Journal of Agriculture and Veterinary Sciences
Volume 6, Number 1, 2014
ISSN: 2277-0062

Evaluation of Forage-Based Diets Fed to Rabbits for Sustainable Development in Nigeria

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ABSTRACT

This study was designed to investigate the performance and nutrients digestibility of rabbits fed forage diets. Twenty four (24) weaners, Rabbits of about five (5) weeks old were used for the study. The rabbits were allocated to four (4) dietary treatments with six (6) replicates of one (1) rabbit each. Diet T1 and T2 contained 50% dry matter *Arachis hypogaea* haulms and 50% *Musa spp* fresh leaves respectively. While Diet, T3 and T4 contained 50% *Amaranthus spinosus* stems and 50% *Amaranthus spinosus* fresh leaves respectively. Each diet T1, T2, T3 and T4 were supplement with 50% maize bran and the experiment lasted for (8) weeks. The result showed a significant decrease ($p<0.001$) in body weight gain, increase in total feed intake and forage intake. Dietary treatment also had significant increase ($p<0.01$) no feed conversion ratio. There was a significant decrease ($p<0.05$) in dressing percentage and carcass weight. While nutrients digestibility of CF, Dm decreased ($p<0.001$), Cp digestibility had significant increase ($P<0.01$). However, rabbits performed better on *Arachis hypogea* haulms, *Amaranthus spinosus* leaves were recommended best.

Keywords: Rabbits, Cheap Animal Protein, Forage, Crop Residues.

Introduction

The acute shortage of animal protein in Nigeria has called for an increased interest in rabbit production. Rabbits are highly prolific animals with short gestation period 32 days and attain maturity weight within a short period of time. Rabbit meat is tasty, delicious and highly digestible. Rabbits have special ability to digest substantial amount of fibre than any other non-ruminants, thus making dietary fibre (non-starch polysaccharide and ligin) a major constituent of commercial rabbits feed (Adejinmi, *et al.,* 2007).

The price of meat from conventional sources such as cattle, sheep, goat, pig and poultry are not within the reach of many Nigerians. Consequently, many Nigerians cannot meet their daily protein requirement (Oluyeni and Roberts, 1978). The need to seek for an alternative source of cheap animal protein becomes imperative. Rabbit's production provides the ready answer. The high cost of meat from conventional sources can be attributed to heavy reliance placed on costly feed ingredients such as cereal grains and grain legumes usually used in feed formulation. Humans also used these grains for food and thus competition for whatever grain is available is great. Thus; finding an animal specie that can efficiently utilized and convert feedstuffs not directly utilized by humans to good quality meat will be very beneficial to mankind (Fekete, 1985) rabbits is such animal specie.

Rabbits raising as emerging livestock farming has a lot of potential for a developing country like Nigeria as one of the means of reducing the wide gap between meat demand and supply. In fact, it has been advocated by many scientist in tropical countries in recent years that rabbit's production represent an economic method of securing cheap animal and protein (Aduku and Olukosi, 1990).

Once the supplies of available nutrients for feeding livestock are increased especially from unconventional sources, the sustainability of animal agriculture will be ensured; in order to overcome these problems the utilization of low quality forage with emphasis on crop residues is being intensified by animal nutritionist (Bogoro, *et al.,* 1994). Nigeria is naturally blessed with abundant fertile soils than can support the abundant cultivation of green natural vegetable that can be used for the feeding of rabbits.

Materials and Methods

The Study Area

The experiment was conducted in Taraba State College of Agriculture Jalingo from April to June 2013. Jalingo the site of the research is located at latitude 8^{o} 50^{1} North and 11^{o} 25^{1} East with annual rainfall ranges of 1000-1500mm from May – November. The temperature range is between $30^{o}C$ and $38^{o}C$ depending on the season. It has an undulating topography with complete group of mountains and hills, the soil type range from sandy to loam which makes the rural inhabitants mostly farmers (arable and livestock).

Experimental Design

Twenty four (24) New Zealand White and Chinchila crossbreed weaned rabbits of about five (5) weeks old with an average weight 750g were used. They were randomly allocated to four (4) treatments groups with six rabbits per treatment in a completely randomized design arrangement. Each replicate consisted of one (1) rabbit. Diet T1 and T2 contained 50% dry matter (DM) *Arachis hypogaea (Groundnut haulms) Musa spp (Banana)* fresh leaves respectively. While Diet T3 and T4 contained 50% *Amaranthus spinosus* fresh stem and *Amaranthus spinosus* fresh leaves respectively. Diets T1, T2, T3 and T4 were supplement with maize bran at 50% level of inclusion.

A wire net beneath each cage was used to collect faeces free of urine contamination. Before the commencement of the experiment, all wire metabolic cages measuring length, 43cm with and 8cm height were thoroughly disinfected with Diazintol ® and allowed to dry. Each cage was provided with feed and water troughs for daily provision of feed and water. *Sulphonamide coccidiostats,* namely triple sulfa (Agar, Holland) and suiperhipraccox-p (Laboratorios Hipra, Spain) and E.S.T Mix WSP antibiotic were used during the experiment as prophylactic treatment against coccidial and bacterial infection respectively.

Source of Experimental Diets

Fresh Diet T2, T3 and T4 were collected every day from the College and its environs. While dies T1 and supplementary diet (Maize bran) were purchased from Sabon-Gari and Yelwa Markets respectively.

Animal Management

Each rabbit was assigned to a cage, initial weight of each rabbit was taken and the average weight of each treatment were also taken to ensure that the difference among the treatment do not exceed ten (10 grammes, Fifty grammes (50gm) each of the diet T1, T2, T3 and T4 were offered to each rabbit every day and the supplementary diet (maize bran) was also offered to each rabbit at 50% level of inclusion (50).

Adjustment period of two (2) weeks was giving to enable the animals to pass out the previous feed eaten and get accustomed to the test feed and the environment. After the preliminary period, the experiment proper continued. The rabbits were fed twice everyday (in the morning 7.00-8.5am with forages and in the evening 4.00-5.00pm with maize bran), water was offered and *libitum* daily.

Data Collection

The quantity of feeds supplied were weighed every morning and the residues (feed refusal) from the previous daily feed were collected and weighed to compute daily feed intake before the commencement of the next feeding.

Weight Measurement and Gain (g)

The initial weight of each rabbit and the average weight of each treatment were taken and subsequently at weekly intervals for the final live weight of each rabbit and weight gain. The final live weight of each treatment was also taken. The experiment lasted for eight (8) weeks.

Digestibility

Invivo method was used in the study to determine digestibility. During the last five (5) days of the feeding trials, the faeces voided by each animal daily were collected and a weighed. True digestibility studies were conducted and faecal samples were oven dried at 70c for 48 hours and stored in sample bottles. The samples were later ground to pass through a 0.1mm screen and then stored for analysis, which was done by A.O.A.C (1990) methods. Digestibility of the faeces and the proximate fractions of the diets by the rabbits were determine by A.O.A.C (1990) methods and then calculated

Carcass Evaluation

At the end of the feeding trails, two (2) rabbit on each experiment diets were randomly selected and starved overnight to clear the guts. Live weights were recorded before bleeding by cutting the jugular veins with a sharp knife. The tail was cut very close to the base before removing the pelt after removing the head and the feet. Evisceration of the rabbit carcass were carried out with a sharp knife and all internal organs were weight separately with the aid of citizen electronic balance and expressed as percentage of dressed carcass weight. The weights and lengths of the components of the gastro-intestinal tracts (GIT) were also taken and the dressing percentage was determined. Each rabbit the lengths of the caecum, large and small intestines were measured with a rule to known the difference in lengths. The stomach were cut and washed with a clean water to remove the contents and wiped before weighing was carried out.

Chemical Analysis

The proximate analysis of the diets and faecal samples were determined by Association of Official Analysis Chemists (A.O.A.C, 1990) to evaluate the feed and faecal sample components such as dry matter (DM), crude protein (CP),

crude fibre (CF), Ether Extract (EE), Ash and Nitrogen Free Extract (NFE). Prior to the chemical analysis, feed and faecal samples were collected, oven dried for 48 hours at 700 and stored in sample bottles. Gross energy was determined using a diabetic oxygen bomb calorie.

Statistical Analysis

The data on performance and digestibility obtained during the experimental period were subjected to mini-tap analysis of variance (ANOVA) (Steel and Torrie, 1980). Significant means were compared using least significant difference (LSD) to determine which means were different from others.

Results and Discussion

The most essential finding in this experiment was that of the average daily forage intake which was highly significant ($P<0.001$) in each treatment of different forage based diets. This finding is contrary to that of the average daily maize bran intake which had no significant different ($P<0.05$). This proves that forages are very important in the diets of rabbits which could reduce the high cost of purchasing convention feeds or ingredient for rabbit feeding. The research is similar to that of Pote *et al.*, (1980) who reported that when forages were given free of choice to rabbits, the amount of pelleted diets or compounded feeds consumption reduces by about 50% with no reduction in growth rate.

Table 1: Proximate Composition and Energy Values

	DM%	Ash	Cp%	EE%	CF	Gross Energy (Kcal/kg)
Amaranthus spinosus stems	63.42	12.61	19.23	4.29	8.09	3392
Amaranthus spinosus leaves	88.73	10.73	16.71	3.51	8.53	3320
Musa spp leaves	89.73	12.61	13.71	2.23	28.61	4450
Arachis hypogaea haulms	92.11	6.71	14.23	1.63	24.61	2985
Maize bran	93.41	1.05	10.87	1.20	1.26	4275

The highest value for dry matter (DM) was recorded (92.11%) on *Arachis hypogaea* haulms and maize bran (93.41%) diets. *Amaranthus spinosus* stem recorded the least value (63.42%). Crude protein (CP) content was highest (19.23%). On *Amaranthus spinosus* stems been accompanied by *Amaranthus spinosus* leaves (16.71%). The lower value was obtained (10.87%) on maize bran. Ether extract (EE) had (4.29%) was obtained on maize bran. Crude fibre content recorded the highest value of (24.61%) on *Arachis hypogaea* haulms diet and that of Ash (12.61%) was *Amaranthus spinosus* stems and *Musa spp* leaves and lower (1.05) on maize bran.

Table 2: Performance Characteristic of Rabbits Fed Different Forage Based Diets Supplement with Maize Bran

Parameters	Diets				
	1	2	3	4	LSD
Average initial weight (g)	773.33	775.00	774.17	773.50	773.50
Average final weight (g)	1186.67	891.67	891.67	1103.33	NS
Average daily weight gain (g)	7.38^{a}	2.32^{c}	1.98^{d}	5.89^{b}	17.71***
Average daily feed intake (g)	62.86^{d}	71.29^{c}	74.81^{b}	82.07^{a}	30.20***
Average daily forage intake	32.34^{d}	40.98^{c}	45.65^{b}	49.11^{a}	59.94***
Average daily maize bran intake (g)	31.70^{b}	29.94^{c}	29.08^{d}	32.98^{a}	NS
Feed conversion ratio	8.59^{a}	39.15^{c}	42.11^{d}	19.42^{b}	5.90***

a, b, c, d means with different superscript on the same rows are significantly different

*** = P<0.001 (means significant at 0.001%)

** = P<0.01 (means significant at 0.01%)

NS = P<0.05 (means not significant at 0.05%)

Average Daily Weight Gain (ADWG)

All rabbits on the four diets gained weight (Table 2). The highest ADWG of 7.38g/day was observed in rabbits on diets 1 followed by diet 4 (5.89g/day) and were highly significant (P<0.001). Diets 2 and 3 had lower values 2.32g/day and 1.98g/day which were also highly significant (P<0.001).

Average Daily Feed Intake (ADFEI)

Rabbits on *Amaranthus spinosis* leaves diet (Table 3) had the highest value (82.07g) of average daily feed intake and was significantly higher (P<0.001), followed by the rabbits on *Amaranthus spinosis* stems (74.81g). Lower values of feed intake were observed (71.29g) and (62.86g) on *Musa spp* leaves and *Arachis hypogaea (*groundnut haulms which were also highly significant (P<0.001).

All the rabbits on the four diets (Table 2) recorded highly significant (P<0.001) of Average Daily Forage Intake (ADFOI) which ranged from 32.34g – 49.11g). Rabbits on diets 4 had the best ADFOI, followed by the rabbits on diets 3, 2 and 1.

Average Daily Maize Bran Intake (ADMBI) (Table 2) showed that there was no significant difference (P<0.05) of ADMBI for all the rabbits on the four experimental diets. The feed conversion ratio (Table 2) of 8.89 was observed in diets 1 been lower (P<0.01) than the 19.42 obtained in diet 4. Similarly, the FCR of 39.15 found in diet 2 was lower (P<0.01) than 42.11 observed in diets 3.

Table 3: Carcass Cut-up Parts as Percentage of Body Live Weight

Parameters	Diets				
	1	2	3	4	LSD
Final Weight	120.00	885.00	975.00	1075.00	NS
Carcass Weight (g)	922.50[a]	400.00[d]	525.00[c]	35.00[b]	3.56*
Stomach Weight (g)	2.44	3.19	1.90	2.32	NS
Dressing %	76.87[a]	45.20[d]	53.85[c]	62.37[b]	3.05*
Liver Weight	5.88	6.15	6.00	8.35	NS
Lung Weight	1.12	1.43	1.25	1.73	NS
Heart Weight	0.75	0.62	0.55	0.56	NS
Kidney	1.24	1.18	1.34	1.43	NS
Length of large intestine (cm)	98.50	103.50	92.50	112.50	NS
Length of caecum (cm)	40.00	37.75	35.50	44.50	NS
Length of small intestine (cm)	204.00	196.00	217.00	224.00	NS

a, b, c, d means with different superscript on the same rows are significantly different.

* = P<0.05 (means significant at 0.05%)

NS = P<0.05 (means not significant at 0.05%)

The results showed that there was significant difference (P<0.05) in carcass weight and dressing percentage. The dressing percentage ranged from 45.20% to 76.87%. While carcass weight ranged from 400.00 – 922.50g. The means of organs weight and kidneys were not significant (P<0.05) affected by the dietary treatments. Treatment means of the intestinal lengths (Table 3) showed that the lengths of small intestine, large intestine and caecum followed the same trend as the organs weight.

Table 4: Nutrient Digestibility of Rabbits Fed Different Forage Based Diets Supplementary with Maize Bran

Parameters	Diets				
	1	2	3	4	LSD
Dry matter digestibility	88.00[c]	93.40[b]	60.67[d]	96.15[a]	5.03**
Crude protein digestibility	83.64[b]	76.15[c]	69.57[d]	97.18[a]	5.57**
Crude fibre digestibility	94.13[a]	65.49[c]	55.59[d]	88.89[b]	9.74***
Ether extract digestibility	34.70	35.61	31.00	36.22	NS
Ash digestibility	24.09	25.00	27.50	28.13	NS
Nitrogen free extract digestibility	51.90	50.60	47.00	45.00	NS

a, b, c, d means with different superscript on the same rows are significantly different.

*** = P<0.001 (means significant at 0.001%)

** = P<0.01 (means significant at 0.01%)

NS = P<0.05 (means not significant at 0.05%)

There are significant difference (P<0.001) in the crude fibre (CF) values among the treatment. Diets T1 and T4 had higher values (94.14 and 88.89) of CF digestibility respectively. Diets T2 and T3 had low values (65.49 and 55.50). Dry matter (DM) and crude protein (CP) digestibility were significant (P<0.01). Dry matter digestibility was high on diet T4 and T2 (96.15 and 93.40) respectively. Diet T1 (88.00) and T3 (60.67) had low values of DM digestibility. While diet T2 (75.16) and T3 (69.67) had low values of CP digestibility. The EE, Ash and NFE digestibility were not significant (P<0.05) among treatments.

Conclusion

There is a lot of forage that can be converted into rabbit meat in Nigeria. The rabbits on the four experimental diets gained weight. There was an indication that all the four forages could be used for the feeding of rabbits, meanwhile *Amaranthus species* could be recommended best due to its short interval of maturity and economical management practices.

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