Original Article

Agricultural Science

Effects of Inclusion Levels of Carrot (*Daucus carota*) Leaf Meal on Performance of Growing Rabbits

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ABSTRACT [ENGLISH/ANGLAIS]

A total of 25 growing rabbits of mixed breeds and sexes were used to evaluate the effect of inclusion levels of carrot leaf meal in concentrate diet on the performance of growing rabbits. The experiment was a completely randomized design involving five treatments which represented five diets with 0, 15, 30, 45 and 60% level of carrot leaf meal inclusion, serving as Tl, T2, T3. T4 and T5. The experiment lasted for 8 weeks. There was significant difference ($p < 0.05$) in weight gains, feed intake and feed: gain ratios. Rabbits fed on T2 diet had the highest weight gain (though not significantly different ($p > 0.05$) from Tl. Dressing percentage was highest for treatment rest treatments. Highest apparent profit of N26.09 was observed in T2 which decreases with increase in the level of CLM inclusion, with T4 and T5 having the least apparent profit of N17.51 and N 4.61 respectively. The higher apparent profit observed in T2 is as result of the total weight gain by animals in that treatment group, which results in high income accruable. From the results obtained it can be concluded that dried carrot leaf meal can be incorporated up to 15% in the diet of growing rabbits without any adverse effect on their performance.

Keywords: Carrot leaf meal, cost, inclusion, performance, rabbit

RÉSUMÉ [FRANÇAIS/FRENCH]

Un total de 25 lapins en croissance de races mixtes et les sexes ont été utilisés pour évaluer l'effet des niveaux d'inclusion de farine de feuilles de carotte dans le régime alimentaire concentré sur les performances de lapins en croissance. L'expérience a été une conception complètement randomisé portant sur cinq traitements qui représentaient cinq régimes avec 0, 15, 30, 45 et 60% au niveau de l'inclusion repas carotte feuille, servant de Tl, T2, T3. T4 et T5. L'expérience a duré 8 semaines. Il y avait une différence significative (p <0,05) chez les gains de poids, la prise alimentaire et aliments: les ratios de gain. Les lapins nourris au T2 ration a eu le plus grand gain de poids (mais pas significativement différent (p> 0,05) de Tl. Dressing pourcentage le plus élevé était de repos pour les traitements thérapeutiques. Plus haut bénéfice apparent de N26.09 a été observé en T2 qui diminue avec l'augmentation du niveau de de l'inclusion CLM, avec T4 et T5 ayant le moins de profit apparent de N17.51 et N 4,61, respectivement. la hausse du bénéfice apparente observée en T2 est à la suite du gain de poids total en animaux de ce groupe de traitement, qui se traduit par un revenu élevé accruable . A partir des résultats obtenus, on peut conclure que la farine de feuilles séchées de carotte peut être incorporé jusqu'à 15% dans l'alimentation des lapins en croissance, sans aucun effet négatif sur leur performance.

Mots-clés: Farine de feuilles de carottes, le coût, l'inclusion, la performance, le lapin

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Accepted/Accepté: February, 2012

Full Citation: Abdu SB, Jokthan GE, Hassan MR, Adamu HY, Yashim SM, Ikani E.Effects of inclusion levels of carrot (daucus carota) leaf meal on performance of growing rabbits World Journal of Life Sciences and Medical Research 2012;2(2):65-70.

INTRODUCTION

Rabbit is described as a pseudo ruminant scavenger capable of coprophagy with high degree of feed efficiency [1]. They are highly prolific animals with a gestation period of 30±2 days and attain maturity within a short period of time [2]. Rabbits are found to be efficient converters of feed to meat and can utilize up to 30% crude fibre as against 10% by most poultry species [3].

Rabbits play an important role in the supply of animal protein to the Nigerian populace [4]. Compared with meat from other species it is richer in protein, certain vitamins and minerals. It contains little fat and has high proportion of essential poly unsaturated linoleic and linolenic fatty acids [1].

However, in spite of these obvious advantages improved feed formulation and strategies for enhancing the production potentials of rabbits, especially in the tropics have not been fully exploited. Intensive livestock farming (Rabbits) in Nigeria has been greatly affected by high cost of feed and feed ingredients especially the conversional protein and energy sources like soya bean cake, groundnut cake and maize [5].

Efforts have been geared towards finding alternatives, inexpensive and readily available feed ingredients. According to [6], such nutritional strategies would involve feeding of rabbits with agro-industrial byproducts together with the use of inexpensive locally available feed ingredients that will drastically bring down the production cost.

Carrot is one of such materials. It is cultivated to obtain its fleshy root. Abundant leaves are generated in the process of carrot cultivation, which little or no use in human food. There is little or no information on the feeding value of carrot leaves in the diet of farm animals. It is with this in mind that this study was carried out to investigate the performance of growing rabbits fed level of carrot leaf meal.

MATERIALS AND METHODS

Location of Study

The study was conducted at the rabbitry unit of the Department of Animal Science, Ahmadu Bello University, Samaru, Zaria located at 11^0 11´S and 38^0E in the northern guinea savannah zone of Nigeria.

Sources and Processing of carrot Leaf Meal (CLM)

The carrot leaf meal used for this study was harvested from carrot plant in the outskirt of Samaru, along Zaria-Kaduna express. The leaves were sum dried, milled in Animal Science Departmental laboratory and bagged before incorporating it into het experimental diets.

Experimental Animals and Their Management

Twenty five (25) weaned rabbits of mixed breed and sexes were obtained from Samaru, were used for this study. Prior to the commencement of the experiments, the rabbits were given prophylactic treatment against internal and external parasites by subcutaneous injection of Ivomec (Ivomevtin®) (0.2ml/rabbit) and a broad-spectrum antibiotic (oxytetracycline L.A®) was also given intra muscularly at the rate of 0.2ml/rabbit. After balancing for weight, the rabbits were randomly grouped into five (5) dietary treatments with five (5) rabbit per treatment in a completely randomized design. The rabbits were housed in a three tier cage unit, with each cage measuring 40 x 40 x 60cm^3. Each cage was equipped with plastic drinkers and aluminium feeders. The cages were housed in a room with concrete floor and windows for proper ventilation. Feed and water was supplied ad *libitum*. Proper sanitary condition was maintained throughout the experimental period. The experiment lasted for eight (8) weeks.

Experimental Diets and Data Collection

The percent composition of the experimental diet is presented in table 1. Five isonitrogenous diets with 18.13% were formulated to contain carrot leaf meal (CLM) at 0, 15, 30, 45 and 60% levels of inclusion. Other ingredients in the diets are soya bean meal (SBM), maize milling waste (MMW), bone meal, salt, brewer dried grain (BDG), and mineral premix.

The rabbits were fed once a day at 7:00 am. Spilled and contaminated feed was recorded, air dried, weighed and subtracted from the amount of feed offered. Feed intake was then determined by difference between feed offered and weigh back. Weight gain was measured weekly. At the end of the experiment, average daily feed intake, average daily weight gain, feed to gain ratio and feed cost per kg weight gain were computed.

Carcass and Organ Evaluation

At the end of the feeding trial, three rabbits were randomly selected from each treatment group and taken to the Animal product processing laboratory of the Animal Science Department for carcass analysis. The animals were starved for twenty four hours and live weight was taken prior to bleeding. Bleeding of the rabbits involved severing their jugular veins with a sharp knife followed by flaying which was done by hanging the animals by the neck to a hook and pulling the skin downwards

Evisceration was carried out, the visceral content comprising the heart, lungs, kidney, and liver were carefully removed and weighed. The weight of the dressed carcass, head, legs and skin were recorded. The dressed carcass was cut into shoulders, thigh and loin. The dressed carcass (loin, shoulder, and thigh) was expressed as a percentage of the live weight. The other organs were expressed as percent of empty carcass. The intestinal length was measure using a measuring tape.

Economic Analysis

The feed cost was computed based on the current market price of feed stuff at the time of experiment. Feed cost per kg live weight gain, cost of total feed consumed, income accruable, apparent profit were calculated based on current cost of live rabbit.

Statistical Analysis

The data obtained from the study was subjected to analysis of variance (ANOVA) procedure of SAS [7] in a completely randomized design. Duncan multiple range test (DMRT) [8] was used to compare the treatment means.

Chemical analysis

The CLM and experimental treatment diets and faces were analyzed for dry matter, crude protein, crude fiber, ash and NFE at the biochemistry laboratory of Animal Science Department according to the [9] procedure.

RESULTS AND DISCUSSION

The result of the proximate analysis of the experimental diet is presented in Table 2. The crude protein (CP) content of CLM (18.13%) was comparable to 14-25%reported by [10] for most browse plants in the tropics. The crude fiber (CF) content (16.82) was comparable to 13.5 – 17% reported by [11] for browse forage plants. Similarly the ash content was higher than 10.2 – 11.7% range reported by Morton [11] for tropical browse plants, indicating high mineral content of CLM. The CP and the CF (16.0 and 7.8%) respectively were within the range reported for recommended for growing rabbits [1].

The result of feed intake (Table 3) shows a significant ($p < 0.05$) difference with increase in the level of CLM inclusion in the experimental diets. Treatment two with 15% CLM inclusion had the highest daily feed intake (81.677 g), which is similar to T1, while T3, T4 and T5 were statistically lower but similar. The decrease in feed intake may be as a result of palatability and texture of feed as was reported by Faniyi [12] to affect intake.

The results of the growth performance (Table 3) showed no significant differences ($p > 0.05$) across treatment in the initial weight of the rabbits. There is however a significant ($p < 0.05$) difference in the final weight, as the level of CLM inclusion increases. T2 and T1 had the higher final weight (1366.7 and 1283.3g) respectively, which are higher than T3 and T4 (1083.3g), which were similar, while T5 had the least (875.0g). The high weight gain recorded in T1 and T2 may be attributed to the increase feed intake, which subsequently affects the performance of rabbits fed on treatment with high level of CLM inclusion.

Final weight gain was significantly different ($p < 0.05$), with T2 (683.3g) having the highest, followed by T1 (673.3) and the least value was observed in T5 (200.0). These values are lower than (715.51 and 603.48) reported by Omole et al. [13], when they fed rabbits with sole *stylosanthes guianensis*, *lablab purpureus* and sun flower forage meals.

Feed conversion ratios which is weight gain divided by feed intake, was significantly ($p < 0.05$) different among the treatment groups, T5 (17.430) having the highest while T1, T2, T3 and T4 were similar and having the lowest value which is in accordance with what Omoikoje et al. [14] reported.

The result of carcass analysis of rabbits fed varying levels of CLM is presented in Table 4. There were significant differences ($p < 0.05$) in live weight, carcass weight. While there were no significant differences ($p > 0.05$) in shoulder, loin and thigh. The values for thigh showed an increasing trend with increase in CLM inclusion as one move from treatment 1 to 5,but with a fallout in treatment 4 which had the least value which was statistically different ($p < 0.05$) from the rest. Similar result has been reported by [15] for growing rabbits fed 18% CP diet. This may be attributed to the high inclusion level of the CLM.

Table 1: This table shows percent ingredients composition of experimental diet (Kg)

Ingredients	Level of CLM inclusion				
	$T_1(0)$	T_2 (15)	$T_3(30)$	T_4 (45)	$T_5(60)$
CLM	0.000	15.0	30.0	45.0	60.0
MMW	75.25	63.56	51.94	40.33	26.85
SBM	12.50	09.19	5.81	2.42	0.90
Bone meal	1.50	1.50	1.50	1.50	1.50
Premix	0.25	0.25	0.25	0.25	0.25
Salt	0.50	0.50	0.50	0.50	0.50
BDG	10.0	10.0	10.0	10.0	10.0
Total	100	100	100	100	100

Cost/kg diet(₦)	45.3	40.58	34.48	29.29	24.98

Table 2: This table shows proximate composition of experimental feed

Parameters	Percent level of CLM inclusion					
	$T_1(0)$	$T_2(15)$	$T_3(30)$	$T_4(45)$	$T_5(60)$	CLM
Dry matter	91.78	92.33	95.26	91.64	93.52	95.51
Crude protein	16.0	16.0	16.01	16.25	16.63	18.13
Crude fiber	12.08	12.86	13.66	14.75	15.12	16.82
Ether extract	2.35	1,00	0.94	0.93	1.17	0.68
Ash	18.87	7.27	27.78	13.33	25.69	13.04
NFE	61.06	77.71	54.78	71.18	47.20	51.68

Table 3: This table shows performance of rabbits fed CLM percentage level of CLM inclusion

Parameters	Percent level of CLM inclusion					
	$T_1(0)$	$T_2(15)$	$T_3(30)$	$T_4(45)$	$T_5(60)$	SEM
Initial weight (g)	610.00	683.33	656.67	633.33	675.00	14.55
Final weight (g)	1283.3^{ab}	1366.7^{a}	1083.3^{bc}	1083.3^{bc}	875.00^{c}	34.01
FWG (g)	673.3^{a}	683.3^{a}	426.7^{ab}	450.00^{ab}	200.0^{b}	33.23
DWG (g)	12.02^{a}	12.20^{a}	7.620^{ab}	8.03^{ab}	3.570^{b}	0.593
Feed intake (g)	72.27^{ab}	81.67^{a}	52.97^{b}	61.65^{ab}	59.917^{b}	2.708
FCR	6.32^{b}	6.78^{b}	7.07^{b}	8.77^{b}	17.430^{b}	0.718

^{abc} means different superscript along rows differ significantly at p<0.05; FWG=Final weight gain; DWG=daily weight gain; FCR=feed conversion ratio

Table 4: This table shows effect of feeding varying levels of CLM on carcass weight

Parameters	Percent level of CLM inclusion					
	$T_1(0)$	$T_2(15)$	$T_3(30)$	$T_4(45)$	$T_5(60)$	SEM
Live Wt.(g)	1266.7^{ab}	1333.3^{a}	1050.0^{b}	1016.7^{b}	783.3^{c}	39.1
Carcass wt. (g)	600.00^{a}	633.33^{a}	466.67^{b}	483.33^{b}	333.33^{c}	20.5
Dressing %	47.20^{a}	47.42^{a}	47.61^{a}	44.43^{ab}	42.43^{b}	0.5
shoulder	39.24^{a}	37.74^{a}	37.19^{a}	36.54^{a}	37.32^{a}	0.7
Loin	25.51^{a}	24.31^{ab}	24.59^{b}	23.48^{c}	22.31^{a}	0.4
Thigh	39.21^{a}	37.04^{b}	37.78^{b}	36.49^{c}	36.94^{c}	0.6

^{abc} means different superscript along rows differ significantly at p < 0.05

Table 5: This table shows cost benefit analysis of substituting SBM with CLM dietary treatment

Parameters	Percent level of CLM inclusion				
	$T_1(0)$	$T_2(15)$	$T_3(45)$	$T_4(45)$	$T_5(60)$
Cost/g diet	45.3	40.58	34.48	29.29	24.98
AVDFI/(g)	72.27	81.677	61.647	52.98	57.92
TFI (kg)	4.047	4.57	3.45	2.96	3.3
CDFI (₦/d)	0.33	0.33	0.18	0.18	0.15
TWG (g)	673.29	683.20	449.85	426.72	199.92
Income accruable (₦)	43.76	44.41	29.24	27.74	12.99
C TFC (₦)	18.37	18.32	10.11	10.23	8.38
Apparent profit (₦)	25.39	26.09	19.13	17.51	4.61

AVDFI =average daily feed intake; DFI= daily feed intake; CDFI= daily feed intake; TFC = total feed consumed; CTFC = total feed consumed; TFI= total feed intake; TWG =total weight gain; N (Nigerian naira N184.00=$1.00)

The results of cost benefit analysis presented in table 5 showed a progressive reduction in cost/kg of feed. This reduction is due to the low cost of CLM, this agrees with [16], who reported a decrease in the cost of feed with inclusion of unconventional feedstuff. Total cost of feed consumed during the entire experimental period was highest for the control treatment (N18.37) and decreases with increasing level of CLM inclusion, with T5 having the lowest (N8.38). This however, is as a result of the reduction in the cost of the feed as result of CLM inclusion.

Highest apparent profit of N 26.14 was observed in T2 which decreases with increase in the level of CLM inclusion, with T3 and T5 having the least apparent profit of N 17.26 and N 4.61 respectively. The higher apparent profit observed in T2 is as result of the total weight gain by animals in that treatment group and also the inclusion of in expensive feedstuff reduces the cost, which resulted in high income accruable.

CONCLUSION

It is concluded that from the result of this study, it was concluded that, inclusion of CLM in rabbit diet has no detrimental effect. It was therefore recommended inclusion of CLM up to 15% in the diet of growing without compromising performance and profit. CLM inclusion reduced the cost of feed in rabbits

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ACKNOWLEDGEMENT / SOURCE(S) OF SUPPORT

The contributions I. Kwano and Ojo of Biochemistry Laboratory and Umar, Bashir, Sani Shanu of the Teaching and Research Farm is acknowledged.

CONFLICT OF INTEREST

No conflict of interests was declared by authors