Sorghum raised the protein content of Sorghum by 11% with a 2:1 mixture of Lablab: *Sorghum almum*. Also on dry matter bases it was deduced that treatment with 75:25%SL had the highest percentage compared to other treatments. From the table, treatment with 75:25%SL recorded a 16% and 27% higher dry matter nutrient intake compared to treatment with 50:50%SL and treatment with 25:75%SL, respectively. Between the three treatments on dry matter bases, it is recorded that diets having higher inclusion levels of *Sorghum almum* tend to have higher nutrient digested compared to other treatments with lower *Sorghum almum* and high Lablab forage. This support the report of Doubling *et al.*(18) that the overall total digestible nutrients in *Sorghum bicolor* are roughly 95% of those in dry rolled yellow dent maize. Crude protein (CP) content was higher by 2.7% in treatment with 100%LL compared to treatment with 100%SA this indicate that among the treatments, treatment with 100%LL had the highest CP and treatment with 25:75%SL had the lowest CP. It has been reported that moderate level of tannin (30-40g/kg legume dry matter) may however result in nutritional advantage in respect of increased bypass protein availability and bloat suppression in cattle (19). *Lablab* has the potential to supply rumen degradable nitrogen in excess of requirements. In a feeding trial, (20) found that the improved plane of nutrition resulted in digestible crude protein intake 3 to 5 times. Across the treatments there was a progressive drop in crude protein. The crude fibre (CF) content was highest in treatment with 100%SA which had a record of 15.8% higher CF compared to treatment with 25:75%SL having the lowest crude fibre. However beyond treatment with 100%SA inclusion level of both *Sorghum almum* and lablab forage most of the parameters decreased ($P0<0.5$), except in treatment with 100%LL that did not follow the same trend. Treatment with 100%SA, 75:25%SL and 50:50%SL had the best result recorded. In the USA, sorghum grain has traditionally been used for livestock feed and stems and foliage for green chop, hay, silage and pasture. Some people in the USA are familiar with sorghum for the syrup made from the sweet juice pressed from stalks of certain sorghum varieties. In Europe, however, there is very little production of sorghum (21).Treatment with 50:50%SL recorded the maximum value of Ether extract (EE) across the treatments, with 100%SA, 75:25%SL and 50:50%SL having the best results.

Table 4. Nutrient digestibility of female rabbits fed varying inclusion levels of Sorghum almum: Lablab mixture

	Inclusion level of Sorghum almum: Lablab mixture (%)					
Parameter	A(100%CG)	B(75:25%SL)	C(50:50%SL)	D(25:75%SL)	E(100%LL)	SEM
Dry matter	84.54^{b}	91.63^{a}	77.22^{c}	66.21^{e}	73.82^{d}	2.11
Organic matter	79.23^{b}	88.65^{a}	86.59^{a}	72.74^{c}	70.70^{c}	1.23
Crude protein	83.47^{a}	79.99^{a}	74.37^{b}	66.29^{c}	85.74^{a}	2.24
Crude fibre	89.63^{a}	89.48^{a}	87.91^{a}	75.43^{b}	78.11^{b}	1.11
Ether extract	78.19^{a}	80.16^{a}	83.10^{a}	68.71^{b}	67.10^{b}	2.22
Ash	87.57^{a}	78.72^{b}	68.25^{d}	72.41^{c}	67.46^{d}	1.37
Nitrogen free extract	74.33^{b}	67.70^{d}	70.14^{c}	83.24^{a}	64.27^{e}	1.10

^{abc} Means with different superscripts within a row differed significantly (P<0.05), SEM = Standard Error of Means; CG = Sorghum almum; SL = Sorghum almum: Lablab Mixture; LL = Lablab.

Nitrogen balance of female rabbits fed varying inclusion levels of *Sorghum almum*: Lablab forage mixture

Utilization of nitrogen in the five experimental groups is shown in Table 5.The intake of nitrogen in treatments with 25:75%SL and 50:50%SL was significantly higher compared to the other treatments. Beyond treatment with 75:25%SL, a progressive increase (P<0.05) was recorded among treatments (75:25%SL,50:50%SL and 25:75%SL) the trend of increase might be due to the increase in the Lablab forage in the diet as compared to the *Sorghum almum*. This result validated the report of (22) that Lablab has the potential to supply rumen degradable nitrogen in excess of requirements. From the record, it was deduced that treatment with 25:75%SL had an appreciable nitrogen balance among all the parameters analyzed except for fecal nitrogen compared to the other treatments. The highest total nitrogen loss was recorded in treatment with 100%SA while the highest total nitrogen retained was recorded with treatment having 25:75%SL and the lowest was recorded with treatment having 100%SA, This simply indicates that treatment with more *Sorghum almum* loss higher nitrogen compared to treatments with lesser *Sorghum almum* and high Lablab forage which retained more of the nitrogen when compared to other treatments. The maximum nitrogen absorbed was recorded in the treatment with 25:75%SL, while treatment with 75:25%SL had the lowest nitrogen absorbed. It was deduced from this record that nitrogen absorbed was lesser with treatments having higher proportion of *Sorghum almum*: Lablab forage, except for treatment with 100%SA. Treatments with 25:75%SL and 100%LL recorded appreciable urinary nitrogen while treatment with 100%SA recorded the highest value.

Table 5. Nitrogen balance of female rabbits fed varying inclusion levels of *Sorghum almum*:Lablab mixture

	Inclusion level of Sorghum almum: Lablab mixture (%)					
Parameter	100%SA	75:25%SL	50:50%SL	25:75%SL	100%LL	SEM
Nitrogen intake (g/d)	3.15[b]	3.06[c]	3.13[b]	3.44[a]	3.47[a]	0.10
Fecal nitrogen (g/d)	0.68[b]	0.65[a]	0.73[c]	0.77[d]	0.87[e]	0.02
Urinary nitrogen (g/d)	0.97[d]	0.85[c]	0.74[b]	0.68[a]	0.67[a]	0.02
Total nitrogen loss (g/d)	1.65[d]	1.50[b]	1.47[a]	1.45[a]	1.54[c]	0.01
Nitrogen retention (g/d)	1.50[e]	1.56[d]	1.66[c]	1.99[a]	1.93[b]	0.02
Nitrogen absorbed	2.47[c]	2.19[e]	2.41[d]	2.68[a]	2.60[b]	0.04
N retained as % of intake	47.62[e]	50.98[d]	53.04[c]	57.85[a]	55.62[b]	0.83

[abc] Means with different superscripts within a row differed significantly * (P<0.05), SEM = Standard Error of Means, NS = Not Significant; SA = *Sorghum almum*; SL = *Sorghum almum*: Lablab Mixture; LL = Lablab.

Conclusion and Application

It can be concluded from this study that:

1. Female rabbits fed forage containing 50:50% inclusion level of Sorghum almum: Lablab mixture performed better than those fed other inclusion levels in terms of weight gain.
2. Therefore, *Sorghum almum: Lablab forage mixture* can be included in the diet of female rabbits up to 50% without decrease in growth performance.

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