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Response of growing Rabbits to different plant fibre sources

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Target Audience: Animal Nutritionists, Feed millers, Livestock producers, Rabbit farmers

Abstract

Four different browse plant leaf meals namely, Gliricidia sepium, Leucanea leucocephala, Tridax procumbens and Aspilia Africana were included separately as dietary fibre source in rabbit diets during which growth performance, nutrient digestibility and haematology were monitored. Thirty 7 weeks old weaner rabbits with initial weight range 753±13.46g -766.58± 4.87 were divided into 5 groups and fed each of the diets that constituted the treatments for 56 days with wheat offal as dietary fibre source in the control. Significantly higher (p<0.05) and similar average daily feed intake (ADFI) was recorded by rabbits fed the control and Gliricidia sepium diets (57.02 ± 0.92g; 56.62± 0.96g respectively) while those on Aspilia Africana (47.61± 0.99 g) and Tridax procumbens (48.7± 0.36g) were similar and lowest (p<0.05). The final live weight (FLW), average daily body weight gain (ADWG), feed conversion ratio (FCR) and protein efficiency ratio (PER) were significantly better (p<0.05) in rabbits fed diets containing Aspilia africana (1.91±0.03 kg; 20.38 ± 0.52 g and 2.34 ± 0.10; 2.59 ± 0.11 respectively) even though similar to values from Tridax procumbens and the control diets. The nutrient digestibility viz; dry matter (DM) Crude protein (CP), neutral detergent fibre (NDF) and acid detergent fibre (ADF) were similar and higher (p<0.05) in rabbits fed Aspilia Africana (81.44 ±0.75%, 68.26 ± 0.35, 56.14 ± 0.13, 53.61 ± 0.08% respectively) and the control diets. The pack cell volume (PCV), haemoglobin concentration (Hbc), red blood cell count (RBC), white blood cell count (WBC) and blood glucose level were not affected (p>0.05) by the dietary fibre sources. Aspilia africana and Tridax procumbens appeared to be a good plant fibre dietary source in growing rabbit than Gliricidia sepium and Leucanae leucocephala.

Key words: Browse plant, dietary fibre, performance, plants, growing rabbit.

Description of Problem

Dietary fibre forms a significant component of rabbit feed to provide energy, protein and other nutrients (1). Even though rabbits have simple stomach that makes them monogastrics, they possess hind-gut fermentation capacity on fibre feedstuffs because of the presence of well-developed caecum, proximal and distal colon that harbours fermentative microbiota (1, 2). Fibre is included in the diets or often time fed as supplement such as farm or kitchen wastes and some browse plants (3). Over the years, research efforts on dietary fibre of rabbit have become very revealing as it indicated the importance of the level and quality at which it is fed (4). Cellulose, lignin, hemicellulose and pectin with different structural compositions also determine the quality of dietary fibre due to the variation in the branching order and saccharide or sugar molecules. Intake of low fibre and its quality in post-weaning diets of rabbit has been implicated in the incidence of gastro intestinal disorders such as diarrhoea that showed up as dilation of the caeco-colic segment and watery intestinal and caecal digesta (5). These authors recorded a mortality and morbidity rate of 30% and 60% respectively in a 28 – 70 day trial. However, inclusion of starch or digestible fibre at the finishing period of rabbit fattening was found to be beneficial as it enhances digestive security against disorders (6). Efficient utilization of dietary fibre in rabbit feed depends on the available fermentable carbohydrate structure which had been reported to correlate with the size of the fermentation chamber and the transit time of the fibre particles (7). Dietary fibre sources in the commercial rabbit pellets are usually agro- industrial by products that had undergone some level of processing with reduced particle size such as bran and offal which are keenly competed for by monogastrates that do not have digestive physiology advantage when compared to herbivores or pseudo-ruminant. Rabbits in the wild selectively pick the forage consumed to meet their energy and fibre needs. The growing need to reduce the competition on the processed agro by-product fibre sources that continue to have corresponding increase in price with the main cereal and the dearth of information on the beneficial browse plant fibre that could replace the agro-wastes motivated the investigation of different dietary plant fibre sources in the diets of growing rabbit. Therefore, the objective of this study is to identify and observe the response of growing rabbit to locally available browse plant when used to replace wheat offal used widely in poultry.

Materials and Methods

Experimental Site and Preparation of Test Forages

The experiment was carried out in the Rabbitary Unit of the Teaching & Research Farm of Ekiti State University, Ado-Ekiti, Nigeria located on latitude 7^{o} 40^{1}N and longitude 5^{o} 15^{1} E. The fresh tender leaves of four different forages namely *Gliricidia sepium*, *Leucaenea leucocephala*, *Tridax procumbens* and *Aspilia Africana* were harvested separately on the University Farm, freed of dirt and air dried to crispy touch during the harmatan season . The leaves were then separately milled using a commercial milling machine (Artec Model 20), stored in well labelled transparent polythene bags. The leaf meals were used separately to replace wheat offal (25%) in a control diet. The wheat offal supplied 28.5% of the total 17.3 % crude protein in the control diet.

Experimental animal, design and procedure

Thirty weaner rabbits of Dutch and New Zealand White crosses aged seven (7) weeks with weight range of 733.80 g – 791.80 g were used for the 56 day study. They were balanced for sex and allotted to 5 treatment groups of 6 animals per group in a completely randomized design feeding trial. They were paired per replicate and allowed to adjust to the environment and experimental diets for 14 days in rabbit wooden hutches raised 40 cm above the floor of the rabbitary, dewormed and anticoccidostat administered as prophylactics. They were fed *ad libitum* daily on the treatment diets with water at 07 hr and 14 hr. Growth performance indices such as average daily body weight gain (ADWG) and average daily feed intake (ADFI) were monitored from which feed conversion ratio (FCR) and protein efficiency ratio (PER) were calculated. Apparent digestibility of dry matter, crude protein, neutral detergent fibre (NDF) and acid detergent fibre (ADF) was determined during the last 10 days of the trial. Blood samples were collected between 07 – 08 hr using syringe through the marginal ear vein into bottles containing ethylene diamine tetra acetate (EDTA) and immediately taken to the laboratory for haematology indices analyses.

Chemical Analyses

Test leaf meals, feed and faeces samples of the rabbits were dried in Gallenkamp table oven at 60^{o} C to constant weight to determine the dry matter. All the samples were analysed separately for proximate composition (8) while the ADF and NDF were also determined as described in (9). Blood samples collected were immediately taken to the laboratory and analysed for the packed cell volume (PCV), red blood cell count (RBC), white blood cell (WBC) and haemoglobin concentration (Hbc) using the Wintrobe microhaematocrit, Neuber haematocyatometer and cyanohaemaglobin procedures respectively according to (10).

Statistical Analysis

All the data collected were statistically analysed using version 6 computer packages for one way analysis of variance and means separated by Duncan Multiple Range Test (11).

Results and Discussion

The proximate composition and fibre fraction values of the wheat offal, *G. sepium, L. leucocephala, T. procumbens* and *Aspilia Africana* are shown in Table 2. All the values were significantly (p<0.05) influenced except the crude protein. The quantity of crude protein in the wheat offal was close to 19.05% recorded in literature (12). Protein contents of all the test forages were all within the range of 14.7 – 17.8% documented (13).

Wheat offal had the highest (p<0.05) values for DM, and fat (83.14±0.12% and 9.06±0.001 respectively). Crude fibre was higher (p<0.05) and similar in *L. leucocephala* (10.84±0.04%) and *G. sepium* (9.15±0.01%) and lowest but also similar in *Aspilia Africana* (6.90±0.2 %), *T. procumbens (*7.50±0.10%) and wheat offal (7.03±0.08%). These values correspond with those documented in literature where expectedly, the protein in the fibre residue or the cell wall components of the various browse plants under study must have been substantially removed to obtain a near true value (6, 9). The final live weight and average daily weight gain followed same trend with highest (p<0.05) but similar values recorded by rabbits fed the control diets (1.91± 0.03 kg and 20.29±0.51g); *T. procumbens* (1.87±0.01kg; 19.69±0.28g) and *Aspilia Africana* (1.89±0.52 kg; 1.89±0.02). Rabbits fed the control diet and those with *G. sepium* and *L. leucocephala* recorded similar and higher values (p<0.05) for the ADFI (57.02±0.92g; 56.62± 0.96g) while animals on diets with inclusion of *T. Procumbens* and *Aspilia africana* had the lowest (48.7±0.36g; 47.61± 0.99g). Wheat offal used in this study had the lowest and comparable lignin level with *G. sepium* (6.87±0.21%) and wheat offal (7.21±0.05 %) which may have accounted for the high feed intake of rabbits on diets with their inclusion. Groups of rabbit on these mentioned treatments also had highest and similar NDF (55.88±0.03% and 61.23±0.02% respectively).

Rabbits fed *Aspilia Africana* diet exhibited the best FCR and PER (2.34± 0.10; 2.59±0.11). Apparent nutrient digestibility values of DM, CP, NDF and ADF were higher (p<0.05) but similar in rabbits fed *Aspilia Africana* and the control diets. The lowest values were recorded by rabbits fed diets containing *G. sepium* (69.83±0.03%; 55.22±0.40%; 51.85±0.19% and 46.88±0.01% respectively). The haematology indices measured viz; PCV, Hbc, RBC and WBC were not affected by the treatment (Table 3).

Studies have shown that diets with high NDF or by implication hemicellulose are well digested by rabbits because they have high utilization for these fibre fractions (15).Conversely, high lignin contents of *T. Procumbens* and *Aspilia Africana* may be responsible for the low ADFI of rabbits fed these diets (4, 6). Though ADFI was higher in rabbits fed the control, *G. sepium* and *L. leucocephala* diets; they were not well utilized as observed in animals on *T. Procumbens* and *Aspilia Africana*. The botanical source of lignin fraction was mentioned to have a modulating effect on the feed intake, retention time and perhaps consequently its utilization (4). In addition, the presence of antinutritional (ANFs) factors flavonoid and or saponin in *G. Sepium*, and mimosine in *L. leucocephala* may have been responsible for poor utilization of these browse plants that the rabbits showed as low body weight gains (14). The ability of the rabbit to re-use the dietary fibre through the action of the microbiota in the ceco-colic segment of the gastro intestinal tract as soft faeces couples with the low lignin content particularly in group of rabbits fed *Aspilia Africana* supported the adequate conversion of the recycle nutrients.

The performance of the rabbits on *G. sepium* and *L. leucocephalia* is an indication that the ANFs effect did not appreciably impact on the health status of the rabbits. This study showed that *Aspilia Africana* leaf meal has the potential to be plant dietary fibre source in rabbit feed.

Conclusion and application

This study showed the potentials of browse plants such as *Gliricidia sepium, Leucenea leucocephala, Tridax procumbens* and *Aspilia Africana* as possible dietary fibre source for rabbits. However, it can be concluded that,

1. Growing rabbits have relatively low feed intake when separately fed *Tridax procumbens* and *Aspilia africana*as the main plant fibre source in their diet.
2. Despite impressive feed intake recorded by rabbits fed *Gliricidia sepium* and *Leucenea leucocephala* as the plant fibre source in their diets, the possible effect of their antinutritional factors component did not support adequate utilization and good conversion by the rabbits.
3. *Aspilia Africana* is a browse plant that has the potentials of replacing wheat offal which is an agro by-product used as a fibre source in rabbit diet. This will reduce the pressure of competition and possibly cost of rabbit diets because adequate dietary fibre in rabbit diet in quantity and quality support good growth performance.

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Table 1. Composition of experimental diets (%)

Ingredients	T1 Control (WO)	T2 *Gliricidia Sepium*	T3 *Leucaena leucocephala*	T4 *Tridax procumbens*	T5 *Aspilia Africana*
Maize	25.00	20.00	20.00	20.00	20.00
Rice bran	19.00	19.00	19.00	19.00	15.00
Groundnut Cake	10.00	10.00	10.00	10.00	9.00
Palm kernel	20.00	20.00	20.00	20.00	20.00
Wheat offal (WO)	20.00	1.29	1.44	1.16	-
Fish Meal	1.00	1.00	1.00	1.00	1.00
Gliricidia Sepium	-	23.71	-	-	-
Leucaena leucocephala	-	-	23.56	-	-
Tridax procumbens	-	-	-	23.84	-
Aspilia Africana	-	-	-	-	30.57
Bone meal	3.00	3.00	3.00	3.00	2.43
Oyster shell	1.00	1.00	1.00	1.00	1.00
*Premix	0.50	0.50	0.50	0.50	0.50
Salt	0.50	0.50	0.50	0.50	0.50
Determined Analyses (%)					
Dry matter	88.10	90.03	89.63	88.24	89.13
Crude Protein	17.03	17.10	17.16	17.11	16.96
Crude fibre	11.76	11.81	11.90	11.54	11.65
Fat	4.22	4.53	4.26	3.98	4.01
Ash	2.08	2.02	2.28	3.01	3.25
ME (MJ) Kcal/Kg (Calc.)	8.99	9.53	9.52	9.54	9.51

*The premix supplied the following kg-1 of diet: Vitamins A 800 I.U.; D3 (1,4731.C.U); Riboflavin 4.20mg; Pantothenic acid 5.0mg; Nicotinic acid 20.0mg; Folic acid 0.5mg; Choline 300mg; Vitamin K, 2.0mg; Vitamin B12, 0.01mg; Vitamin E, 2.5I.U; Manganese, 56.0mg; Iodine, 1.0mg; Iron 20.0mg; Copper 10.0mg; Zinc 50.0mg and Cobalt 1.25mg

Table 2. Proximate and fibre analysis of test forages used as dietary fibre source (%)

Forage Species/Fibre sources	DM	CP	Fat	CF	Cellu lose	Lignin	ADF	NDF	Ash
Wheat offal	83.14[a] ± 0.12	18.10 ±0.02	9.06[a] ±0.01	7.03[b] ±0.08	8.50[b] ±0.04	6.87[b] ±0.21	53.27[b] ±0.15	55.88[a] ±0.03	4.83[c] ±0.01
Gliricidia Sepium	24.18[b] ±0.01	19.78± 0.05	6.92[b] ±0.02	9.15[a] ±0.01	14.78[a] ±0.06	7.21[b] ±0.05	24.71[c] ±0.25	61.23[a] ±0.02	9.85[ab] ±0.03
Leucaena leucocephala	26.33[b] ± 0.08	19.91± 0.01	6.08[b] ±0.01	10.84[a] ±0.04	9.81[b] ±0.11	8.97[a] ±0.33	37.5[b] ±0.02	66.20[a] ±0.09	7.81[ab] ±0.01
Tridax procumbens	24.97[b] ±0 .02	19.67± 0.06	5.20[c] ± 0.02	7.50[b] ±0.10	3.11[c] ±0.28	10.17[a] ±0.01	42.50[c] ±0.01	55.40[a] ±0.16	10.90[b] ±0.05
Aspilia Africana	23.88[b] ± 0.03	15.34± 0.03	6.40[b] ±0.00	6.90[b] ±0.02	2.01[c] ±0.08	8.63[a] ±0.09	48.02[a] ±0.13	53.11[b] ±0.05	12.60[a] ±0.02

a, b, c Means within the same column with different superscripts differ significantly (p<0.05).

Table 3. Growth Performance of rabbits fed different plant fibre sources.

Parameters	T1 Control (WO)	T2 *Gliricidia Sepium*	T3 *Leucaena leucocephala*	T4 *Tridax procumbens*	T5 *Aspilia Africana*
Initial Live weight (g/rabbit)	758.47±30.0	759.11±3.51	758.43±6.59	766.58± 4.87	753.55± 13.46
Final Live weight (kg/rabbit)	1.91±0.03[a]	1.79± 0.02[b]	1.81±0.03[b]	1.87± 0.01[a]	1.89±0.02[a]
Average daily weight gain (g/rabbit)	20.29 ± 0.51[a]	18.42 ±0.27[b]	18.77 ± 0.54[b]	19.69 ± 0.28[a]	20.38 ± 0.52[a]
Average daily feed intake (g/rabbit)	57.02[a] ± 0.92	56.62[a] ± 0.96	54.37[b] ± 0.63	48.7[c] ± 0.36	47.61[c] ± 0.99
Feed conversion ratio	2.82[c] ± 0.11	3.07[d] ± 0.01	2.89[b] ± 0.10	2.48[ab] ± 0.05	2.34[a] ± 0.10
Protein efficiency ratio	2.15[c] ± 0.08	1.88[d] ± 0.00	2.01[c] ± 0.08	2.36[b] ± 0.04	2.59[a] ± 0.11

a, b, c Means within the same row with different superscripts differ significantly (p<0.05)

Table 4. Apparent nutrient digestibility of rabbits fed different plant fibre sources (%)

Parameters	T1 Control (WO)	T2 *Gliricidia Sepium*	T3 *Leucaena leucocephala*	T4 *Tridax procumbens*	T5 *Aspilia Africana*
Dry matter	74.11 ^{a} ± 0.91	69.83 ^{c}±0.03	70.23 ^{c}±0.10	78.39 ^{b}±0.08	81.44 ^{a} ±0.75
Crude protein	66.45 ^{a} ± 0.25	55.22 ^{c}±0.40	58.33 ^{c} ± 0.15	69.21 ^{ab} ± 0.25	68.26 ^{a} ± 0.35
Neutral detergent fibre	58.1 ^{a} 1± 0.31	51.85 ^{c} ± 0.19	52.91 ^{c} ±0.21	54.21 ^{ab}±0.97	56.14 ^{a} ± 0.13
Acid detergent fibre	50.34 ^{a} ± 0.22	46.88 ^{c}± 0.01	48.11 ^{c}± 0.03	50.42 ^{b}±0.12	53.61 ^{a} ± 0.08

a, b, c Means within the same row with different superscripts differ significantly (p<0.05

Table 5. Haematology of rabbits fed different plant fibre sources

Parameters	T1 Control (WO)	T2 *Gliricidia Sepium*	T3 *Leucaena leucocephala*	T4 *Tridax procumbens*	T5 *Aspilia Africana*
Packed cell volume (%)	33.93±0.08	35.04±0.97	35.91±1.61	34.69±1.14	35.43±0.67
Haemoglobin concentration (g/dl)	12.19±0.18	12.33±0.34	12.21±0.28	12.56±0.77	12.66±0.67
Red blood cell (10^6/mm^3)	5.30±0.53	6.61±0.40	6.70±0.43	6.34±0.68	5.92±0.97
White blood cell (10^6/mm^3)	7.44± 0.48	6.56± 0.76	6.72±0.73	6.76±1.53	7.13±1.06
Glucose (mg/dl)	125.67±1.53	151.0±6.56	125.67±7.43	154.00±8.72	158.67±3.51

a, b, c Means within the same row with different superscripts differ significantly (p<0.05)