

Effect of Replacing Groundnut Cake with *Alternanthera brasiliana* Leaf Meal in Varying Proportions on Nutrient Digestibility and Nitrogen Utilization by Weaned Rabbits

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ABSTRACT

The objective of this study was to evaluate the apparent nutrient digestibility and nitrogen utilization by rabbits fed varying proportions of *Alternanthera brasiliana* leaf meal (ABLM) and groundnut cake (GNC) based diets. Five experimental diets 0%, 5%, 10%, 15% and 20% levels of ABLM substitution for GNC were formulated. The chemical composition of the experimental diets was determined. Apparent nutrient digestibility, nitrogen utilization and total digestible nutrients by rabbits were also determined. Fifteen female weaned Chinchilla white rabbits between the ages of 6 – 10 weeks, weighing 400 – 600g were used for the digestibility trial. Three animals were allotted to each of 5 treatments in a completely randomized design. Parameters measured include: apparent digestibility of dry matter and crude protein, nitrogen intake, urinary nitrogen, nitrogen balance and retention, and total digestible nutrients. Results revealed that the apparent digestibility of dry matter and crude protein decreased with increasing level of ABLM in the diets, however the apparent digestibility of dry matter and crude protein were similar for rabbits on 0% and 10% ABLM diets, while there were significant variations among 5%, 15% and 20% ABLM diets. Same trend was observed for nitrogen intake, urinary nitrogen, nitrogen balance and retention, and total digestible nutrients. It is concluded that *Alternanthera brasiliana* leaf meal can replace groundnut cake in the diets of rabbits up to 10% level of inclusion for optimum nutrient digestibility and nitrogen retention.

Key words: *Alternanthera brasiliana*, groundnut cake, Nitrogen utilization, nutrient digestibility, rabbits

INTRODUCTION

A major problem facing developing countries especially Nigeria is the galloping population without a corresponding increase in animal protein production. Animal products contribute only 15 – 20% of the total protein intake of an average Nigerian contrary to 33% recommended by FAO (2012). This wide margin between the recommended protein intake and the average consumption rate has resulted in an ever increasing demand for animal protein by the Nigerian populace. To increase protein intake in Nigeria, there is urgent need to increase the production of animals that are highly prolific with short generational interval and can utilize forage efficiently, such as rabbits.

The traditional sources of vitamins and protein used in livestock rations, such as fish meal, bone meal groundnut cake, are becoming expensive in developed countries (Gondwe *et al.*, 1999). The availability of such ingredients is not adequate because of the spiralling cost of raw materials and ever increasing competition with the human beings for the same food items. Hence, the search for

alternative feed sources has become inevitable to reduce feed cost. (Swain *et al.*, 2011). *Alternanthera brasiliana* (Joy weed) is an example of such alternative feed source that can be incorporated into the diets of rabbits (Mako *et al.*, 2015). *Alternanthera brasiliana* is available all year round and it is under-utilized as fodder.

Rabbits have been recognized to have important role to play in the supply of animal protein to humans, especially in the tropical and subtropical regions. Rabbits occupy a vital midway between ruminants and monogastric animals and can utilize low-grain and high roughage diets efficiently (McNitt *et al.*, 1996). Rabbits production has several benefits; they have excellent reproductive potential all year round, faster growth rate, low grain and high roughage diets utilization and therefore can be produce from locally available forage and feed materials common in the tropics (Mokoro *et al.*, 2015). This study was therefore designed to evaluate the nutrient retention by weaned rabbits fed *Alternanthera brasiliana* based diets.

MATERIALS AND METHODS

Experimental site

This research work was conducted in the rabbitry unit of the Department of Agricultural Sciences, College of Science and Information Technology, Tai-Solarin University of Education, Ijagun, Ogun State, Nigeria.

Materials

Four hutches were constructed with strong wire-netting, iron roofing sheets and galvanized wire netting for cages' floor. The hutches were of 60cm x 60cm x 90cm dimension with wooden stands of 90cm from the floor. There are a total of five cells in each hutch. A window netting and polythene nylon were attached underneath each cell is for the collection of urine and faeces of the rabbit for digestibility trials. Each leg of the hutches was placed inside a cylindrical tin containing engine oil to prevent soldier ants' infestation. Plastic feeding and water troughs used were cast in concrete chambers to prevent tipping over of feeders and drinkers by the rabbits.

A kitchen weighing scale was used for feed rationing. A sensitive weighing balance was used to weigh the left-over feeds and a weighing scale was also used to weigh the animals weekly to determine the weight gain of the rabbits during the period of the experiment.

Collection of test ingredient (*Alternanthera brasiliensis*)

Alternanthera brasiliensis (Joy weed) was collected at Tai Solarin University of Education and its surrounding environments (i.e. Ijagun, Ijele, Ijebu-Ode etc). The leaf is found everywhere during the rainy and dry season. The leaves were sun-cured for about 2-3 weeks and later milled into powdery form to make *Alternanthera brasiliensis* Leaf Meal (ABLM).

Experimental diets

Five experimental diets corresponding to five dietary treatments were formulated (Table 2): Treatment 1: 20% Groundnut cake (GNC) and 0% ABLM to act as the control diet, Treatment 2: 15% of GNC and 5% ABLM, Treatment 3: 10% of GNC and 10% ABLM, Treatment 4: 5% of GNC and 15% ABLM. Treatment 5: 0% GNC and 20% ABLM. The proportions of other ingredients like maize offal, wheat offal, bone meal, salt, limestone and premix in the diets were constant. The rabbit mash diets mentioned above was turned into pelleted diets at a feed mill.

Chemical analysis

Crude protein, crude fibre, ether extract and total ash of experimental diets were analyzed in triplicates using standard procedure of A.O.A.C (2012). The crude protein

was determined with the micro kjeldahl distillation apparatus.

Nutrient retention evaluation

Fifteen rabbits (three rabbits from each treatment) were randomly selected from the twenty (20) used for feeding trial, for determining the nutrient retention and nitrogen balance of the diets. The rabbits were confined in individual modified (Akinsoyinu, 1974) metabolism cages for a separate collection of faeces and urine. The rabbits were offered the feed at 0800 h. The left-over feed or ort were weighed the following morning at 0700 h and deducted from the total amount served for the determination of feed intake. The ort was sampled daily and mixed for the entire collection period on an individual basis using an air tight plastic bag. Samples from the ort were taken for proximate composition analysis. Fresh water was served each day. The animals were weighed at the beginning and end of the digestibility trials. During seven days of collection period, total faeces were collected and weighed daily. A 10 % sample of total faeces was stored in a freezer at -10 °C. After 7 day collection period, the sample from each day was bulked, mixed and dried in the oven at 60 °C for chemical analysis. Total urine output was collected and weighed daily in the morning using measuring plastic containers. At collection, 2 ml of 10 % sulphuric acid was added to each container to prevent microbial growth and loss of nitrogen. Ten percent of total urine was sampled daily and stored at -4 °C for nitrogen analysis.

Nutrient retention was determined for crude protein, ether extract, crude fibre, ash and nitrogen free extract using the formula as follows:

$$\frac{\text{Nutrient in feed} - \text{Nutrient in faeces}}{\text{Nutrient in feed}} \times 100$$

Nitrogen utilization was also determined by analyzing the nitrogen content of the urine

Statistical analysis

Data obtained were analyzed and subjected to analysis of variance procedure (ANOVA) of SAS (2012). Significant means were separated by Duncan's Multiple Range Test of the same statistical package.

RESULTS AND DISCUSSION

The ingredient and chemical composition of the experimental diets are presented in Tables 1 and 2 respectively. The CP content (13.32 – 16.40 g/100g DM)

Table 1: Ingredient composition of experimental diets for rabbits

Ingredients	Diet 1 (0% ABLM)	Diet 2 (5% ABLM)	Diet 3 (10% ABLM)	Diet 4 (15% ABLM)	Diet 5 (20% ABLM)
Maize offal	66.8	66.8	66.8	66.8	66.8
ABLM	0	5	10	15	20
GNC	20	15	10	5	0
Wheat offal	10	10	10	10	10
Bone meal	1.5	1.5	1.5	1.5	1.5
Limestone	1	1	1	1	1
Salt	0.5	0.5	0.5	0.5	0.5
Premix	0.2	0.2	0.2	0.2	0.2
Total	100	100	100	100	100

of the experimental diets is above the minimum level of (7.7%) recommended for maintenance for goats and (12-16%) for rabbits (NRC, 2002). This is an indication that diets based on ABLM will meet the CP requirements of livestock. The CP of the experimental diets decreased with increasing level of ABLM ranging from 13.32 to 16.40 in 20% and 0% level of inclusion respectively. This is in agreement with report of Adeniji and Lawal (2012) for replacing groundnut cake with *Moringa oleifera* leaf meal.

Apparent digestibility (g/100g DM) of nutrients by rabbit is presented in Table 3. The digestibility values of DM, CP, CF, EE, ash and NFE ranged significantly among treatment means. The digestibility for CP ranged from 70.04 – 81.97 g/100g DM in rabbits on 20% ABLM and 10% ABLM respectively. Same trend was observed for digestibility of DM, CF, EE, Ash and NFE. However, these values are higher than the value of (27.02%) reported for *Gliricidia sepium*, (Babayemi, 2007), but in agreement with values reported elsewhere for rabbits fed rumen digesta (Anoh *et al.*, 2014). Rabbits on 10% ABLM inclusion recorded the highest digestibility values for all nutrients investigated, these results revealed marked improvement in digestibility up to 10% inclusion of ABLM, reflecting efficient utilization of nutrients. These result is in agreement with the findings of Obek and Tewe (1992), who reported that feeding cassava leaves with concentrate to pigs resulted in better utilization of nitrogen from leaves and improves digestibility of nutrients. However, the result is at variance with the findings of Iyayi (2001) who reported that digestibility values of dry matter, CP, CF, EE, Ash and NFE were not significant when growing rabbits were fed diets containing *Albizia saman* pods. The apparent digestibility of CP by rabbit on 0% and 10% ABLM inclusion levels were similar; this suggested that at 10% level of inclusion ABLM can replace GNC without deleterious effects on the performance of rabbits.

The digestibility of CF was low in all treatments than other nutrients, this findings is in agreement with findings of Oduguwa (2006). Rabbits are less efficient at digestibility of fibre than sheep and cattle (Adegbola and Okonkwo, 2002). The lower digestibility of CF could be due to the type of fibre in the diet, since fibres from different sources could vary in their digestibility depending on the proportions of cellulose, hemicellulose and lignin.

Table 4 shows N- utilization by rabbits fed varying proportions of *Alternanthera brasiliana* leaf meal in replacement of groundnut cake. N-intake, faecal-N, urinary-N, Total N- Loss, N-Balance, and N- retention differed significantly ($p < 0.05$) among treatment means. These values ranged from 1.75-2.30; 0.17 – 0.22; 0.20 – 0.24; 0.38-0.46; 1.29 – 1.92 g/d and 73.61 – 83.49 % respectively. Intake of rabbits on 0 % ABLM was similar to that of rabbits on 10 % ABLM, but was significantly different from rabbits on other treatments. The highest (1.92 g/d) and least (1.29 g/d) N-balance were observed for rabbits on 10% and 20% ABLM diets respectively. The same trend was observed for N-retention (%). The highest total nitrogen loss (0.46 g/d) was recorded for rabbits on 20% ABLM, while the lowest value (0.38 g/d) was recorded for rabbits on 10% ABLM. These results are lower when compared with findings elsewhere (Adamu *et al.*, 2014).

Total digestible nutrients by rabbit fed sun-cured ABLM {Digestible Crude Protein (DCP), Crude Fibre, (DCF), ether extract (DEE), Nitrogen free extract (DNFE)} are presented in Table 5. The values ranged significantly from 9.45-14.72; 2.75-10.42; 6.53-8.82 and 23.01-43.84 respectively. The highest value of DCP was recorded for rabbits on 10% ABLM, while the lowest value was recorded for rabbits on 20% ABLM.

Varying nutrient of weaned rabbits

Table 2: Proximate composition (g/100g DM) of experimental diets

Parameters	Level of <i>Alternanthera brasilliana</i> leaf meal				
	0%	5%	10%	15%	20%
Dry matter	89.52	88.91	88.57	87.85	89.26
Crude protein	16.4	14.95	13.89	13.45	13.32
Crude fibre	6.01	7.96	10.52	11.88	12.87
Ether extract	4.89	5	5.01	7.04	7.1
Ash	7	10.88	11.62	12.05	13.78
Nitrogen free extract	65.7	61.21	59.1	57.41	54.8

Table 3: Apparent digestibility (g/100g DM) of nutrients by weaned rabbits fed varying proportions of ABLM

Parameters	Levels of <i>Alternanthera brasilliana</i> leaf meal					±SEM
	0%	5%	10%	15%	20%	
Dry matter	85.63 ^a	80.30 ^b	86.78 ^a	77.28 ^c	71.54 ^d	0.38
Crude protein	73.53 ^b	72.31 ^c	81.97 ^a	71.61 ^{bc}	70.04 ^d	0.41
Crude fibre	57.54 ^b	57.01 ^c	62.10 ^a	54.84 ^d	46.89 ^e	0.42
Ether extract	74.47 ^{ab}	61.17 ^b	74.80 ^a	55.18 ^c	45.20 ^d	0.39
Ash	89.31 ^b	85.16 ^c	90.33 ^a	82.75 ^d	78.64 ^e	0.42
Nitrogen free extract	94.51 ^a	93.54 ^b	94.94 ^a	92.60 ^c	86.92 ^d	0.53

^{a,b,c,d,e} = Means on the same row with different superscript are significant (p< 0.05)

Table 4: Nitrogen Utilization by weaned rabbits fed *Alternanthera brasilliana* based diets

Parameters	0% ABLM	5% ABLM	10% ABLM	15% ABLM	20% ABLM	±SEM
Nitrogen intake (g/d)	2.21 ^a	2.00 ^b	2.30 ^a	1.89 ^c	1.75 ^d	0.002
Faecal nitrogen (g/d)	0.17 ^d	0.20 ^b	0.18 ^c	0.20 ^b	0.22 ^a	0.001
Urine nitrogen (g/d)	0.22 ^b	0.24 ^a	0.20 ^c	0.22 ^b	0.24 ^a	0.001
Total nitrogen loss (g/d)	0.39 ^d	0.44 ^b	0.38 ^d	0.42 ^c	0.46 ^a	0.001
Nitrogen balance (g/d)	1.82 ^a	1.56 ^b	1.92 ^a	1.43 ^c	1.29 ^d	0.002
Nitrogen retention %	82.30 ^a	78.00 ^b	83.49 ^a	75.68 ^c	73.61 ^d	1.52

^{a,b,c,d,e} = Means on the same row with different superscript are significant (p< 0.05). ABLM= *Alternanthera brasilliana*

Table 5: Total digestible nutrients (g/100g DM) by weaned rabbits fed different levels of ABLM

Parameters	<i>Alternanthera brasilliana</i> leaf meal					SEM
	0%	5%	10%	15%	20%	
Crude protein	13.40 ^b	12.79 ^c	14.72 ^a	10.70 ^d	9.45 ^e	1.23
Crude fibre	9.60 ^b	6.61 ^c	10.42 ^a	6.16 ^d	2.75 ^e	1.01
Ether extract	7.30 ^b	7.22 ^c	8.82 ^a	7.04 ^d	6.53 ^e	1.2
Nitrogen Free Extract	42.94 ^b	37.64 ^c	43.84 ^a	32.09 ^d	23.01 ^e	2.12
Total digestible nutrients	73.24 ^b	64.42 ^c	77.81 ^a	55.99 ^d	41.75 ^e	3.21

^{a,b,c,d,e} = Means on the same row with different superscript are significant (p< 0.05)

Same trend was observed for all nutrients. These results are higher than previous studies involving Guinea grass with *Leucena leucocephala* (Adejumo, 1987) and *Panicum maximum* with *Ficus religiosa* (Bamikole *et al.*, 2003). The high total digestible nutrients (TDN); apparent digestibility of nutrients, and positive N- balance obtained in the current study may be indicative of proper utilization of the feed stuffs.

CONCLUSION

The result of this study revealed that at 10% ABLM inclusion level, optimal digestibility and utilization was attained. It can be concluded that high levels of nutrient intake by rabbits confirmed the high nutritive value of *Alternanthera brasilliana* and its potential as forage that can support rabbit production. *Alternanthera brasilliana* leaf meal can replace GNC in the diet of rabbits up to 10% without any deleterious effect.

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