Utilization of *Arachis hypogea* (Groundnut) and *Lablab purpureus* (lablab) Forage Meal Fed Sole or Mixed by Growing Rabbits

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Summary

Thirty-six crossbred growing rabbits were used to evaluate performance of rabbits on sole and mixed forage meals in a 3 x 2 factorial experiment consisting three treatments made of Arachis hypogea *(groundnut, GFM),* Lablab purpureus *(lablab, LFM) forage meals and 50:50 mixture of both forage meals (GLFM), and two sex groups (males and females) in a completely randomized design. Both forages were harvested, chopped and milled before inclusion at 50% rate into the concentrate diet to make complete diets and offered at 125 g/rabbit/day in earthen feeders in the morning at 08.00 hr. Results obtained indicated that forage type did not affect final weight of rabbits. Feed intake and weight gain respectively were similar for GFM (75.26 ± 4.18, 6.02 ± 1.18 g/day), LFM (78.91 ± 3.50, 7.86 ± 0.99 g/day) and GLFM (74.35 ± 3.54, 7.53 ± 1.00 g/day). Feed cost and feed cost/kg gain were also similar for all the forage types. Male and female rabbits had similar final weight, feed intake, weight gain, feed cost and feed cost/kg gain. While weight gain was higher on GFM (7.95 ± 1.29 g/day) and LFM (7.37 ± 1.39 g/day) than GLFM (5.25 ± 1.29 g/day) for male rabbits, for female rabbits, weight gain was similar on GLFM (9.81 ± 1.53 g/day) and LFM (8.33 ± 1.39 g/day) and lower on GFM (4.09 ± 1.97 g/day). Saving/kg gain for male rabbits fed GFM and LFM was $ 0.64-0.81 than GLFM while it was $ 0.91-1.35 for female rabbits fed LFM and GLFM than GFM.*

Résumé

Utilisation de l'arachide (*Arachis hypogea)* et du lablab (*Lablab purureus)* comme aliments fourrageux simples ou composés pour lapins en croissance

Trente-six lapins en croissance de race croisée ont été soumis á une alimentation á base de fourrageux simples ou mixtes dans une expérimentation factorielle 3 x 2 avec un plan expérimental complètement aléatoire. Trois traitements ont été appliqués: Arachis hypogea *(arachide ou GFM),* Lablab purureus *(lablab ou LFM) en aliments fourrageux simples et un mélange (GLFM) de ces deux fourrages dans un rapport 50:50. Les lapins ont aussi été étudiés en fonction du sexe (mâle et femelle). Les deux fourrages ont été récoltés, broyés et moulus avant inclusion à hauteur de 50% chacun dans l'aliment composé dans le but d'obtenir un aliment complet. La ration individuelle était de 125 g/lapin/jour chaque matin à 8 heures. Les résultats obtenus ont indiqué que le type de fourrage n'influence pas la prise de poids des lapins. La quantité d'aliment ingéré et la prise de poids étaient respectivement similaires pour le GFM (75,26 ± 4,18; 6,02 ± 1,18 g/jour), le LFM (78,91 ± 3,50; 7,86 ± 0,99) et le GLFM (74,35 ± 3,54; 7,53 ± 1,00 g/jour). Le coût de l'aliment et le coût de l'aliment par kg de prise de poids ont aussi suivi le même cours pour tous les types de fourrages. Les lapins, mâles et femelles, ont eu des résultats similaires en ce qui concerne leurs poids en fin d'expérience, les quantités d'aliment ingéré, les prises de poids, le coût de l'aliment et le coût de l'aliment par kg de prise de poids. Tandis que la prise de poids était plus élevée pour le GFM (7,95 ± 1,29 g/jour) et le LFM (7,37 ± 1,39 g/jour) que le GLFM (5,25 ± 1,29 g/jour) pour les mâles; et pour les femelles, la prise de poids était similaire pour le GLFM (9,81 ± 1,53 g/jour) et LFM (8,33 ± 1,39 g/jour) et plus faible pour le GFM (4,09 ± 1,97 g/jour). L'économie réalisée par kg de prise de poids des mâles alimentés par le GFM et le LFM était de 0,64-0,81 US$ comparée au GLFM tandis qu'elle était de 0,91-1,35 US$ pour les femelles alimentées par le LFM et le GLFM comparée au GFM.*

Introduction

The use of forages in rabbit feeding is normal practice, and rabbit producers are advised to feed forages as supplement to a basic concentrate diet, in order to meet the fibre and some of the vitamin requirements

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(6). Forages are offered to rabbits as fresh, dry (hay) or meal. Studies have shown that whether offered separately or in complete diets as meal, forages elicit growth response in rabbits (1, 3, 4, 5, 6). In addition to fibre and vitamins, forages especially legume forages also provide protein and energy. Studies have also shown that rabbits can utilize 50 g of concentrate with forage grasses or legumes and still grow at a rate of 5-13 g/day (3, 5). Feeding of high concentrate level or diets with high nutrient density, may be ideal under intensive rabbit production or in temperate regions where growth rate of rabbits is high, and rabbits bred for fast growth, are raised. Even under intensive production systems, feeding of forages especially the forage alfalfa is practiced to provide fibre and other nutrients. Under tropical conditions, where growth rate is not as fast as under temperate conditions, and where famers are generally resource poor and can therefore not afford to feed formulated concentrates because they are often expensive, but have forages in abundance either fresh, dry or as agricultural by-products, it makes a lot of sense to find ways of utilizing these forages in feeding rabbits at affordable prices. This study was undertaken to evaluate the performance of weaner rabbits on sole and mixed groundnut and lablab forage meals.

Materials and methods

Study site

The experiment was conducted in the Rabbitry of the National Animal Production Research Institute, Shika, Nigeria (10°11' N and 7°8' E, 650 m above sea level).

Animals and housing

Progenies from crossing between New Zealand White, California and Chinchilla rabbits were used for this study. The rabbits were obtained from breeding does and bucks kept in the Rabbitry over the years. The kits were weaned at 4-5 weeks after kindling into colony cages and fed the concentrate used for the study. The health of the rabbits was monitored routinely by the Institute Veterinary doctors. The rabbits were kept individually in metal cages covered with wire mesh of dimensions 60 x 60 x 50 cm located in a completely walled house with open windows.

Experimental procedure

Thirty six rabbits with average weight of 1.2 ± 0.1 kg were allocated to three treatments (n= 12 rabbits/ treatment) consisting of *Arachis hypogea* (groundnut), *Lablab purpureus* (lablab) forage meals and 50:50 mixture of both forage meals (to make up the 50% forage fraction of the diet), and two sex groups (males, n= 16 and females, n= 20) in a 3 x 2 factorial experiment in a completely randomized design. The forages were chopped and ground with a laboratory forage miller before inclusion into concentrate diet at 50% inclusion rate while for the mixed forage group, a 25:25 combination of groundnut and lablab forage meals was included at 50% inclusion rate into the concentrate diet to make complete diets as follows.

1) 50% concentrate plus 50% groundnut forage meal (GFM)
2) 50% concentrate plus 50% lablab forage meal (LFM)
3) 50% concentrate plus 25% groundnut forage and 25% lablab forage meals (GLFM).

The concentrate consisted of 22% CP and 2600 kcal ME/kg and contained in percentage proportion: maize 39.24, groundnut cake 42.26, maize offal 15.00, bone meal 3.0, salt 0.25, and vitamin/mineral premix 0.25. The vitamin/mineral premix was obtained from the market and it contained per kilogram ration: Vitamin A 1251 IU, Vitamin D3 2750 IU, Vitamin E 151 IU, Vitamin K 0.002 g, Vitamin B_2 0.006 g, Nicotinic acid 0.035, Calcium D-Pantothenate 0.01 mg, Vitamin B_6 0.0035 g, Vitamin B_{12} 0.02 g, Folic acid 0.001 g, Biotin 0.0005 g, Vitamin C 0.025 g, Cholin chloride 0.39 g, Zinc bacitracin 0.02 g, Methionine 0.2 g, Avatec (Lasolocid) 0.09 g, Manganese 0.1 g, Iron 0.05 g, Zinc 0.04 g, Copper 0.002 g, Iodine 0.00153 g, Cobalt 0.000225 g and Selenium 0.0001 g.

The complete diets were made up of a mixture of 50% concentrate and 50% groundnut or lablab forage meal thoroughly mixed manually on the ground for the sole forage treatments. For the mixed forage treatment, 50% concentrate was mixed with 25% groundnut forage meal and 25% lablab forage meal to make a 100% complete diet. The diets were then fed to the rabbits for eight weeks. Table 1 shows the proximate composition of the forages and diets fed to the rabbits.

Lablab forage was obtained from the Forage Production Unit after harvest and seed removal while groundnut forage was obtained from the Rabbit Research Unit farm after harvest of the nuts and dried under shade.

The rabbits were given the experimental diets for one

Table 1
Proximate composition of groundnut, lablab forage meals and complete diets fed to growing rabbits (%DM)

	Dry matter	Ash	Ether extract	Crude fibre	Crude protein
Groundnut forage meal	96.82	17.77	8.63	33.18	10.31
Lablab forage meal	96.42	19.26	4.56	28.40	12.43
Groundnut forage meal diet	88.99	11.11	15.67	17.49	17.28
Lablab forage meal diet	87.47	6.16	13.01	27.28	14.56
Groundnut + Lablab forage meal diet	89.05	10.47	15.79	26.25	16.19

week before data collection to allow them adjust to the diets. 125 g/rabbit/day feed was offered to the rabbits in earthen feeders in the morning at 08.00 hr. Water was supplied daily in earthen pots. The rabbits were treated against ecto- and endo-parasites using 10 mg/ml ivomectine (Pantex®, Holland). Feed wastage and/or leftover were measured daily while weight change was monitored weekly. Parameters monitored were feed intake and weight changes, feed conversion ratio, feed cost and feed cost/kg gain.

Statistical analysis

Feed intake was computed as feed offered minus feed left over and wastage. Cost of concentrate was computed at $ 2.53/kg and $ 0.13/kg of forage [1 dollar ($)= 150 Naira (₦)]. Data collected were subjected to analysis of variance test (12) for factorial experiment using General Linear Model procedure in a completely randomized design. Pair-wise difference method was used to separate significant means.

Results

Forage type did not affect final weight of rabbits. Feed intake was similar for GFM, LFM and GLFM**.** Weight gain was also similar for all forage types. Feed cost and feed cost/kg gain was similar for all the forage types. Comparing the feed cost/kg gain of rabbits fed LFM and GLFM with GFM, showed savings/kg gain was $ 0.27-0.40 for rabbits fed sole lablab (LFM) and mixed forage (GLFM) than rabbits fed sole groundnut forage (GFM) diet and $ 0.10 between sole lablab forage (LFM) diet and mixed forage diet (GLFM).

Performance of male and female rabbits on the forage types is shown in table 2. There was interaction (P< 0.05) between forage type and sex of rabbits on weight gain. Feed intake was higher on GFM than LFM and lowest on GLFM for male rabbits. Feed conversion was similar (P> 0.05) for mixed forage than sole groundnut and lablab forage meals. Feeding sole groundnut and lablab forage meal diets to male rabbits gave saving/kg gain of $ 0.64-0.81 than mixed forage diet while feeding sole groundnut forage meal diet gave a saving/kg gain of $ 0.17 than lablab forage meal diet. Performance of female rabbits on the forages was similar (Table 2) except for weight gain which was significantly lower for GFM than for LFM and GLFM. Feed conversion was lower (P> 0.05) for groundnut forage than lablab and mixed forage. Saving/kg gain was $ 0.91-1.35 for female rabbits fed sole lablab and mixed forage meal diets while saving/kg gain was $ 0.68 for female rabbits fed mixed forage meal diet than sole lablab forage meal diet. No mortality was observed for rabbits during the study.

Discussion

Feed intake in this study is lower than feed intake of 139.69-139.92 g/day that was obtained by Iyeghe-Erakpotobor (5) for rabbits fed groundnut forage and *Stylosanthes hamata* hay. Forage meals in complete diets were used in this study while the forage hays were offered separately with concentrate in their study, indicating a likely effect of form of offer of forages on feed intake. Similar intake of rabbits on the forages indicates their general acceptance by rabbits. Medium levels of legumes were consumed by rabbits offered groundnut, lablab, green gram, cowpea, verano stylo and horse gram (6).

Feed intake of male rabbits was slightly higher than females. Lazzaroni *et al*. (11) however, reported higher feed intake by females than male rabbits. Lazzaroni and Biagini (10) also obtained higher feed intake by female Carmagnola Grey rabbits than males. The pattern of intake shown by male and female rabbits indicates some level of preference for the forages when offered sole or in combination by male and female rabbits. It appears therefore that the preference of male and female rabbits for the forage meals was divergent. One would have thought that preference should not be exhibited by the sexes for the forages since they were incorporated in complete diets and they were both legumes shown to have similar preference by rabbits (6). Forages have different characteristics such as texture, hairiness, nutrient composition and

Table 2
Performance of male and female rabbits on sole and mixed forage meal diets (Lsmean ± SE)

Sex	Male			Female		
Forage meal	Groundnut	Lablab	Groundnut + Lablab	Groundnut	Lablab	Groundnut + Lablab
Initial weight (kg)	1.34 ± 0.13	1.21 ± 0.14	1.20 ± 0.14	1.20 ± 0.20	1.14 ± 0.14	1.06 ± 0.16
Final weight (kg)	1.74 ± 0.15	1.59 ± 0.16	1.47 ± 0.15	1.40 ± 0.22	1.58 ± 0.16	1.58 ± 0.18
Total feed intake (kg)	4.16 ± 0.24	4.02 ± 0.26	3.71 ± 0.24	3.87 ± 0.37	4.35 ± 0.26	4.16 ± 0.29
Feed intake (g/d)	78.07 ± 4.58	75.50 ± 4.94	70.01 ± 4.58	72.45 ± 6.99	82.31 ± 4.94	78.68 ± 5.42
Weight gain (g/d)	7.95 ± 1.29^{a}	7.37 ±1.39^{a}	5.25 ± 1.29^{ab}	4.09 ± 1.97^{b}	8.33 ± 1.39^{a}	9.81 ± 1.53^{a}
FCE (gain/intake)	0.11 ± 0.02	0.10 ± 0.02	0.06 ± 0.02	0.06 ± 0.03	0.10 ± 0.02	0.13 ± 0.02
Feed cost ($/d)	0.014 ± 0.001	0.014 ± 0.001	0.013 ± 0.001	0.013 ± 0.0013	0.015 ± 0.001	0.014 ± 0.001
Feed cost/gain ($)	2.043 ± 0.41	2.21 ± 0.44	2.85 ± 0.41	2.92 ± 0.63	2.04 ± 0.44	1.59 ± 0.49
Saving/kg gain ($)	0.811	0.644	-	-	0.907	1.354

^{ab}Means bearing different superscripts are significantly different (P< 0.05).

taste which might affect their appeal to animals. It is likely that, this might be the reason for the divergent preference observed in this study.

Weight gains obtained in this study are similar to gains of 5.80 to 7.69 g/day obtained when rabbits were fed verano stylo, groundnut haulms and combination of groundnut and stylo supplemented with 50 g concentrate (5). Daily weight gain of 5.8-7.7 g obtained are similar with gains reported for rabbits on groundnut haulms, sweet potato and soybean forage (8, 4), mucuna, lablab and groundnut haulms (7) supplemented with 50 g concentrate. Legume forages are rich sources of protein especially in the leafy parts. Rabbits fed with verano stylo, lablab, cowpea and groundnut forages, cook stylo and centro (*Centrosema pubescens*) showed good performance when these legumes were offered in combination with small amounts of concentrate (6).

Weight gain was similar for male and female rabbits in this study. Ekpo *et al*. (2) also did not observe any difference between the sexes in growth performance of rabbits fed unpeeled, peeled cassava tuber and cassava peel meals while, Laxmi *et al*. (9) reported non-significant effect of sex on body weights of rabbits at ages 4, 8, and 16 weeks. Significantly lower weight gain by female rabbits fed sole groundnut forage meal diet than sole lablab forage and mixed forage meal diets and for male rabbits fed diet containing mixed forage meal than sole groundnut and lablab forage meal diets also indicates gender preference for the forages and hence better performance on the preferred forage by the rabbits which in this case is groundnut forage meal for males and mixed groundnut and lablab forage meal for female rabbits.

Feed conversion efficiency of rabbits fed the forage meal diets in this study is better than was reported by Iyeghe-Erakpotobor (5). However, similar conversion of feed by rabbits on the forage meal diets observed in this study is at variance with the report of Iyeghe-Erakpotobor (5) who observed significant differences in feed conversion of rabbits offered sole groundnut forage and mixed groundnut and stylo (*Stylosanthes hamata*) than sole stylo forage. Though feed conversion efficiency was similar for male and female rabbits fed the forage meal diets, divergent feed conversion efficiency observed for male and female rabbits indicate the preferences of the rabbits, for whether the forage is offered sole or in combination.
Male rabbits appeared to prefer sole forage meals than mixed forage meal and hence had better conversion efficiency on these forages, while females who appeared to prefer mixed forage meal and lablab forage meal than sole groundnut meal diet also had better conversion efficiency on these forages than the less preferred forage meal. Amata and Bratte (1) reported feed conversion ratio did not differ significantly for gliricidia leaf meal levels but cost/kg feed and cost/kg body weight gain significantly reduced with level of gliricidia leaf meal.

In this study however, feed cost and feed cost/kg gain were similar for all the forages and sex. Though feed conversion efficiency, feed cost and feed cost/kg gain were not different statistically, there was considerable saving/kg gain of rabbits fed the forage meals and for male and female rabbits on the forage meals. The savings/kg gain obtained when translated over time could give significant increase in returns to farmers. This is could translate to quite considerable savings and probably go a long way in increasing the farmer's profit margin when the farmer's animal production over time is considered.

It is concluded from this study that rabbits perform equally well on groundnut, lablab and mixed forage meal diets. Male and female rabbits however have divergent preference for the forages when fed sole or mixed. Male rabbits preferred groundnut and lablab forage meal while female rabbits preferred mixed and lablab forage meal to groundnut forage meal diets. It is important that in feeding forages to rabbits especially for commercial meat production, differences in preference of male and female rabbits should be considered for optimum profitability.

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