PJN
ISSN 1680-5194

PAKISTAN JOURNAL OF NUTRITION

ANSInet
308 Lasani Town, Sargodha Road, Faisalabad - Pakistan
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Pakistan Journal of Nutrition 6 (4): 391-396, 2007
ISSN 1680-5194

Effects of Feed Restriction on Performance, Carcass Yield, Relative Organ Weights and Some Linear Body Measurements of Weaner Rabbits

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Abstract: Effects of feed restriction on performance, carcass yield, relative organ weights and some linear body measurements were investigated in weaner rabbits in a sub-humid environment in north central Nigeria. Twenty four weaner rabbits of mixed breeds and sexes with an average initial weight of 804.17±71.20g were used for the study which lasted six weeks. There were three dietary treatments consisting of diet A, *ad libitum* (24 hrs) feeding (control), diet B, 8 hrs per day feeding (7.00 a.m-3.00 p.m) and diet C, skip-a-day feeding. This feeding arrangement was carried out within the first five weeks of the experiment, after which all the animals in the three treatment groups were fed *ad libitum* for one week. Animals were fed pelletized commercial grower's feed supplemented with Centrosema pubescens. Drinking water was also supplied *ad libitum* throughout the duration of the experiment. Each treatment group was replicated four times while each replicate comprised two rabbits housed in the same cage. The initial and final body weights, feed conversion ratio, mortality, fasted weight, slaughter weight, carcass weight and dressing percentage were not significantly ($p>0.05$) affected by feed restriction. However, average weekly feed intake (454.94, 356.36 and 331.48g) and average weekly body weight gains (1137.50, 1127.50 and 1007.50g) were significantly ($p<0.05$) influenced; with higher values recorded among rabbits fed *ad libitum* compared to those on 8 hrs feeding per day and skip-a-day feeding respectively. There were no significant differences ($p>0.05$) in relative weights of liver, kidneys, spleen and heart among the treatment groups. Significant difference ($p<0.05$) was found in the relative weight of lungs, with rabbits on 8 hrs feeding per day and those on skip-a-day feeding having an edge over those fed *ad libitum* (0.61 versus 0.50). There were no significant differences ($p>0.05$) in heart girth, body length, face length and ear length among the dietary treatments studied. The present results have indicated that feed restriction could be exploited in the feeding regimen of rabbits, especially in periods of inadequate supply of concentrates and forages.

Key words: Body measurements, carcass characteristics, feed restriction, performance, weaner rabbits

Introduction

Rabbit production has gained considerable interest recently in Nigeria because of the exorbitant prices of the conventional sources of meat, such as cattle (beef), goats (chevon), sheep (mutton), pig (pork) and poultry. They are renowned for their fecundity and prolificacy (Biobaku and Dosumu, 2003); ability to utilize forages (Aduku and Olukosi, 1990); and low in fat and cholesterol levels (Biobaku and Oguntona, 1997).

It has been reported that rabbits, especially the newly weaned ones should not be maintained on sole forage without a little supplement of a balance concentrate. This is to guarantee maximum productivity (Ojebiyi *et al*., 2006). However, inadequate and high cost of feed ingredients brought about mainly by the stiff competition between man and monogastric animals such as rabbits and poultry for grains is the major constraint to rabbit production (Agunbiade *et al*., 2002). In order to address this problem, Iheukwumere *et al*. (2004) stressed the need to find alternative ways, which are cheap, adequate and readily available for feeding livestock. Similarly, Alawa *et al*. (1990) advocated the development of alternative feeding materials that will be relatively cheap when compared with commercial feeds or conventional feed stuffs.

In recent years, there has been an increased interest in studying feed restriction in broiler rabbits as a means of reducing the cost of production. Early feed restriction also helps to address problems associated with early-life fast growth rate such as increased body fat deposition, high incidence of metabolic disorders and high mortality (Urdaneta-Rincon and Leeson, 2002; Gidenne *et al*., 2003; Hassanabadi and Moghaddam, 2006). Limited feed intake depresses growth during the period of restriction, but reduced growth can be later compensated by realimentation (Szendro *et al*., 1989; Acar *et al*., 1995). This was consolidated in a similar study in sheep where it was concluded that animals would make a complete recovery after a severe nutritional check in early post-natal life if given the opportunity to do so (Krausgrill *et al*., 1997). According to Palsson's (1955) hypothesis of differential growth,

bones and internal organs are not affected by feed restriction to the same degree as muscle and fat. In another investigation, Bruno *et al.* (2000) reported that food restriction reduced bone length and width but did not affect bone weight. Restriction of rabbits improves feed efficiency (Tumova *et al.*, 2003). According to Eiben *et al.* (2001) and Rommers *et al.* (2001), feed restriction during rearing, followed by a short flushing and a delay of first insemination to an older age, seems to represent a promising strategy for optimizing body development of young and improving their productivity and longevity.

While reports on the effect of feed restriction on the performance of chickens abound in literature (Cable and Waldroup, 1990; McGovery *et al.*, 1999; Oyedeji, 2003), similar investigations with rabbits especially in the semi-humid tropics are scanty. Therefore, this study was embarked upon to determine the effects of feed restriction on performance, carcass yield, relative weights of visceral organs and some linear body measurements of weaner rabbits.

Materials and Methods

Study location: The experiment was conducted at the rabbitry of the Teaching and Research Farms, Faculty of Agriculture, Nasarawa State University, Keffi, Shabu-Lafia Campus. It is within the guinea savanna zone of North Central Nigeria and located between latitudes 6°15'N and 9°30'N and longitudes 6°30'E and 11°00'E respectively. The altitude ranges between sea level and 600m. The general climate is tropical, having distinct rainy and dry seasons. The mean environmental temperature of the area ranges between 28.5 and 30.9°C, while the mean annual rainfall ranges between 1270 and 1530mm. Mean daily actual sunshine hours ranges from 3.71-7.20. The vegetation type is dominated by savanna trees and small patches of woody shrubs.

Experimental design: Twenty four weaner rabbits of mixed breeds and sexes with an average weight of 804.17±71.20g were randomly assigned to three dietary treatments in a completely randomized design. Each treatment group was replicated four times. Each replicate comprised two rabbits housed in the same cage. The dimension of each cage made of wood and poultry wire mesh was 64×62×48cm.

Prior to the commencement of feeding trial, the experimental animals were acclimatized for one week, dewormed and all standard management practices strictly and subsequently followed. The three dietary treatments were, diet A, *ad libitum* (24 hrs) feeding (control); diet B, 8hrs per day feeding (7.00 am-3.00p.m.) and diet C, skip-a-day feeding. This feeding arrangement was carried out within the first five weeks of the experiment, after which all the animals in the three treatment groups were fed *ad libitum* (without feed restriction) for the remaining one week of the study which lasted six weeks. Animals were fed pelletized commercial grower's feed with the following characteristics: crude protein 14.5%, fat 7.0%, crude fibre 7.2%, calcium, 0.8%, available phosphorus 0.4% and metabolizable energy 2500kcal/kg. Their feeding was also supplemented with *Centrosema pubescens*. Fresh and clean water was however, supplied *ad libitum* throughout the duration of the experiment.

Data collection: Data on initial and final body weights (g), average weekly feed intake (g), average weekly body weight gain (g), Feed Conversion Ratio (FCR) and mortality were recorded. Feed intake was estimated by the difference between the amount offered and the left over collected the following day. Feed conversion ratio was determined by dividing feed intake by weight gain. At the sixth week of the feeding trial, four rabbits were randomly selected from each of the three treatment groups. The rabbits were fasted for twenty four hrs (giving only water) and individually weighed using a 20-kg scale. They were then slaughtered by severing the carotid arteries and jugular veins, skinned and eviscerated for carcass analysis. After the removal of the visceral organs and head, the remaining part was measured as carcass weight and this was later expressed as percentage of the fasted weight to get the dressing percentage (Fielding, 1991). The relative weights of the liver, kidneys, lungs, spleen and heart were determined using the formula:

$$\text{Relative organ weight} = \frac{\text{Fresh organ weight}}{\text{Fasted weight of rabbit}} \times 100$$

Linear body measurements of each rabbit were also taken on a weekly basis. They included, heart girth, measured as body circumference just behind the forelegs; body length, taken from the head to tail drop; ear length, measured from the base of the animal's ear to its tip; and face length, distance from the head to the lower lip. All measurements were recorded in centimeters (cm) using a tape rule.

Data analysis: Data were processed by one-way analysis of variance using Genstat (2005) statistical package. The significance of difference among treatment groups was tested using Least Significance Difference (LSD) method on the level ($p<0.05$).

Results and Discussion

Mean values for the performance indices of rabbits are presented in Table 1. There were no significant differences ($p>0.05$) in the initial body weights of rabbits among the treatment means (800-812.5g). This is an

Table 1: Effect of feed restriction on rabbit performance

	Treatment diets			
Performance indices	*Ad libitum* feeding	8hrs feeding	Skip-a-day feeding	SEM
Initial body weight (g)	800.00	812.50	800.00	71.20
Final body weight (g)	1338.75	1248.75	1165.00	65.80
Average weekly feed intake (g)	454.94[a]	356.36[b]	331.48[b]	12.85
Average weekly body weight gain (g)	89.79[a]	72.71[b]	66.04[b]	4.02
FCR (feed conversion ratio)	5.08	4.97	5.01	0.25
Mortality	0	0	0.25	

SEM: Standard error of means, Means in the same row bearing different superscripts differ significantly ($p<0.05$)

indication that the experimental animals were balanced for weight. The final body weights of rabbits were not significantly different ($p>0.05$) among diets A, B and C respectively. However, rabbits fed *ad libitum* had a higher mean value (1338.75g) compared to the values 1248.75 and 1165.00 recorded for rabbits fed 8 hrs per day and those subjected to skip-a-day feeding respectively. The present values are comparable to 1418,1180 and 1191(g) reported by Tumova *et al.* (2004) for rabbits fed *ad libitum* and those quantitatively restricted. However, the values obtained are lower to 2652, 2721 and 2748g recorded by Tumova *et al.* (2002). This difference could be attributed to breed difference and the intensity or duration of restriction. The better access of animals in treatment A to feed could have translated to the higher average value obtained in this study. There were significant differences ($p<0.05$) in the average weekly feed intake of rabbits among the treatment groups. Rabbits on diet A (*ad libitum* feeding) had a higher (454.94g) value compared to those on dietary treatments B and C (356.36g and 331.48g), which were not significantly ($p>0.05$) different from each other. The present finding is in agreement with the reports of Perrier and Ouhayoun (1996) and Tumova *et al.* (2003). The average weekly body weight gains of the rabbits showed significant differences ($p<0.05$) among the treatment groups. Animals on dietary treatment A (*ad libitum* feeding had significantly higher value (89.79g) than those subjected to 8 hrs feeding per day (72.7g) and skip-a-day feeding respectively (66.04g). This is not surprising since growth rate is slower during feed restriction period than when there is unrestricted access to feed. This could have resulted to the higher body weight gains of rabbit on dietary treatment A. Similar results have been reported by several other workers. Tumova *et al.* (2002) reported that weight gain was significantly reduced in dietary group with stronger restriction. Snetsinger (1994) reported in chickens decrease in body weight gains of broilers with increase in severity of feed restrictions. Decrease in the body weight gain during feed restriction is a function of plane of nutrition (Snetsinger, 1994), thereby resulting in inadequate intake of nutrients required to sustain rapid growth and development (Esonu *et al.*, 2002). Statistically, there were no significant differences in feed conversion ratio among the treatment means ($p>0.05$). Rabbits on 8 hrs feeding per day, however, required less feed to produce a one-gram gain in body weight (4.97) and also showed better conversion of feed to meat. This was followed by animals subjected to skip-a-day feeding (5.01) and *ad libitum* feeding respectively (5.08). The lower value recorded in treatment B could be attributed to a slighty better digestibility of nutrients. Perrier and Ouhayoun (1996) and Gidenne (1993) reported improved digestibility of nutrients and feed efficiency in rabbits at restricted feeding period. No significant differences ($p>0.05$) were found in the mortality rate of rabbits among the treatment groups. The only mortality recorded in rabbits subjected to skip-a-day feeding could not be linked to dietary effect as revealed by post mortem examination. The present finding is in consonance with the submission of Osman (1991) and Gidenne *et al.* (2003) that feed restriction did not affect mortality of rabbits.

Effect of restricted feeding on carcass characteristics of rabbits are presented in Table 2. There were no significant differences ($p>0.05$) in the fasted weights of rabbits among the treatment groups. The mean value of the fasted weight of dietary treatment A (*ad libitum* feeding) (1387.50g) was however, higher than those of animals fed 8 hrs per day (1250g) and those on skip-a-day feeding (1175.0g) respectively. No significant differences ($p>0.05$) in the slaughter weights of rabbits were observed among the dietary treatments. The values obtained ranged from 1130-1337.5. However, animals fed *ad libitum* seemed to give a better performance, followed by those fed 8 hrs per day and those on skip-a-day feeding. The slaughter weight values obtained in the present study were a reflection of the fasted weights. The treatment groups were also not significantly different ($p>0.05$) from each other in carcass weights. The values obtained ranged from 605.5-740.33g. Iheukwumere *et al.* (2004), however, obtained a different result in broiler finisher birds. In their own experiment, the carcass weights of birds fed *ad libitum* were significantly better than those at the highest level of feed restriction. Analysis of variance revealed that the differences among the treatment groups in dressing percentage were not significant ($p>0.05$). The values recorded for rabbits fed *ad libitum*, 8 hrs per day and

Table 2: Effect of feed restriction on carcass yield and visceral organ weights of rabbits

	Treatment diets			
Carcass characteristics	*Ad libitum* feeding	8hrs feeding	Skip-a-day feeding	SEM
Carcass yield				
Fasted live weight (g)	1387.50	1250.00	1175.00	64.80
Slaughter weight (g)	1337.50	1217.50	1130.00	59.50
Carcass weight (g)	740.33	664.92	605.5	37.60
Dressing percentage	53.28	53.12	51.64	0.96
Visceral organs				
Liver	2.76	2.91	3.02	0.09
Kidney	0.34	0.34	0.33	0.008
Lung	0.50[b]	0.61[a]	0.61[a]	0.006
Spleen	0.07	0.06	0.04	0.002
Heart	0.24	0.22	0.21	0.006

SEM: Standard error of means, Means in the same row bearing different superscripts differ significantly ($p<0.05$)

Table 3: Effect of feed restriction on average linear body measurements (cm) of rabbits

Treatment diets	Heart girth	Body length	Face length	Ear length
Ad libitum feeding	19.79	28.13	11.87	10.62
8-hour feeding	19.63	27.98	12.00	10.54
Skip-a-day feeding	19.04	27.13	11.54	10.24
SEM	0.60	1.01	0.30	0.26

SEM: Standard error of means, Means in the same column are not significantly different ($p>0.05$)

those on skip-a-day feeding were 53.28, 53.12 and 51.64% respectively. However, in broiler finisher birds, Iheukwumere *et al.* (2004), reported that there was a significant decrease in dressing percentage at the level of highest feed restriction. No significant differences ($p>0.05$) were observed in relative weights of liver among the dietary treatments. The values for *ad libitum* feeding, 8 hrs per day feeding and skip-a-day feeding were 2.76, 2.91 and 3.02 respectively. The one-week re-feeding period in the present study could have somehow impacted on the weight of the liver with rabbits on the highest level of feed restriction benefiting the most. Analysis of variance revealed no significant ($p>0.05$) differences in the relative weights of kidneys among the treatment means. The values obtained were 0.34. 0.34 and 0.33 for *ad libitum*, 8 hrs per day and skip-a-day feeding respectively. Tumova *et al.* (2004) reported similar results where feed restriction did not have any significant effect on kidneys weight. There were significant differences ($p<0.05$) in relative weights of lungs among the treatment groups. Rabbits on 8 hrs feeding per day and skip-a-day feeding had significantly higher values (0.61, 0.61) than those fed *ad libitum* (0.50). The present result contradicts the findings of Tumova *et al.* (2004), where there were no significant differences among rabbits fed *ad libitum* and those on feed restriction. No significant differences ($p>0.05$) were found in relative weights of spleen among the treatment means. The relative weights were 0.07,0.06 and 0.04 for rabbits fed *ad libitum*, those on 8 hrs feeding per day and those subjected to skip-a-day feeding. There were no significant differences ($p>0.05$) among the treatment means in relative weights of heart. Rabbits fed *ad libitum*, those on 8 hrs feeding per day and those on skip-a-day feeding had 0.24, 0.22 and 0.21 values respectively. The present results agree with the findings of the earlier workers that feed restriction did not significantly affect the weight of the heart (Susbilla *et al.*, 1994; Tumova *et al.*, 2003; Iheukwumere *et al.*, 2004).

Average linear body measurements of rabbits on the three different treatment groups are presented in Table 3. No significant differences ($p>0.05$) were observed among the treatment groups. The heart girth values for rabbits on *ad libitum* feeding, those on 8 hrs feeding per day and rabbits subjected to skip-a-day feeding were 19.79, 19.63 and 19.04 cm respectively. The body length values were 28.13, 27.98 and 27.13 cm for dietary treatments A, B and C respectively. The face length values ranged from 11.54-12.00 cm, while a range of 10.24-10.62 cm was obtained in respect of ear length. Although heart girth and ear length have been reported to respond to environmental conditions such as feed and temperature, this was not reflected in the performance of rabbits under the three dietary treatments. The finding on face length is not surprising, since it is a cephalic measurement that exhibits very little variability because of its close association with cranial bone. Similarly, body length is almost independent of the environment and therefore, usually indicate inherent size. The present results have indicated that the body dimensions of rabbits that are not under too long and severe restriction are not significantly influenced. This is somehow an aid to rabbit growth and selection process.

Conclusion: The results obtained from this study have indicated that feed restriction did not significantly influence some of the performance indices, carcass yield, relative organ weights and body dimensions investigated. This could therefore be exploited in the feeding regimen of rabbits, especially in periods of scarcity of commercial feed and forages for rabbit feeding.

Recommendation: Since restricted rabbits can exhibit an accelerated rate of body weight gain, typical of compensatory growth, during realimentation period when they are fed *ad libitum*, it is therefore recommended that further studies should be carried out with emphasis on the mode of compensatory growth in rabbits.

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