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Original Contribution

GROWTH PERFORMANCE, CARCASS YIELD AND BLOOD PROFILES OF GROWING RABBITS FED CONCENTRATE DIET SUPPLEMENTED WITH WHITE LEAD TREE (*LEUCAENA LEUCOCEPHALA)* OR SIRATRO (*MACROPTILIUM ATROPURPUREUM*) LEAVES IN NORTH CENTRAL NIGERIA

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ABSTRACT

Thirty (30) 8-week old rabbits of average initial weight of 900 g were used to determine the Growth Performance, Carcass yield and Blood profiles of growing rabbits fed Concentrate diet supplemented with White lead tree (*Leucaena leucocephala)* or Siratro (*Macroptilium atropurpureum*) leaves in North Central Nigeria. The experiment was in a completely randomized design (CRD) with 5 treatment diets replicated thrice. The control group (T1) was fed a formulated rabbit diet, in T2, 10 % of the formulated rabbit feed was replaced with White lead tree fresh leaves, in T3, 20 % of the formulated rabbit feed was replaced with White lead tree fresh leaves, in T4, 10% of the formulated rabbit feed was replaced with Siratro fresh leaves and in T5, 20% of the formulated rabbit feed was replaced with Siratro fresh leaves. The study lasted 56 days. Feed and water were supplied *ad libitum*. Performance data indicated that body weight gain and feed conversion ratio were significantly ($P<0.05$) better in rabbits fed on 10% white lead tree and 10% Siratro inclusion than those fed on the 20% white lead tree and 20% Siratro inclusion levels. There were significant ($P<0.05$) differences in the organs weights of the rabbits except for lung and spleen ($P>0.05$). The weights of liver, heart and kidney were significantly ($P<0.05$) higher for rabbits on 20% white lead tree and 20% Siratro diets than those on other diets. The results of the packed cell volume, red blood cell count, white blood cell count, mean corpuscular volume, mean corpuscular haemoglobin concentration, serum protein, albumin and creatinine of rabbits on 10% white lead tree and 10% Siratro inclusions were better ($P < 0.05$) than those on 20% white lead tree and 20% Siratro inclusion. Mean corpuscular haemoglobin, haemoglobin, globulin and urea were not influenced ($P>0.05$) by the dietary treatments. From the results, it was concluded that inclusion of 10% white lead tree or 10% Siratro leaves in rabbits' diet had no adverse effects on the performance, carcass yield and blood profiles of growing rabbits.

Key words: white lead tree, Performance, Siratro, Rabbits, Carcass, Haematology.

INTRODUCTION

Rabbits have been recognized to have a very important role to play in the supply of animal protein to Nigerians especially in the rural and peri-urban areas. They are efficient converters of feed to meat and can utilize up to 30% crude fibre as against 10% by most poultry species. To make rabbit rearing more viable as a small-scale business, (1) have advocated the development of alternative feeding materials that will be relatively cheap when compared with commercial feeds or conventional feedstuffs. Rabbits have the potential of utilizing such unconventional feedstuffs as Velvet bean (M*ucuna utilis*) leaf meal (2), Neem (*Azadirachta indica*) leaf meal (3), Pigeon pea (*Cajanus cajan*) seed meal (4) and other diverse plant materials.

In several separate studies which involved feeding trials, leaf meals from *Aspilia africana and Tridax procumbens* (5), *Leucaena leucocephala* (6), *Balanites aegyptiaca* (7) were reported to supply nutrients and improve the performance of rabbits. Similarly, leaf meals from *Centrosema, Manihot*, *Tithonia*, *Gmelina arborea* and *M. Puberula* have been reported to supply nutrients and improve the performance of pigs (8).

Like most legumes, White lead tree and *Siratro* are deep rooted legumes which have their origin in Mexico and Jamaica respectively, but have become naturalized in Nigeria (9). They thrive throughout the year and readily come to

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mind as an unconventional protein source with lots of potentials to be exploited in rabbit feeding. White lead tree leaves, flower, seeds and shoots are good sources of nutrients for livestock. Young leaves of White lead tree contain more protein than the mature ones. (10) indicate that in spite of the nutritive potential of White lead tree, its use by cattle as feed may result in certain undesirable effects. White lead tree levels should not exceed 30% for ruminants, 20% for rabbits, and 7.5% for poultry on a dry matter basis (11). There is paucity of information on the utilization of Siratro *by livestock. (12) evaluated the reproductive performance of rabbits fed wheat bran with tropical forages or* White lead tree. The authors reported that White lead tree was superior to other forages studied including Siratro.

The anti-nutritional factors (ANFs) present in these legumes such as mimosine, tannin, phytin, oxalate, saponin etc. has limited the percentage that can be included in the diet. Although, some animals have built resistance with micro organisms that can degrade these ANFs and its product, information is still needed regarding the potential of these legumes as a feed for growing rabbits. Therefore, the current study was undertaken to determine the nutritional worth of White lead tree and Siratro leaves as a feed supplement for growing rabbits.

MATERIALS AND METHODS

Animals and housing

The study was conducted with thirty(30) 8-week old hybrid (New Zealand white x Chinchilla) rabbits that had initial body mass ranging from 910 to 920 g. They were of both sexes and randomly assigned to 5 treatment diets in a completely randomized design (CRD). Each treatment was replicated 3 times with each replicate having 2 (male and female) rabbits.

The rabbits were housed in a 3-tier rabbit cages, which had a total of 15 hutches at 5 hutches per tier. The cages were located inside a building equipped with vents and windows for ventilation. Each hutch (100 cm x 40 cm x 40 cm) was partitioned with a wooden board and wire mesh and fitted with aluminum drinkers, feeders (15 cm x 10 cm x 10 cm) and an aluminum tray for collection of faeces.

Diets

Fresh forages (succulent stems and leaves) of White lead tree and Siratro were harvested from the surroundings of the Rabbitry unit within the College community where they grew as weeds. They were cleaned of sands and other contaminants and fed with normal concentrate diets. The concentrate diet was formulated to contain 16% crude protein and 2540 kcal/kg metabolizable energy as shown in **Table 1.** Five dietary treatments consisting of forage and concentrate were fed in the following orders and designated as T1 (Control diet), T2, T3, T4 and T5 respectively.

Table 1. *Percentage composition of Concentrate diet*

Ingredients	**%**
White maize	70.0
Local fish meal	1.0
Soybean meal	14.0
Palm kernel meal	12.0
Bone meal	2.50
Vitamin premix*	0.25
Salt	0.25
Total %	**100**
Calculated nutrients	
Crude Protein %	16.0
Crude Fibre %	3.76
ME (Kcal/kg)	2540.9
Avail. Ca %	0.99
Avail. P %	0.41

The control group (T1) was fed a formulated rabbit diet, in the second group (T2), 10 % of the formulated rabbit feed was replaced with White lead tree fresh leaves, in the third group (T3), 20 % of the formulated rabbit feed was replaced with White lead tree fresh leaves, in the fourth group (T4), 10% of the formulated rabbit feed was replaced with Siratro fresh leaves and in the fifth group (T5), 20% of the formulated rabbit feed was replaced with Siratro fresh leaves. The rabbits were fed for 56 days. Proximate composition of experimental diets and forages is given in **Tables 1 and 2** respectively.

Table 2. *Proximate composition of the Concentrate and Forage diets*

Nutrients, % DM	**Concetrate**	**Leucaena**	**Siratro**
Dry Matter	87.50	91.26	90.38
Crude protein	15.75	17.76	18.72
Crude fiber	4.75	11.42	11.41
Ash	14.90	11.21	10.30
Ether extract	6.35	4.21	3.16
Nitrogen free extract	45.81	41.05	42.09

Data Collection

The study lasted for 8 weeks (56 days) during which the rabbits were fed the concentrate and forage diets *ad libitum*. The rabbits were weighed at the start of the experiment and subsequently on a weekly basis. Parameters measured include weight gain, feed intake, feed conversion ratio (FCR), etc.

Haematological and biochemical indices

At the end of the experiment, 3 rabbits were slaughtered per treatment (i.e, 1 rabbit per replicate) and used for haematological and serological studies. About 5mls of blood sample was collected from the jugular vein of each slaughtered rabbit and put into sterilized glass tubes/bottles containing Ethylene Diaminetetra-acetic Acid (EDTA) for the haematological study. Similarly, blood samples meant for serum biochemical studies were collected into plain bottles (without anticoagulant) to enhance serum separation. Serum was obtained by centrifugation and the harvested serum samples were used for analysis. The packed cell volume (PCV), red blood cells (RBC), haemoglobin (Hb), white blood cells (WBC), mean corpuscular volume (MCV), mean corpuscular haemoglobin (MCH) and mean corpuscular haemoglobin concentration (MCHC) were analyzed according to (13) methods. The blood serum was also used to determine serum total protein (STP). Albumin, globulin, creatinine and urea were determined using the BCG (bromocresol green) method as described by (13).

Carcass and Organs Evaluation

One rabbit from each replicate was selected, weighed (g), starved overnight to clear the gut and stunned. After slaughtering, the tail close to the base was first removed, and then the head, feet and pelt. During evisceration, the internal organs and other gut contents were removed and weighed. Then the skinless carcass was weighed and expressed as percentage of the live weight. The organ weights were expressed as percentage of the dressed weight.

Chemical and Data Analyses

Both concentrate and forages were analyzed for proximate composition using the methods of (14). All data collected were subjected to analysis of variance (15). Differences between the treatment means were separated using Duncan's New Multiple Range Test at 5% level of significance.

RESULTS

Table 2 shows the proximate composition of the concentrate and forage diets. The dry matter, crude protein, crude fiber, ash, ether extract and the nitrogen free extract respectively were 87.50, 15.75, 4.75, 14.90, 6.35 and 45.81% for concetrate diet. White lead tree leaves contained dry matter of 91.26, crude protein of 17.76, crude fiber of 11.42, ash of 11.21, ether extract of 4.21 and nitrogen free extract of 41.05% while the Siratro leaves contained 90.38, 18.72, 11.41, 10.30, 3.16 and 42.09 for dry matter, crude protein, crude fiber, ash, ether extract and the nitrogen free extract respectively.

The growth performance of the growing rabbits fed on the experimental diets is shown in **Table 3**. The rabbits had similar body weights at the start of the experiment. Average body weight and average feed intake of rabbits on the control, 10% white lead tree and 10% siratro diets were significantly (P<0.05) higher than rabbits on 20% white lead tree and 20% siratro diets. Feed conversion ratio was significantly (P<0.05) better for rabbits on 10% white lead tree and 10% siratro diets than those on other diets. Rabbits on 20% white lead tree and 20% siratro had poorer weight gain (7.81, 8.40g), poorer feed intake (49.42, 47.58g) and poorer FCR (6.33, 5.66).

Table 3. *Growth performance traits of growing rabbits fed concentrate and forage diets*

Parameters	T1	T2	T3	T4	T5	SEM
Initial weight	918.19	916.02	921.43	915.67	920.81	4.40 ^{ns}
Final weight	1532.06^{a}	1665.22 ^{a}	1358.51^{b}	1579.32^{a}	1391.43^{b}	68.71*
Total weight gain	613.87 ^{a}	749.22 ^{a}	437.08 ^{b}	663.65 ^{a}	470.62 ^{b}	57.33*
Av. daily weight gain	10.96 ^{a}	13.38 ^{a}	7.81 ^{b}	11.85 ^{a}	8.40 ^{b}	1.51*
Total feed intake	3185.51 ^{a}	3068.22 ^{a}	2767.43^{b}	3100.09^{a}	2664.46^{b}	65.78*
Av. daily feed intake	56.88 ^{a}	54.79 ^{a}	49.42 ^{b}	55.36 ^{a}	47.58^{b}	1.17*
Feed conversion ratio	5.19^{b}	4.09^{a}	6.33^{b}	4.67^{a}	5.66^{b}	0.40*
Mortality	0	0	1	0	1	-

SEM=Standard error of mean.* = P<0.05, ns = Not significant.

Table 4 shows the effect of dietary treatments on the dressed carcass and organ percentage of the rabbits.There were significant (P<0.05) differences in the weight of organs of the rabbits except for lung and spleen. The weights of liver, heart and kidney were significantly

(P<0.05) higher for rabbits on 20% white lead tree and 20% siratro diets than those on other diets. However, the weight of lungs and spleen were not influenced (P>0.05) by the dietary treatments.

Table 4. *Dressed Carcass and Organ Percentage of growing rabbits fed Concentrate and Forage diets*

Parameters	T1	T2	T3	T4	T5	SEM
Dressed carcass	65.95[a]	66.90[a]	60.10[b]	66.16[a]	59.98[b]	0.43[*]
Liver	3.05[b]	3.44[b]	4.64 [a]	3.55[b]	4.49[a]	0.48[*]
Heart	0.33[b]	0.40[a]	0.32[b]	0.38[a]	0.30[b]	0.02 [ns]
Kidney	0.60[b]	0.70[b]	0.87 [a]	0.71[b]	0.85 [a]	0.10[*]
Lung	0.61	0.62	0.59	0.64	0.60	0.04 [ns]
Spleen	0.04	0.05	0.04	0.05	0.02	0.02[ns]

SEM = Standard error of mean. * = P<0.05, ns = Not significant

The effect of dietary treatments on the haematological characteristics and serum biochemical indices of the rabbits fed the experimental diets are presented in **Table 5** and **Table 6** respectively. The values obtained for packed cell volume, red blood cell count, white blood cell count, mean corpuscular volume, mean corpuscular haemoglobin concentration, serum protein, albumin and creatinine of rabbits on 10% white lead tree and 10% siratro inclusions were better (P < 0.05) than those on 20% white lead tree and 20% siratro inclusion. The values obtained for mean corpuscular haemoglobin, haemoglobin, globulin and urea compared favourably (P>0.05) with those in the control group.

Table 5. *Haematolgical indices of growing rabbits fed Concentrate and forage diets.*

Parameters	T1	T2	T3	T4	T5	SEM
PCV (%)	47.65[a]	46.77[a]	44.70[ab]	45.10[a]	43.00[b]	1.90[*]
WBC (x 10^3mm^3)	10.99[a]	8.87[b]	8.20[b]	9.85[a]	8.60[b]	0.75[*]
RBC (x 10^3mm^3)	7.56[a]	6.87 [a]	5.55[b]	6.95 [a]	6.85 [a]	0.81[*]
MCV (fl)	83.45[a]	78.75 [a]	70.55[b]	80.75[a]	76.60[b]	3.09[*]
MCH (pg)	20.45	20.85	19.95	19.70	20.95	1.45 [ns]
MCHC (%)	28.76[a]	25.78[ab]	24.55[b]	28.10[a]	25.75[ab]	1.76[*]
Hb (g/dl)	11.97	10.47	11.18	9.46	11.15	0.81[ns]

a, b, c means on the same row with difference superscripts are significantly different * = P<0.05, ns = Not significant, SEM = Standard error of mean, PCV = Packed cell volume, RBC = Red blood cell, WBC = White blood cell, MCV = Mean corpuscular volume, MCH = Mean corpuscular haemoglobin, MCHC = Mean corpuscular haemoglobin concentration, Hb=Haemoglobin

Table 6. *Serum biochemical indices of weaner rabbits fed Concentrate and forage diets.*

Parameters	T1	T2	T3	T4	T5	SEM
Total Protein (g/dl)	7.35[a]	6.03[a]	5.81[b]	6.39[a]	5.97[ab]	0.71[*]
Albumin (g/dl)	4.47[a]	3.02[ab]	2.84[b]	3.54[a]	3.00[b]	0.33[*]
Globulin (g/dl)	2.88	3.01	2.97	2.85	2.97	0.50[ns]
Creatinine (mg/dl)	0.95[a]	0.87[a]	0.51[b]	0.84[a]	0.59[b]	0.06[*]
Urea (mmol/l)	2.89	2.01	2.83	2.01	1.78	0.19 [ns]

SEM=Standard Error of mean. [abc] Means with different superscripts are significantly different (P<0.05). * = P<0.05, ns = Not significant

DISCUSSION

The growth performance parameters were generally in agreement with those observed in the previous studies (3, 4). Body weight gain per day and daily feed intake were enhanced by supplementing the feed with 10 % White lead tree and 10% Siratro leaves (T2 and T4).

However, the body weight gain were significantly reduced in rabbits on diets supplemented with 20 % White lead tree and 20% Siratro leaves. This significant decline in weight gain and feed intake at 20 % dietary inclusion of White lead tree and Siratro leaves could be attributed to the presence of some anti-nutritional factors (ANF),which are thought to be prevalent in most raw legumes (16). Previous studies have indicated that the presence of some antinutritional factors like tannins in the diets results in poor palatability and consequent decrease in feed intake due to its astringent property as a result of its ability to bind with protein of saliva and mucous

membrane (1). Also, phytic acid is widely distributed in commonly consumed foods and found in almost all feeds of plant origin. Phytic acid as powerful chelating agent reduces the bioavailability of divalent cations by the formation of insoluble complexes which are mostly not available to monogastrics (17). In consequence, the consumption of feed containing high phytin content could produce a deficit in the absorption of some dietary minerals and can also adversely affect the digestibility of protein by inhibiting a number of digestive enzymes in the gastro-intestinal tract such as pepsin, trypsin and chymotrypsin (18). Furthermore, (19) reported that when rabbits feed on 30% of white lead tree leaf blended meal, there were low growth rate and feed utilisation was inefficient. At 20% of white lead tree blended meal, rabbits experience severe alopecia. Mortality was generally low across the treatment groups with one death occurring in T3 and T5 while T1, T2 and T4 recorded none. This invariably confirms that the effect of anti-nutritional factors in diets 1, 2 and 4 were within tolerable limit. The result of this study further validates the assertion of (6) who recommended that for good performance of rabbits, doe or buck, 10% white lead tree leaves should be blended with their feed.

There were significant ($P<0.05$) differences in the organs weights of the rabbits except for lung and spleen. It is a common practice in feeding trials to use weights of some internal organs like the liver or kidneys as indicators of toxicity because they should differ significantly if there was any serious effect of antinutritional factors on them being major detoxification organs (20). The difference in weight would arise because of increased metabolic rate of the organs in attempt to reduce toxic elements or anti-nutritional factors to non-toxic metabolites (21). It was obvious in this study that the weight of organs such as liver, heart and kidney were significantly ($P<0.05$) higher in rabbits on 20% white lead tree and 20% siratro leaves as a result of increased metabolic rate. This observation agrees with the report of (22) who observed that rabbits fed diets containing 20% Sun dried white lead tree leaves had alopecia, necrotic spots, liver congestion, edema and highest percentage of mortality. These authors also reported that diets containing more than 1% of mimosine and tannin impaired the growth performance and had deleterious effects on the liver of rabbits. (23) indicated that inspite of being an excellent source of nutrients white lead tree forage as well as seed contains a number of toxic constituents which severely limit livestock performance. They further found out that tannin concentrations are higher in leaf meal than in seed and that these toxins reduce digestibility of proteins and results in marked low metabolizable value of white lead tree leaf meal in poultry. The values reported for the various organs in this study however conforms with those reported for rabbits on Velvet bean leaf meal (2), rabbits on boiled pigeon pea seed meal (4) and rabbits on concentrates, *Aspilia africana and Tridax procumbens* (5).

Hematological studies

The results of the haematological indices are presented in **Table 3**. There were significant differences ($P< 0.05$) among treatment groups for all the haematological parameters except for mean corpuscular haemoglobin (MCH) and haemoglobin (Hb). The PCV values (43.00-47.65%) obtained in this study were within the range of 41.00 to 47.00% reported by (2) for rabbits on Velvet bean leaf meal and 37.40 to 47.90% reported by (7) for growing rabbits fed *Balanites aegyptiaca* leaves. These values were however higher than (36.50 to 38.70%) reported by (5) for rabbits on concentrates, *Aspilia africana* and *Tridax procumbens*. PCV is an index of toxicity reduction in the blood and it suggests presence of a toxic factor which has adverse effect on blood formation. This is an indication that both concentrate and forage diets fed were not toxic to the health status of the rabbits. In this study, the values obtained for WBC (8.20-10.99 $x10^3mm^3$) of rabbits were within the reference range of 6.40 to 12.90 $x10^3/ mm^3$ as reported by (24) for healthy young rabbits. Decreased WBC below the normal range is an indication of allergic conditions, anaphylactic shock and certain parasitism or presence of foreign body in circulating system while elevated values (leucocytosis) indicate the existence of a recent infection, usually with bacteria (25). Rabbits on diets T2, T3 and T5 had similar ($P > 0.05$) values which revealed that the effect of diets were similar on the rabbits. The RBC values (5.55-7.56x $10^3/mm^3$) were within the range 3.07 to 8.50 $x10^6/mm^3$ reported by (26). The values for MCV were higher in T1, T2 and T4 (83.45fl, 78.75fl and 80.75fl) than those on other treatment groups. However, they were all within the range of 67.90-90.00fl reported by (7) who fed *Balanites aegyptiaca* leaves to young rabbits. (27) had earlier reported that any increase in MCV, MCH and decrease in MCHC of rabbit above or below the normal range indicates macrocytic and hypochronic anemia, probably due to the increased activity of bone marrow and deficiency of some haemopoietic factors influencing the capacity

of bone marrow to produce red blood cells.There were no significant differences (P>0.05) among treatments for mean corpuscular haemoglobin (MCH) and haemoglobin (Hb).This is an indication that the experimental diets contain higher quality proteins that met the rabbit's nutritional requirements. The Hb values obtained in this study (9.46-11.97g/dl) fall within the range of 9.0-17.4 g/dl reported by (7).The values 24.55-28.76 % observed for MCHC in this study were within 23.60-27.55% reported by (2) who on Mucuna leaf meal to young rabbits in the tropics.

Serological analyses revealed that dietary treatments produce significant effect (P<0.05) on serum chemistry of the young rabbits with the exception of globulin and urea (Table 6).The recorded variations in serum total protein stemmed from the different rate of protein metabolism and utilization by the rabbits. The values obtained were in line with earlier observation for healthy rabbits (3, 7, 28). Rabbits on T1 had higher serum total protein value (7.35g/dl). This indicated that the diet was relatively of good quality and that rabbits fed this diet were more efficient in protein metabolism and utilization. Rabbits on diets T2, T4 and T5 showed similar values (P >0.05).This revealed that the rate of protein metabolism and utilization were similar.The serum albumin values (2.84 to 4.47g/dl) obtained in this study fall within the range (4.0 to 7.2 g/dl) reported by (7) and the range (5.81to 6.75 g/dl) reported by (28). Abnormal serum albumin usually indicates an alteration of normal systematic protein utilization and low dietary protein intake (28). There were no significant differences (P>0.05) among treatments for globulin and urea. The values of 2.88 to 3.01g/dl obtained for globulin was higher than 1.90-2.80g/dl reported by (29) who fed weaner rabbits with *moringa oleifera* leaf meal diets but fall within the range of 0.2 to 2.9g/dl reported by (7).The blood urea ranged from 1.78 to 2.89mmol/l. The values were within the range (2.5 to 4.2mmol/l) reported by (7) who fed young rabbits with *Balanites aegyptiaca* leaf meal diets and (2.50 to 5.80mmol/l) reported by (30) who fed sesame seed meal to rabbit in tropical environment. All the serological parameters evaluated were significantly higher in rabbits on diet 1 except for globulin value which was highest in rabbits on diet 2. This could be attributed to higher intake of concentrate which is usually high in starch since the diet was deprived of forage.

CONCLUSION

This study determines the growth performance, carcass yield and blood profiles of growing rabbits fed concentrate diet supplemented with White lead tree or Siratro leaves in North Central Nigeria. The study observes that the inclusion of white lead tree and siratro leaves beyond 10% in rabbit's diet leads to poor feed intake and feed conversion ratio as the average body weight gain and final weight gain also decreased with diets at 20% levels. The reduced performance of rabbits on 20% level of inclusion could be due to the amount of anti-nutritional factor present at that level. Carcass yield and blood profiles of rabbits were influenced (P<0.05) by the dietary treatments. From the results, it was concluded that inclusion of 10% white lead tree or 10% siratro leaves in rabbits' diet has no adverse effects on the performance, carcass yield and blood profiles of growing rabbits.

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