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Growth performance and economics of feeding sole concentrate, sole forage and their mixtures to weaner rabbits

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Abstract

Replacement and supplementation of concentrate diets by forage is very promising in rabbit production since they are classified as pseudo-ruminants. The study assessed the performance and the economics of feeding sole concentrate, sole forage and their mixtures to weaner rabbits. The control treatment (T_1) was fed with concentrate and forage simultaneously in the morning and afternoon, Rabbits in treatment 2 (T_2) received forage in the morning and concentrate in the afternoon. Rabbits in treatment 3 (T_3) got concentrate diet in the morning and forage in the afternoon, Treatment 4 (T_4) rabbits were given sole concentrate in the morning and afternoon while those in treatment 5 (T_5) were fed sole forage in morning/ afternoon. Thirty (30) weaner crossbreed rabbits (both sexes) with an initial weight range of 750-770 g were divided into five groups of six rabbits (5 males and I female) each and randomly assigned to the five treatments in a completely randomized design (CRD) with each treatment having three replicates of two rabbits in a 63-day feeding trial. Data collected were daily feed intake, weekly body weight, weekly body weight gain, feed conversion ratio (FCR) and cost of feed were computed and subjected to Analysis of Variance (ANOVA) using S.A.S (2002) software package. The results revealed that rabbits on (T_4), (T_3) and (T_2) had significantly ($p<0.05$) higher final body weight and daily weight gain of 2000, 1950g, 19000g and 19.84g 19.21g, 19.05g respectively The result further shows that rabbits on sole forage (T_5) had the highest ($P<0.05$) daily forage intake (83.50g) among the treatments while those on sole concentrate (T_4) treatment had the least feed intake (60.90g). Rabbits on T_4 were the best in terms of FCR followed by concentrate/forage mixture T_3, T_2, and T_1. The results further show that rabbits on sole forage (T_5) had the highest ($P<0.05$) daily forage intake (83.50g) among the treatments while those on sole concentrate (T_4) treatment had the least feed intake (60.90g). Rabbits on T_4 were the best in terms of FCR followed by concentrate/forage mixture T_3, T_2, and T_1. The result shows that sole forage treatment (T_5) had the lowest feed cost of N131.5 while the highest feed cost of N378.86 was recorded for rabbits in T_4. However, rabbits on sole forage or concentrate diets had about 49.17 and 16.83 percent reductions while T_4 and T_2 had -10.74 and -46.43 percent additions in feed cost per kg. Better returns of investment per rabbit were noted for rabbits in T_4 followed by those of T_3. Profit or gross margin was the better for rabbit on T_3.For optimum performance and economic returns, feeding rabbit with concentrate in the morning/forage in the afternoon (T_3) is recommended.

Keyword: Concentrate, Economics, Forage, Performance, Weaner Rabbits,

Performances de croissance et économie de l'alimentation de concentré de sole, de fourrage de sole et de leurs mélanges pour les lapins sevrés

Résumé

Le remplacement et la supplémentation des régimes concentrés par le fourrage sont très prometteurs en production cunicole puisqu'ils sont classés comme pseudo-ruminants. L'étude a évalué la performance et l'économie de l'alimentation de concentré de sole, de fourrage de sole et de leurs mélanges sur des lapins sevrés. Le traitement témoin (T_1) a été nourri avec du concentré et du fourrage simultanément le matin et l'après-midi. Les lapins du traitement 2 (T_2) ont reçu du fourrage le matin et du concentré l'après-midi. Les lapins du traitement 3 (T_3) ont reçu un régime concentré le matin et du fourrage l'après-midi, les lapins du traitement 4 (T_4) ont reçu du concentré de sole le matin et l'après-midi tandis que ceux du traitement 5 (T_5) ont reçu du fourrage de sole le matin/l'après-midi. . Trente (30) lapins croisés sevrés (les deux sexes) avec un poids initial compris entre 750 et 770 g ont été divisés en cinq groupes de six lapins (5 mâles et 1 femelle) chacun et assignés au hasard aux cinq traitements selon un plan complètement randomisé (PCR) avec chaque traitement ayant trois répétitions de deux lapins dans un essai d'alimentation de 63 jours. Les données recueillies étaient l'apport alimentaire quotidien, le poids corporel hebdomadaire, le gain de poids corporel hebdomadaire, le taux de conversion alimentaire (TCA) et le coût de l'alimentation ont été calculés et soumis à une analyse de variance (ANOVA) à l'aide du progiciel S.A.S (2002). Les résultats ont révélé que les lapins sur (T_4), (T_3) et (T_2) avaient un poids corporel final et un gain de poids quotidien significativement plus élevés ($p < 0,05$) de 2000, 1950g, 19000g et 19,84g 19,21g, 19,05g respectivement. Le résultat montre que les lapins recevant du fourrage de sole (T_5) avaient la consommation quotidienne de fourrage la plus élevée ($P < 0,05$) (83,50 g) parmi les traitements, tandis que ceux recevant un traitement au concentré de sole (T_4) avaient la consommation alimentaire la plus faible (60,90 g). Les lapins sous T_4 étaient les meilleurs en termes de TCA suivis des mélanges concentré/fourrage T_3, T_2 et T_1. Les résultats montrent en outre que les lapins recevant du fourrage de sole (T_5) avaient la consommation quotidienne de fourrage la plus élevée ($P < 0,05$) (83,50 g) parmi les traitements, tandis que ceux recevant un traitement au concentré de sole (T_4) avaient la consommation alimentaire la plus faible (60,90 g). Les lapins sous T_4 étaient les meilleurs en termes de TCA suivis des mélanges concentré/fourrage T_3, T_2 et T_1. Le résultat montre que le traitement de fourrage unique (T_5) avait le coût d'alimentation le plus bas de ₦131,5 tandis que le coût d'alimentation le plus élevé de ₦378,86 a été enregistré pour les lapins dans T_4. Cependant, les lapins nourris avec du fourrage unique ou des régimes concentrés avaient des réductions d'environ 49,17 et 16,83 %, tandis que T_4 et T_2 avaient des ajouts de -10,74 et -46,43 % du coût de l'alimentation par kg. De meilleurs retours sur investissement par lapin ont été notés pour les lapins du T_4 suivis de ceux du T_3. Le profit ou la marge brute était le meilleur pour le lapin sur T_3.

Mot-clé : Concentré, Économie, Fourrage, Performance, Lapins sevrés

Introduction

Rabbit production is one of the livestock enterprises that can ensure food security, reduce poverty and also increase supply of the animal protein needed to meet the increasing population's daily requirements. Rabbit production has great investment potential due to its minimal capital outlay and rapid reproduction ability (Adedeji *et al.,* 2012). Their meat is highly nutritious when compared with other meat sources (Nistor *et al.,* 2013; Ajala and Balogun (2004)). Domestic rabbits (Oryctolagus *cuniculus)* are ubiquitous, providing protein, fibre, research models and companionship. They have high reproductive potentials utilize low grain and high roughage diets and breed all year-round (Iribeck, 2001; Arijeniwa *et al,* 2000).

Rabbits being pseudo-ruminants can feed on both concentrates and forages. Feeding of concentrates alone to animals reduces feed consumption and crude fibre digestion (Davidson and Spreadury, 1975; Butcher *et al*., 1981; Adegbola *et al.,* 1985;Akinmutimi *et al.,*2006). On the other hand forages, especially legumes with their protein content have the potential of meeting the needs of cheaper feed sources for rabbits (Iyegehe-Erakpotobor, 2007). However, feeding forage alone will not support adequate growth performance, therefore the replacement or supplementations of concentrate diets with forage is very promising in rabbit production (Adegbola *et al.,* 1985; Akaeze *et al.,*2014). There are published works on the feeding of concentrates and forages on the performance of rabbits. There is seemingly no information on the feeding time of concentrates and forage mixtures (feeding regime or the time of feeding) and their economics on weaner rabbits. This study is focused on assessing the growth and economic effects of feeding sole concentrate or forage and their mixtures on weaner rabbits.

Materials and methods

***Location of the study*:** The study was conducted at the Rabbit Unit of the Department of Animal Science Farm, Akwa Ibom State University, Obio Akpa Campus, located in Oruk Anam L.G.A., Akwa Ibom State in the southern part of Nigeria. The area lies between latitude $4^0$50N and longitude $7^0$45 and $7^0$55E and it's in the hot humid tropics with a climate that is characterized by two seasons (the rainy season which spans between April and October while the dry season spans between November and March). The rains are always heavy and of high intensity ranging between 2,250mm and 2,500mm annually. Temperature are uniformly high throughout the year ranging between 26 and 28^0C, solar radiation ranges from 4.11 to 4.95mm, partly due to the high value of insulation and temperature (SLUS-AK, 1994).

Experimental diet and design: The ingredients used for the formulation of diets were purchased from livestock shops in Uyo metropolis, Akwa Ibom State. Soya beans were toasted at temperature of 98-100^0C for 25 minutes in a condemned iron pot to remove the anti-nutrients present in it and then sprayed on corrugated roofing sheet to cool. Ingredients were milled using the Hammer feed mill available in the campus while the mixer in the mill was used for mixing before bagging and storing. The forages (*Panicum maximum* (Guinea grass)*, Pennisentum purpureum* (Elephant grass), *Tridax procumbens* (Tridax), *Calopogonium mucunoides* (Calopo leaves), *Centrosema pubescens* (Centrosema leaves) and *Luffa cylindrinca* (sponge weed), were harvested within the vicinity of the experimental site in the evening, washed and kept overnight to reduce the moisture content before being fed to the rabbits the following morning.

Thirty (30) weaner rabbits of both sexes were randomly allotted to five treatments in a Completely Randomized Design (CRD) experiment that lasted for 63 days. The treatments (T) were: (T_1 or the control control) concebtrate and forage fed simultaneously in the morning and

afternoon; (T_2) forage fed in the morning, and concentrate in the afternoon; (T_3) concentrate fed in the morning and forage in the afternoon, (T_4) and (T_5) were fed only concentrates and forages respectively in the morning and afternoon. Table 1 shows the composition of concentrate diet and mixed forages fed to the rabbits.

Experimental animals and management: A total of 30 weaner rabbits (cross breeds of New Zealand White and Chinchilla) of both sexes of about 6-7 weeks old were purchased from a reputable rabbit vendor in Uyo, Akwa Ibom State for the study. The animals were allowed one week for acclimatization and then allotted to five treatment groups of six rabbits after balancing for both sexes and body weight. The concentrate diet and forages were weighed and supplied to them separately in concrete feeders at 6.30am and 12.30pm daily. Fresh clean water was provided for the rabbits every day, while the leftover were weighed daily to ascertain the actual amount of feed consumed by the rabbits. At the slightest notice of cocccidiosis in the animal droppings, the rabbits were also given anti-coccidial medicaments and vitamin-based medications periodically as prophylactics to prevent and cure diseases incidences during the experimental period that lasted for 63 days. The rabbits were weighed at the beginning of the experiment and at weekly intervals to obtain the initial and changes in weekly body weights, respectively.

Data collection and analysis: Proximate analysis of the concentrate and forages fed to the experimental animals were carried out. Daily feed intake (g), initial body weight, weekly body weight, weekly body weight gain and feed conversion ratio (FCR) data were collected while economic analysis was carried out using the prevailing market prices of the different feed ingredients to ascertain the effect of the treatments on feed cost, profit and return on investment of the different treatments. Data collected were analysed using Analysis of Variance (ANOVA) and significant means were separated using Duncan Multiple Range Test (DMRT) at 5% level of probability.

Results and discussion

The proximate composition of the concentrate diets and forages fed to the experimental rabbits during the study is presented in Table 1. Crude protein (CP) of the concentrate and mixed forages were 18.37% and 18.49 % respectively which were within the bracket of 18% recommended by Orgain (2011) for optimum performance of rabbits. The crude fibre (CF) content of the concentrate and mixed forages were 4.0% and 29.04% respectively.

Table 1: Diet composition/proximate analysis of concentrate and forages fed to the weaner rabbits

Ingredients	Percentage (%)	
Maize	43.86	
Soya bean meal	23.23	
Wheat offal	15.00	
Crayfish waste	11.61	
Bone meal	2.60	
Palm oil	3.00	
Vit/min. premix	0.20	
Methionine	0.25	
Lysine	0.25	
Total	100	
Analyzed nutrient (%)	**Concentrate**	**Forages**
Dry matter (DM)	81.55	24.78
Crude protein (CP)	18.37	18.49
Crude fibre (CF)	4.0	29.04
Ether extract (EE)	8.53	5.52
Ash	4.50	5.63
Nitrogen free extract (NFE)	64.63	41.30

The value of 4.0% crude fibre recorded for concentrate was lower while that of forage 29.04 % was higher than values recommended by Ekpeyong (1988); Yusuf *et al.* (2010) and Orgain (2011) for dietary fibre level of 13-14% and 12-15% and 18- 25% for normal growth.

Table 2 presents the results of growth performance of the weaner rabbits on different treatment groups. Although, the initial body weight of rabbits were approximately the same,

there were significant differences in the mean final body weight and body weight gains among the treatments. Final body weights and daily weight gain of 1950g, 1980g, 2000g and 19.05g.19.21g, 19.84g respectively were recorded for rabbits on (T_2), (T_3) and (T_4). These were significantly ($p<0.05$) higher than that of (T_1) and (T_5).

Table 2: Performance of weaner rabbits fed sole concentrate, sole forage and their mixtures

Variables	T_1	T_2	T_3	T_4	T_5
Initial body weight (g)	750	750	770	750	770
Final body weight (g)	1900[b]	1950[a]	1980[a]	2000[a]	1820[c]
Daily body weight gain (g)	18.25[b]	19.05[a]	19.21[a]	19.84[a]	16.67[c]
Feed conversion ratio (FCR)	4.00[b]	3.97[b]	3.62[b]	3.07[c]	5.01[a]
Daily total feed intake/rabbit (g)	73.10[b]	75.60[b]	69.40[c]	60.9[d]	83.50[a]
Intake of concentrate (g/day)	31.50[b]	36.78[b]	23.36[c]	60.90 [a]	-
Intake of forages (g/day)	41.51[c]	38.82[d]	46.10[b]	-	83.50[a]
Feed intake/rabbit (Kg)					
Intake of Concentrate (kg)	1.99[b]	2.32[b]	1.47[c]	3.84[a]	-
Intake of Forage (kg)	2.62[c]	2.4.5[b]	2.90[b]	-	5.26[a]

T_4 was better in terms of the FCR because the animals were not allowed to select or preference their feed as compared to the T_1. Probably, feeding the rabbits with concentrate followed with forage; feeding forage followed with concentrate as well as concentrate alone enhanced better utilization and assimilation of the feed offered than simultaneously their feeding on concentrate /forage and forage alone.

The result further shows that rabbits on sole forage (T_5) had the significantly ($P<0.05$) highest daily forage intake (83.50g) among the treatments while those on sole concentrate (T_4) treatment had the least feed intake (60.90g). The low feed intake value for (T_4) may be due to the fact that a small quantity of the concentrate provides a balance ration for the growing rabbit (NFE and potein content of the experimental feed composition table). This result agrees with the reports of Spreadbury and Davidson (1975), Afolayan *et al.* (2009); Ekereuke *et al*. (2013) and Gidenne (2015). They opined that, rabbits and broilers will consume more of high fibre feed at a constant growth rate while they consume less of lower fibre feed to obtain its nutrient requirements thereby improving feed efficiency. On the other hand, a larger quantity (83.50g) of forage was consumed by the animals on T_5 (sole forage) because of its high fibrous content.

There were significant differences ($p<0.05$) in the feed conversion ratio (FCR) among the treatments. Rabbits on T_4 were the best in terms of FCR and this could be attributed probably to the nutrient balance in the compounded concentrate ration. Also, FCR is a function of weight of feed consumed/weight gain, the less the amount of feed used to deposit more weight the better the FCR. The result from this work is in line with the report of Gidenne (2015) that rabbit consume less of lower fibre feed to obtain its nutrient requirements thereby improving feed efficiency.

The economic analysis of rabbits on different experimental diets is presented in Table 3. The result shows that T_5 had the lowest feed cost of N131.5 followed by T_3 (N215.24). The sole concentrate had the highest feed cost of N378.86 as well as the best growth performance a

Table 3: Economic analysis of feeding sole concentrate, sole forage and their mixtures to weaner rabbits

Variables	T1	T2	T3	T4	T5
Total Feed intake/rabbit (Kg)					
Intake of Concentrate (kg)	1.99[b]	2.32[b]	1.47[c]	3.84[a]	-
Intake of Forage (kg)	2.62[c]	2.45[b]	2.90[b]	-	5.26[a]
Cost of feed consumed/rabbit(₦)					
Cost of concentrate feed /kg	97.10	97.10	97.10	97.10	-
Cost of forage /kg	25.00	25.00	25.00	-	25.00
(i) Cost of Conc consumed (₦ /kg)	193.23	225.27	142.74	372.86	-
ii) Cost of forage consumed (₦ /kg)	65.50	61.25	72.50	-	131.50
(iii) Total feed cost/rabbit (₦/kg)	258.73	286.52	215.24	372.86	131.50
(iv) %age reduction in feed cost (%)	-	-10.74	16.81	-46.43	49.17
Revenue /rabbit (₦)					
(i) Price per young rabbit (₦/kg)	1500	1500	1500	1500	1500
(ii) Price per Live Weight (₦ /kg)	2280	2340	2376	2400	2184
(iii) Profit/rabbit (₦/kg)	521.27	553.48	660.76	521.14	552.50
(iv) Profit/weight gain	28.56	29.05	34.40	26.27	33.14

expected. The results further indicates that feed cost per kilogramme for the growing rabbits decreased with feeding rabbits with sole forage and forage/concentrate mixtures. There would be about 49.17 and 16.83 percent reductions in feed cost per kg for young rabbits when sole forage (T_4) and concentrate in the morning /forage in the afternoon (T_3) are fed respectively. There would also be about -10.74 and -46.43 percent additions in feed cost per Kg for young rabbits when sole concentrate (T_4) and forage in the morning /concentrate in the afternoon (T_2) are fed. Price/Live weight which can be considered as the revenue generated per rabbit per treatment show better returns for T_4 followed byT_3 T_2 T_1 and T_5 (₦2400, ₦2376, ₦2340, ₦2280 and ₦2184) respectively. The revenue generated per treatment is as a result of the body weight attained as supported by the feed consumed by the rabbits. Although, T_4 generated the highest revenue, the profit or gross margin was the least for rabbit on this treatment group. T_3 was the best in terms of profit generated per weight gain (N34.40).

Conclusion

The growth performance of the rabbits on the T_3 (concentrate in the morning/forage in the afternoon) and T_4 (sole concentrate diet) were better in terms of final weight and body weight gain than rabbits on the diets of sole forage (T_5). Rabbits on sole forage and concentrate forage mixtures diets had relatively lower cost of feed/kg. FCR was higher for T_4, followed by T_3 rabbits (concentrate in the morning/forage in the afternoon). Also rabbits on T_3 were relatively cheap to produce in terms of feed cost with high profit hence is recommended.

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