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PERFORMANCE AND SERUM CHEMISTRY OF RABBITS FED GRADED LEVELS OF CASSAVA PEELS, LEUCAENA LEUCOCEPHALA AND GLIRICIDIA SEPIUM LEAVES BASED DIETS.

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ABSTRACT

Thirty-six, 7 to 8 weeks old New Zealand White rabbits were allocated to three dietary treatments of 6 rabbits per diet with 2 replicates per treatment. Diet **T1**, the control diet was a conventional ration formulated from basic ingredients. Diet **T2** was composed of 50% cassava peels, and 25% each of *Leucaena leucocephala and Gliricidia sepium* leaves, while diet 3 **(T3)** was compounded by mixing 33.33% each of cassava peels, *Gliricidia sepium* leaves and *Leucaena leucocephala*. The feeds and water were offered *ad libitum* and the study lasted 12 weeks. The control diet (Diet **T1**) was superior ($P<0.05$) to the other herbage combinations in terms of apparent digestibility, total digestible nutrients, feed conversion and protein efficiency ratios. Not surprisingly, the same diet produced the best live weight gain. Body weight gain ranged from 16.1g/day in the control group to 12.32g and 4.49g in Diet **T2** and diet **T3** respectively. However, Diet **T2** had better nutritive value amongst the cassava peels and herbage combinations by having higher ($P<0.05$) apparent digestibility, total digestible nutrients, feed conversion and protein efficiency ratios than diet **T3**. Serum sodium was highest in diets **T2** and **T3** ($P<0.05$) and lowest in the control group. Potassium levels were unaffected by the dietary treatments. Total protein was highest in rabbits fed the control diet ($P<0.05$) but similar in **T2** and **T3** rabbits. Aspartate amino transferase (AST) and cholesterol were highest in the Control ($P<0.05$) group and decreased in the rabbits on other diets In summary it is recommended that total replacement of conventional diets in rabbit diets could be achieved at relatively low cost based on a combinations of 50% cassava peels and 25% each of *Leucaena leucocephala* and *Gliricidia sepium* leaf meals as the diet produced performance similar to conventional diets. Higher levels of leucaena and gliricidia severely depressed growth and performance.

KEYWORDS: Cassava peels, *Glyricidia sepium*, *Leucaena leucocephala*, rabbits, serum metabolites, growth.

Running Title: Performance of rabbits fed cassava peels, *Glyricidia sepium and Leucaena leucocephala* combinations.

INTRODUCTION

The price of feed grade protein remains high in most markets in Nigeria but wide nutrient variations exist in protein sources and with the ban on meat and bone meal in animal feeds in Europe which may eventually extend to other parts of the world, livestock producers need to take a fresh look at alternative proteins available from vegetable sources. A very practical option is to make leguminous pasture more digestible for animals and rear animals that can readily digest fibrous feed materials without a reduction in performance. In Nigeria, agro-industrial by products such as cassava peels, feather meal, almond seed meal and *leucaena* and *gliricidia* leaves continue to find relevance in the livestock industry and a few of them have been tried in livestock rations (Adejumo and Akpokodje, 1990; Adejumo, 1998; Lobo and Gill, 2000). *Leucaena leucocephala* and *Gliricidia sepium* have good amino acid profile and crude protein content (Jones, 1979; Ekpenyong, 1986). The toxicity of leucaena due to its content of the amino acid *mimosine* limits its use in animal production. Cassava peels has received very prominent attention as an energy source for ruminant and non-ruminant livestock in spite of its content of the toxic antinutritional factor hydrocyanic acid (Tewe *et al.*, 1999; Akinfala and Tewe, 2002). However, simple processing ranging from soaking, fermentation, sun or oven drying for cassava peels and sun drying or oven drying for *leucaena* leaves have greatly improved their utilisation and digestibility (Akinfala and Tewe, 2002; Adejumo and Akpokodje, 1990). The rising costs of producing animals to market weight makes it imperative for farmers to focus on short cycle animals or "micro livestock" (Vietmeyer, 1985) and design new feeding technologies to meet the high demand for reasonably priced meat products. Rabbits, due to their early maturity, high feed efficiency, short generation interval, high fertility and a digestive system that classifies them as monogastric herbivores have become an important source of animal protein world wide.

This study was therefore designed to assess the potential of graded combinations of these "green" feed sources with cassava peels as complete replacement for convention rations.

MATERIALS AND METHODS

Thirty-six, 7 to 8 weeks old New Zealand White rabbits weighing between 675g and 720g and balanced for weight were randomly allocated to three dietary treatments in individual cages and managed intensively for 10 weeks after an initial adjustment period of 2 weeks. The three diets were formulated (Table 1) such that Diet **T1**, the control diet was a conventional ration formulated from basic ingredients. Diet **T2** was composed of 50% cassava peels, and 25% each of *leucaena* and *gliricidia* leaves, while Diet 3 **(T3)** was compounded by mixing 33.33% each of cassava peels, *Gliricidia sepium* leaves and *Leucaena leucocephala*.

The cassava peels were purchased from local cassava processing mills, sun dried and milled. The *leucaena* and *gliricidia* leaves were also sun dried and milled and the appropriate percentages of the three materials thoroughly mixed as described elsewhere (Adejumo and Akpokodje, 1990).

Drinking water was provided *ad libitum* with the use of nipple drinkers and the feeds were supplied in the troughs. Feed intake was measured individually twice weekly and body weight every week.

Digestibility Trials

At the beginning of the eighth week, four rabbits were selected at random from each of the three diets, weighed and placed in individual metabolic cages designed for easy collection of faeces and urine They were allowed a 3-day adjustment period before starting the metabolic trials. Thereafter the rabbits were given feed of uniform weight for a 7-day period and the remnants collected before the next

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Table 1: Gross Composition of Experimental Rations Treatments

Ingredients (%)	T1 (Control)	T2	T3
Maize	35.26	0.00	0.00
Dried brewers grains	52.88	0.00	0.00
Groundnut cake	5.11	0.00	0.00
Fish meal	3.00	0.00	0.00
Oyster shell	2.00	0.00	0.00
Bone meal	1.00	0.00	0.00
Premix*	0.25	0.00	0.00
Salt (NaCl)	0.50	0.00	0.00
Cassava Peels	0.00	50.00	33.33
Gliricidia sepium	0.00	25.00	33.33
Leucaena leucocephala	0.00	25.00	33.33
TOTAL	100.0	100.0	100.0
Nutrient Composition of Diets			
Dry matter	92.0	90.2	88.8
Crude protein	15.5	13.4	15.3
Crude fibre	11.0	16.5	18.9
Ether extract	8.0	5.5	6.5
Nitrogen free extract	57.8	57.2	52.4
Ash	7.7	7.4	7.8
Gross energy Kcal Kg^{-1}	2310	2610	2670

**Vitamin mineral premix contained (g kg^{-1}) diet: Thiamine (0.02), riboflavin (0.34), cyanocobalamine (0.00035), niacin (0.10), amino/aminobenzoic acid (0.10), retinyl acetate (0.04), ergocalciferol (0.04), choline HCL (200), $CaCo_2$ (15.258), $COCL_2$. $6H_2O$ (1.078), $CuSO_45H_20$ (0.019), $FeSO_4$ H_2O (1.0787), $MgSO_4$ (2.292), $MnSO_4$. $2H_2O$ (0.178), KIO (0.032), K_2 PO_4 (15.559*

feeding and weighed. The wet faeces were collected daily from each animal, weighed, and 2g of it dried at 100°C for 24 hours and stored in air tight bottles. Another part of the wet faeces of the individual animals were oven dried at 50°C for 48 hours. The samples were then bulked for chemical analyses. Urine output from each animal was collected through a slanting stainless steel trough attached to the cages into sample bottles. 10% of each urine sample was treated with 3% tetra oxo-sulphate acid (H_2SO_4) to prevent escape of nitrogen and deep frozen for chemical analysis.

At the tenth week of the experiment, the animals were fasted overnight weighed and sacrificed for serum collection (Onifade et al., 1999). Serum metabolites (aspartate aminotransferase (AST), alanine aminotransferase (ALT), cholesterol and total protein) were assayed by standard colorimetric methods using Sigma kits (Harris, 1995; Moss and Henderson, 1999). Serum sodium and potassium were determined by flame photometry as described by Ackerman and Toro (1975)

The proximate compositions of the rations, faecal samples and urine were determined by standard methods (A.O.A.C, 1990).

The data collected during the experiment were analysed by analysis of variance and means compared by the Duncan's Multiple Range Test (Daniel, 1995).

RESULTS

The nutrient compositions of the diets are provided in Table 1. Diet **T2** with 50% cassava had a lower crude protein and ether extract than the other diets. Diet **T2** also had higher fibre and nitrogen free extractives than the other diets. However, data in Table 3 showed diet **T2** stimulating the highest feed consumption followed by the control ($P<0.05$) and the lowest was recorded in Diet **T3**. The control diet (Diet **T1**) was superior ($P<0.05$) to the other diets (T2,T3) in terms of apparent digestibility, total digestible nutrients, feed conversion

Table 2: Proximate Composition of Faeces of Rabbits fed Graded Levels of Cassava Peels, *Leucaena leucocephala* and *Gliricidia sepium* Leaves.

Treatments

Proximate Analysis %	T1 (Control)	T3	T3
Crude Protein	17.00 ±0.57^{b}	15.5 0 ±0.49^{a}	15.25 ±0.21^{a}
Crude Fibre	17.90 ±0.57^{a}	28.21 ±1.13^{b}	28.55 ±1.34^{b}
Ether Extract	2.95 ±0.64^{a}	4.25 ±0.35^{b}	3.30 ±0.52^{ab}
Nitrogen free extract	53.10± 0.14^{b}	43.30 ±1.14^{a}	45.65 ±1.07^{a}
Ash	9.05 ±1.49	8.35± 1.21	7.10 ±1.42
Faecal dry matter	57.05 ±0.78^{b}	53.50 ±0.71^{a}	57.75 ±0.71^{b}
Dry matter feed intake (g/day)	67.55	81.96	50.04
Apparent nutrient balance (g/day)	10.50	28.46	-7.70

Values are means ± SEM (Standard Error of the Means)
^{a,bc}. Means in the same row with different superscripts are significantly different (P<0.05)

Table 3: Performance Indices of Rabbits fed Graded Levels of Cassava Peels, *Leucaena leucocephala* and *Gliricidia sepium* Leaves.

Treatments

Performance and metabolic indices	T1 (Control)	T3	T3
Feed intake (g/day)	73.42 ±1.50^{b}	90.86 ±2.15^{c}	56.23 ±0.53^{a}
Live weight gain (g/day)	16.61 ±0.38^{c}	12.32 ±0.24^{b}	4.49 ±0.10^{a}
Apparent digestibility (%)	49.16 ±0.12^{c}	46.64 ±0.36^{b}	41.96 ±2.01^{a}
Total digestible nutrients (%)	54.20 ±0.74^{c}	47.91 ±0.13^{b}	43.89 ±2.09^{a}
Feed conversion efficiency	4.40± 0.44^{a}	7.35 ±0.64^{b}	12.52 ±1.07^{c}
Protein efficiency ratio	1.46 ±0.07^{a}	1.01± 0.04^{b}	0.54 ±0.04^{c}

Values are means ± SEM (Standard Error of the Means)
^{a,bc}. Means in the same row with different superscripts are significantly different (P<0.05)

Table 4: Serum Chemistry of Rabbits fed Graded Levels of Cassava Peels, Leucaena leucocephala and Gliricidia sepium Leaves.

Treatments

Parameters	T1(Control)	T3	T3
Sodium (meq/L)	131.93 ±1.50^{a}	155.33±9.46^{b}	166.23 ±15.53^{b}
Potassium (meq/L)	6.5±0.84	7.13±0.92	5.59 ±0.74
Total protein (g/100ml)	7.23±0.53^{b}	6.23±0.16^{a}	5.77±0.16^{a}
AST (iu/L)	18.02±0.82^{c}	11.32 ±0. 26^{a}	13.96 ±0.41^{b}
ALT (iu/L)	38.67 ±0.74^{a}	47.67 ±0.23^{b}	44.67±0.47^{c}
Cholesterol (mg/100ml)	33.94± 0.84^{b}	32.56 ±0.37^{b}	29.52 ±0.37^{a}

Values are means ± SEM (Standard Error of the Means)
^{a,bc}. Means in the same row with different superscripts are significantly different (P<0.05)

and protein efficiency ratio. The same diet also produced the best live weight gain. Body weight gain ranged from 16.1g/day in the control group to 12.32g and 4.49g in Diet T2 and Diet T3 respectively. However, Diet T2 had the best nutritive value amongst the cassava peels and herbage combinations by supporting significantly better ($P<0.05$) apparent digestibility, total digestible nutrients, feed conversion and protein efficiency ratios in rabbits fed the diets than animals on diet T3 (Table 2). Rabbits on diets T1 and T2 were in positive nutrient balance while rabbits maintained on Diet T3 had negative nutrient balance and this is reflected in the poor performance revealed by Table 3.

Serum chemistry as influenced by the diets is summarized in Table 4. Serum sodium was highest in diets T2 and T3 ($P<0.05$) and lowest in the control group. Potassium levels were unaffected by the dietary treatments. Total protein was highest in rabbits fed the control diet ($P<0.05$) but similar in rabbits on the other diets. AST and cholesterol were highest in the Control ($P<0.05$) group and progressively lower in the rabbits on other diets. ALT was highest in serum of rabbits on diet T2 ($P<0.05$) followed by diet T3 group and lowest in the rabbits on the control diet.

DISCUSSION

This study has explored the practical possibility of totally replacing conventional feed ingredients in rabbit diets with whole composites constituted of graded compositions of sun dried cassava peels, *Leucaena leucocephala* and *Gliricidia sepium* leaves.

Cassava peels, *Leucaena leucocephala* and *Gliricidia sepium* leaves combination at 50:25:25% level performed better than at 33.3:33.3:33.3% combinations and supported feed intake, growth rate, feed efficiency, protein efficiency, and other performance indices at levels just below the performance of rabbits fed conventional diets. Crude protein requirements of rabbits have been put at a range of 10.4 to 25.5% with optimum levels at 15% (Spreadbury, 1978) so the trial diets were slightly low in protein. In spite of its very low crude protein content, Diet T2 with 11% crude protein compared with 14.6% crude protein in Diet T3 performed much better than diet T3. This is possibly due to the high crude fibre and low nitrogen free extracts in diet T3. Another factor responsible for the poor nutritive quality of diet T3 is the high content of *leucaena* and *gliricida* coming in at 33.3 % each. The growth rate of 16.61g, 12.32g and 4.49g /day recorded for diets T1to T3 respectively are very low compared to values recorded in other regions of the world especially the temperates where better feed ingredients have achieved body gain of 35-40g per day. Sun drying alone has not been able to achieve total reduction of the toxin mimosine in *leucaena* leaves and the high level of incorporation must have resulted in its poor utilisation. Workers elsewhere have had to supplement leucaena with ferrous sulphate (Lopez *et al.*, 1979) to reduce the toxicity of mimosine. The ability of rabbits to tolerate mimosine at 25% level is due to its dual nature as a monogastric herbivores as monogastrics have not shown positive performance on diets containing high levels of leucaena although swine has been reported (Adejumo and Akpokodje (1990) to tolerate leucaena up to 50% level. The results of the serum metabolites indicated a lowering of AST in the herbage and cassava diets but an elevation of ALT in the same diets. This interaction is a bit erratic and is not specific on effects of the diets on liver function. However, the decline in protein and cholesterol could be traced to the higher fibre and lower protein content of the cassava and *leucaena* and *gliricidia* leaf meals.

The slightly raised levels of serum sodium and potassium in the rabbits fed the cassava peels and LLM and GLM are possible reflections of the higher mineral profile of *leucaena* and *gliricidia* Leaf meals. In conclusion, the very poor performance and negative nutrient balance of rabbits on Diet (T3) compared with the control group and the T2 group suggests that total replacement of conventional diets could be achieved with rabbits at relatively low cost based on a combinations of 50% cassava peels and 25% each of *Leucaena leucocephala* and *Glinicidia sepium* leaf meals as higher levels of *leucaena* and *gliricidia* severely depressed growth and performance.

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