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Growth Performance, Organ Characteristics and Carcass Quality of Weaner Rabbits Fed Different Levels of Wild Sunflower (*Tithonia diversifolia* Hemsl A. Gray) Leaf-Blood Meal Mixture

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Abstract: Thirty-two crossed-bred rabbits of mixed sexes were used to investigate the effect of different inclusion levels of Wild Sunflower Leaf-blood Meal (WSFLBM) mixture on growth performance, carcass and organ characteristics of weaned rabbits in a completely randomized experimental design. Four diets were formulated to contain 0% (control), 5, 10 and 20% WSFLBM. The trial lasted for 56 days. Results showed that rabbits on 5, 10 and 20% inclusion levels had daily feed intake, average daily weight gain and feed to gain ratio that were comparable ($p>0.05$) to those on control diet. The feed cost per kg diet was significantly ($p<0.05$) reduced as the level of inclusion of WSFLBM mixture increased. The feed cost per kg weight gain was however not affected ($p>0.05$). Relative weights of heart, lung, kidney, spleen, stomach, pancreas and large intestine of rabbits on WSFLBM diets compared favourably with those rabbit on the control diet ($p>0.05$). It was concluded that wild sunflower leaf-blood meal mixture (WSFLBM) could be efficiently utilized and tolerated by weaner rabbits up to 20% inclusion level without any deleterious effect. However, further investigation into the long - term effect on internal organs and reproductive performance is suggested.

Key words: WSFLBM, cross-bred rabbits, feed intake, organ weights, feed cost

INTRODUCTION

Rabbits play an important role in the supply of animal protein to the Nigerian populace (Amaefule *et al*., 2005). They are efficient converters of feed to meat and can utilize up to 30% crude fibre as against 10% by most poultry species (Egbo *et al*., 2001). Rabbits can utilize unconventional feedstuffs (Igwebuike *et al*., 2001) such as blood meal and diverse forage materials such as wild sunflower.

This is why attention is now being shifted to rabbit production in order to solve the problem of shortage of protein. To make rabbit rearing more viable as a small-scale business Alawa *et al*. (1990) have advocated the development of alternative feeding materials that would be relatively cheaper when compared with commercial feeds or conventional feedstuffs.

Various studies have been conducted to determine the feeding values and chemical composition of wild sunflower leaf meal in both broilers and layer diets (Odunsi *et al*., 1996, 1999; Farinu *et al*., 1992) and in ruminant animals (Akinlade *et al*., 2004) but little had been reported on the effect of feeding the forage of wild sunflower to rabbits. Scott (1974) reported that the leaves of tropical grasses

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and forage legumes are excellent sources of protein, vitamin and xanthophylls. Sunflower is of high nutritional value, containing all the known essential amino acids and also is rich in minerals and vitamins especially the B-complex vitamins (Day and Levin, 1954).

Many researchers had research on blood meal (Wahlstrom and Libal, 1977; Galal *et al*., 1977; Njoku, 1985). Blood meal contains 77.35% CP, 0.53% fat, 1.46% CF, 0.3% calcium and 0.2% phosphorus (Aduku, 1993). Thus it could be a good protein source for livestock species including such as rabbit. Fetuga *et al*. (1974) reported that blood meal protein was better than plant protein and it is high in lysine and leucine. Although Bamgbose (1991) and Adeniji and Balogun (2002) had reported feeding combination of blood and rumen contents in the layers diet little is known about the effect of the combination of both wild sunflower and blood meal on the performance of rabbit.

This study was designed to investigate the effect of feeding a combination of wild sunflower leaf-bloodmeal mixture on growth performance and carcass characteristics of weaner rabbits.

MATERIALS AND METHODS

Location of Experiment

The experiment was carried out at the Rabbitary unit of Teaching and Research farm of Ladoke Akintola University of Technology (LAUTECH), Ogbomoso, Nigeria. The area is located within the derived savanna zone of Nigeria. The study area is located on Latitudes 8°. 07^{1} N and 8° 12^{1}N and Longitudes 4° 04^{1}E and 4° 15^{1}E. The mean annual rainfall is 1247 mm with a relative humidity of between 75 and 95%. It is situated at about 600 m above sea level with a mean annual temperature of 26.2°C (Oguntoyinbo, 1978). The study was carried out between February and March, 2005.

Preparation of Experimental Diets

The wild sunflower used was harvested when the first inflorescence had opened in 50-80% of the plants. Wild sunflower leaf meal was prepared by air-drying the leaf and the succulent stalks on a concrete floor inside a well-ventilated roofed house to preserve its nutritive value as much as possible. The dried leaves were then milled into WSFLM.

Blood meal used was prepared by boiling freshly collected bovine blood from the abattoir for 60 min. The coagulum was spread on a concrete floor and sun-dried until completely dried. It was then hammer milled into blood meal.

The wild sunflower leaf meal and the blood meal were mixed together in ratio 2:1, respectively to form the wild sunflower leaf-blood meal mixture.

The test ingredients WSFLBM were incorporated into four diets at levels of 0, 5, 10 and 20%.

Animals and Their Management

Thirty-two cross-bred 5-8 weeks old weaner rabbits of mixed sexes with an initial weight range of between 594 and 608 g were randomly allocated to four dietary treatment groups in a completely randomized experimental design. There were 8 rabbits per treatment and each rabbit constituted a replicate.

The rabbits were housed individually in all-wire metabolic cages, which were designed for easy collection of faeces and urine. The rabbits were provided with water *ad-libitum* while feed was served twice daily at 08:30 and 15:30 h. Feed offered and the left over were weighed to determine feed intake of the animals. After the initial weight, weekly weights were taken. These records were used to monitor and determine the performance parameters in terms of mean weight gain and feed: gain ratio.

Digestibility Trial

Faecal samples were collected daily for one week during the seventh week of the experiment, oven-dried at 80°C until a constant weight was attained. The dried faeces were analyzed for the proximate constituents and the results were used to determine digestibility of the feed nutrients by the rabbits.

Carcass Evaluation

At the end of the experiment (eight weeks) all the rabbits were slaughtered. Prior to slaughtering, the rabbits were tagged, fasted for 12 h and weighed to determine the final live weight. The fur was removed by scalding. Evisceration was carried out immediately by removing the viscera and intestine. The weight of the carcass, head and internal organs were taken. Five gram samples of the left thigh muscles were collected from all the animals for proximate analysis of the nutrient content (protein, fat and ash).

Chemical Analysis

The proximate components of the test ingredients, samples of the diets, faeces and muscle were determined by the AOAC (1990).

Statistical Analysis

All the data collected on daily weight gain, feed to gain ratio, feed cost per kg gain, internal organs and carcass weights, nutrient digestibility and muscle composition were subjected to analysis of variance (ANOVA) according to Steel and Torrie (1980) and where significant differences between the means were indicated, Duncan's Multiple Range test (Duncan, 1955) was used to separate the means.

RESULTS AND DISCUSSION

The percentage and proximate composition of the experimental diets as well as the proximate composition of the test ingredients is presented in Table 1 and 2.

Table 1: Percentage composition of the experimental diets

	Diets			
Ingredients	1	2	3	4
Maize	15.0	12.00	9.00	3.00
Maize bran	30.0	30.00	30.00	30.00
Groundnut cake	10.0	8.25	6.50	3.00
Palm kernel cake	31.0	31.00	31.00	31.00
Fish meal	1.5	1.25	1.00	0.50
WSFLBM	0.0	5.00	10.00	20.00
Bone meal	3.0	3.00	3.00	3.00
Premix *	2.0	2.00	2.00	2.00
Oil	4.0	4.00	4.00	4.00
Salt	0.5	0.50	0.50	0.50
Molasses	3.0	3.00	3.00	3.00
Total	100.0	100.00	100.00	100.00
Determined analysis				
Crude protein	16.18	17.50	19.46	19.68
Crude fibre	7.60	7.80	8.20	8.70
Ether extract	16.25	16.41	16.20	15.84
Ash	9.53	9.56	10.88	14.88
ME (kcal kg^{-1})	3719.00	3720.00	3725.00	3476.00
NFE	50.44	48.73	45.26	40.90

*: Vitamin-mineral premix contained the following (g kg^{-1}): vit A, 1500 IU; vit E, 11 IU; vit B_2, 10 mg; vit B_3, 40 mg; vit B_6; 20 mg; choline chloride, 400 mg; Mn, 120 mg; Fe, 70 mg; Cu, 10 mg; I_2 2.2 mg; Se, 0.2 mg; Zn, 45 mg; Co, 0.02 mg

Table 2: Proximate compositions of test ingredients

Nutrients DM (%)	WSFLBM	BM	WSLM	Diet 1	Diet 2	Diet 3	Diet 4
Crude protein	50.52	83.12	21.21	16.18	17.50	19.46	19.68
Crude fibre	14.30	0.61	10.50	7.60	7.80	8.20	8.70
Ether extract	10.99	1.30	10.00	16.25	16.41	16.20	15.84
Ash	14.00	8.83	18.09	9.53	9.56	10.88	14.88
NFE	10.19	6.14	40.20	50.44	48.73	45.26	40.90

WSLM: Wild Sunflower Leaf Meal, BM: Blood Meal

Table 3: Performance characteristics of weaner rabbits fed graded levels of WSFLBM mixture

	Diets				
Parameters	1	2	3	4	SL
Initial live weight (g)	594.63±41.3	607.25±52.3	608.63±58.7	608.13±40.5	NS
Final live weight (g)	1220.60±43.1	1285.30±52.6	1247.98±46.1	1288.60±30.9	NS
Weight gain (g day^{-1})	10.61±0.60	11.49±0.36	10.83±0.79	11.53±0.57	NS
Feed intake (g day^{-1})	50.71±1.89	51.86±2.37	50.75±2.08	54.60±0.57	NS
Feed to gain ratio	4.86±0.26	4.53±0.21	4.87±9.35	4.78±0.35	NS
Feed cost kg^{-1} feed (N)	43.71±0.0^{a}	42.50±0.00^{b}	41.29±0.00^{c}	38.88±0.00^{d}	*
Feed cost/kg weight gain (N)	212.27±11.5	192.57±8.93	200.90±17.68	193.31±10.54	NS

NS = No significant difference ($p>0.05$), *: Significantly different ($p<0.05$), ^{a,b,c}: Means within rows with different superscript are significantly different ($p<0.05$)

The wild sunflower leaf meal, blood meal and wild sunflower leaf-blood meal mixture contained 21.21, 83.12 and 50.52% crude protein, respectively.

The performance of the rabbits fed WSFLBM is presented in Table 3 and 4. The daily weight gain, daily feed intake as well as the feed: gain ratio, feed cost/kg weight gain, were not significantly ($p>0.05$) affected by the dietary treatments.

The percentage dress weight, relative weights of heart, lungs, kidney, spleen, stomarch, pancreas and large intestine were not significantly ($p>0.05$) different among the treatments. While the liver weight of rabbits on diet 4 (20% WSFLBM) was significantly ($p<0.05$) higher, the small intestine (3.1±0.01 g) and caecal (3.29±0.10 g) weights were significantly ($p<0.05$) lower compared to other diets (Table 4). The cost per kilogram of feed for diets 1, 2, 3 and 4, respectively, significantly ($p<0.05$) reduced as the inclusion level of WSFLBM increased.

Dry matter digestibility, crude protein digestibility, crude fibre digestibility and the muscle composition were not significantly ($p>0.05$) affected by the dietary treatments (Table 5). However dietary treatments had significant ($p<0.05$) influence on ether extract, ash and nitrogen free extract digestibility.

The value of crude protein obtained for wild sunflower leaf meal used in this study was higher than the values reported by Odunsi *et al*. (1996). The difference could be due to the stage of growth as at harvest and the processing procedure.

The crude fibre value obtained was similar to those obtained for groundnut haulms (21.6%) and potato leaves (21.21%) by Adama and Nma (2002) but was lower than the 29.15% of Leucaena leaf meal (Farinu *et al*., 1992).

The daily weight gain obtained in this study though not significantly ($p>0.05$) different among treatments, was similar to 10.1 g reported by Adama and Nma (2002) when groundnut leaves were fed to rabbits and 12 g reported by Omole and Ajayi (1976) who fed dried brewer's grain to rabbit but lower than 17.65-18.80 recorded by Agunbiade *et al*. (1999) on cassava leaf and peel meal. It was much lower than 25.5-31.0 g reported by Lebas *et al*. (1986) for temperate regions. The lower weight gains under tropical condition could be due to differences in ecological conditions of the experimental sites, age of the rabbits used for the different experiments, varying components used as well as lower genetic potential. Lebas (1983) had earlier reported that high ambient temperature depresses feed intake and weight gain.

Table 4: Percentage internal organs and carcass weights of weaner rabbit fed graded levels of WSFLBM

	Diets				
Organs (% carcass weight)	1	2	3	4	SL
Head (%) dressed	12.19±0.58	11.80±0.33	11.23±0.44	10.93±0.39	NS
Weight (%)	60.68±1.16	61.45±1.10	61.69±0.99	61.89±0.96	NS
Heart	0.42±0.03	0.36±0.02	0.35±0.02	0.35±0.02	NS
Lungs	0.19±0.06	0.97±0.00	0.70±0.07	0.87±0.09	NS
Kidney	1.09±0.06	1.00±0.08	1.06±0.05	1.19±0.06	NS
Liver	4.25±0.18^{b}	4.52±0.19^{b}	4.40±0.16^{b}	5.38±0.32^{a}	*
Spleen	0.09±0.01	0.09±0.01	0.07±0.01	0.10±0.01	NS
Stomach	2.17±0.01	2.25±0.17	2.16±0.14	2.15±0.11	NS
Large intestine	1.64±0.09	1.58±0.17	1.70±0.30	1.28±0.10	NS
Small intestine	4.16±0.32^{a}	4.01±0.25^{a}	4.11±0.24^{a}	3.10±0.20^{b}	*
Caecum	4.15±0.02^{a}	4.12±0.38^{a}	3.65±0.11^{ab}	3.29±0.10^{b}	*
Pancreas	0.15±0.30	0.13±0.03	0.09±0.03	0.15±0.02	NS

NS = No significant difference ($p>0.05$), *: Significantly different ($p<0.05$), ^{a,b,c}: Means within rows with different superscript are significantly different ($p<0.05$)

Table 5: Effect of experimental diets on nutrient digestibility and chemical composition of rabbit lean meat

	Diets				
Nutrients	1	2	3	4	SL
Digestibility (%)					
Dry matter	70.00±2.15	72.50±5.96	71.60±6.04	68.40±5.21	NS
Crude protein	63.90±2.17	68.20±6.79	69.40±7.10	68.20±4.82	NS
Crude fibre	34.80±4.83	39.10±13.61	37.80±15.45	39.30±8.82	NS
Ether extract	97.30±0.14^{ab}	97.80±0.42^{a}	97.10±0.42^{ab}	96.70±0.42^{b}	*
Ash	71.60±1.33^{b}	72.80±5.13^{b}	68.80±6.45^{b}	81.40±3.75^{a}	*
NFE	68.80±4.53^{a}	74.30±4.88^{a}	64.20±1.48^{ab}	55.90±5.02^{b}	*
Muscle composition (%)					
Dry matter	23.78±2.20	25.32±1.37	22.84±1.13	24.25±1.06	NS
Crude protein	37.19±0.56	37.37±0.67	37.45±0.43	37.72±0.44	NS
Ether extract	11.22±0.52	11.99±0.67	12.67±0.17	11.14±0.75	NS
Ash	6.13±0.09	5.99±0.09	6.04±0.13	6.19±0.15	NS

NS = No significant difference ($p>0.05$), *: Significantly different ($p<0.05$), ^{a,b,c}: Means within rows with different superscript are significantly different ($p<0.05$)

The feed-to-gain ratio of between 4.53 and 4.87 obtained in this study is within the range of values reported by Adejumo (2002), for rabbits on Gliricidia leaf meal, Iheukwumere *et al*. (2002) on rice milling waste and Adegbola and Okonkwo (2002) on cassava leaf meal. This shows that the test ingredient (WSFLBM) compared favourably with other non-conventional ingredients such as rice milling waste, cassava leaf meal and gliricidia leaf meal as feedstuff for rabbits.

The reduction observed in feed cost per kilogram feed is an indication that WSFLBM could be used to reduce the cost of rabbit feed.

The inclusion of WSFLBM mixture did not affect weight of most carcass parts. This was in agreement with the results obtained by Adama and Haruna (2002) Adama and Danwake (1999) and Sankhyan *et al*. (1991) but was contrary to the report of Collin (1976) when he compared the effect of 10 and 17% crude fibre in rabbit diets and observed that the carcass yield was reduced at the higher crude fibre level.

The significantly ($p<0.05$) higher liver weight recorded for rabbits on diet 4 (20% WSFBLM) indicated the possibility of liver overload. This could be due to the effect of anti-nutrients in the wild sunflower leaf meal (Dutta *et al*., 1986) at this level. The caecum of rabbit fed diet 4 was smaller probably because the diet contained more fibre and less of non-fibre component which normally goes into caecum for fermentation. In order words, less activity took place in the caecum of rabbit on the diet compared to the others. Similarly the high fibre content resulted in less absorption in the small intestine and consequently small size of the small intestine. Sakaguchi (1992) stated that the lining of the small intestine has numerous tiny projections called villi, which are used for absorption.

The higher digestibility values obtained for ether extract could be due to addition of fat to the ration. This may be the reason for the lower digestibility of crude fibre. However, the lower digestibility values recorded for crude fibre in this study is similar to the observation of earlier workers (Joyce *et al*., 1971; Cheeke *et al*., 1986).

The digestibility coefficients recorded in this study for dry matter, crude protein, crude fibre and energy (NFE) for the four diets were comparable to those obtained by Adegbola and Okonkwo (2002) and Adama and Haruna (2002). The non-significant results obtained when rabbit muscle were analyzed is in line with the work of Adama and Haruna (2002) when they fed different dietary sources of fibre to rabbits. The values for proximate composition of the meat were higher than the values reported by Das and Bujarbarua (2005).

CONCLUSION

It could be concluded that WSFLBM mixture could be efficiently utilized and tolerated by weaner rabbits up to 20% inclusion level without any deleterious effect on performance. Incorporation of WSFLBM mixture reduced feed cost per kilogram weight gain especially at 20% inclusion level, meaning that there will be more income for the Farmer. However, further investigation into higher levels of inclusion beyond 20% as well as the long term effect on internal organs and reproduction will be the focus of further study.

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