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Research Article

EFFECT OF YEAST SUPPLEMENTATION AND ALTERNATIVE HOUSING SYSTEMS ON PERFORMANCE OF RABBITS

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ABSTRACT

Thirty two weaned New Zealand White rabbits of either sex were randomly assigned to four treatments in four tier cages or in pens with wire mesh floor. The experiment consisted of two housing and dietary treatments, each. Experimental rabbits in treatment groups T_1 and T_2 were housed in cages while those in T_3 and T_4 in pens with wire mesh floor. Standard concentrate diets without yeast supplementation were fed to T_1 and T_3 while T_2 and T_4 were fed concentrate diets supplemented with 2% yeast (*Saccharomyces cerevisiae* and *Candida rugosa* @ 2 X 10^{13}billion cfu). At 13 weeks of age, rabbits raised with 2% yeast supplementation had significantly ($P<0.05$) higher body weight gain (940.63, 973.63 vs. 916.23, 953.75 g) than the rabbits raisedwithout yeast supplementation (T_1& T_3). The rabbits reared under pen system (T_3 and T_4) irrespective of yeast supplementation had significantly ($P<0.05$) higher weight of fore part (251.92, 255.40 vs. 222.94, 237.81 g) and hind part (236.28, 314.77 vs. 287.75, 298.12 g) and lower weight of intermediate part (236.28, 240.23 vs. 267.66, 277.36 g) than the rabbits reared under cage system.

Key words: Rabbits, cage, pen, yeast, growth, carcass traits

Introduction of rabbit as an important species in the 17th livestock census indicates that Department of Animal Husbandry, Government of India has identified it as a small versatile livestock species with an immense potential to improve the socio-economic status of the rural masses and substantial contributor towards the Gross Domestic Product (GDP) as well (Livestock Census, 2003). Decades back, planners had realized the importance and potential of rabbits farming towards the agriculture based Indian economy (Risam *et al.*, 2005) but the developments pertaining to improved feed formulation and proper housing strategies for enhancing the productive potential of rabbits were not fully exploited. Such strategies, if incorporated will ensure greater productivity of rabbits raised on by-products feedstuffs. One such strategy is dietary supplementation of yeast (*Saccharomyces cerevisiae*) in rabbit diet (Onifade *et al.*,1998). Besides physiological, biophysical, pathological and biochemical factors that are important to animals, ethological or behavioral factors are also used to access domestic animal welfare. However, there are no unanimous standards for evaluation of different housing systems for the rabbit welfare and growth performance. The behavioral studies are currently in use to revise the rabbit housing requirements like space per rabbit and enrichment of environment. Hence the present study was undertaken to study the effect of dietary supplementation and housing systems on growth performance and carcass traits in rabbits.

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MATERIALS AND METHODS

Thirty two New Zealand White rabbits of either sex of 6 weeks of age having average boady weights of 618.59 g were procured from Disease Free Small Animal House, LUVAS, Hisar after due approval from the Institutional Animal Ethics Committee of the University. Rabbits were randomly assigned to four treatments in four tier cages (0.45 X 0.45 m, 0.40 m high, 1 rabbit/cage, 4.94 rabbits/ m^2, n=16) or in pen with wire mesh floor (1.50 X 2.00 m, 1.00 m high, 4 rabbits/pen, 1.33 rabbits/ m^2, n=16) in a closed room where the temperature (20±5°C) and humidity (60+15%) were maintained during the trial. The experiment consisted of two housing and dietary treatments each. The rabbits in treatment groups T_1 and T_2 were housed in cage system while those in T_3 and T_4 were housed in pen system. The rabbits of groups T_1 and T_3 were fed control concentrate mixture as per Indian Council of Agricultural Research standards (ICAR, 2008) while in treatment T_2

and T_4 the rabbits were fed control concentrate mixture supplemented with 2% yeast (*Saccharomyces cerevisiae* and *Candida rugosa;* 10^{13} billion colony forming units/kg) at a rate of 20g/kg concentrate feed. The concentrate mixture was prepared by mixing half crushed ingredients and contained maize, deoiled rice polish, soybean meal, groundnut cake, gram, mineral mixture and iodized salt (Table 1). In addition to concentrate feed, locally available berseem (*Trifolium alexandrinum*) fodder was also fed *ad libitum*. The concentrate mixture and roughage were chemically analyzed for proximate principles (AOAC, 2005).

The kits were offered concentrate in the morning and roughage in the afternoon and residual feed was weighed and discarded before offering fresh feed. The kits were given *ad lib* feed and clean drinking water throughout the experiment. The feed containers were hanged tightly at neck level of rabbits to avoid any spilling and wastage of feed. The study was carried out for a period of 45 days. The rabbits were dewormed with ivermectin 200 µg/kg subcutaneously and also treated prophylactically against coccidiosis with coccidiostat according to manufacturer's prescription.

All the rabbits were weighed at the beginning and at the end of the experimental trial, of which 16 rabbits (4 per treatment) were randomly selected for carcass traits analysis. Selected animals were numbered for slaughter and were transferred in small groups to the slaughter facility at the Livestock Products Technology department of the university. Slaughtering of rabbits and carcass dissection was done as per the recommendations of Blasco *et al.* (1992). After weighing, rabbits were stunned with a hard blow to the skull behind the ears and then slaughtered. The slaughtered rabbits were bled, and then their skin, genitals, urinary bladder, gastrointestinal tract contents and distal parts of legs were removed. Carcasses (with thoracic cage organs, liver, kidneys) were weighed as hot carcass (HC), then chilled at 4^0C in a refrigerator for 24 h in a ventilated room. The chilled carcasses (CC) were weighed. Heart, lungs, liver, kidneys, oesophagus, trachea, thymus and head were removed from each carcass to obtain reference carcass

Table 1
Chemical composition of concentrate mixture and berseem fed to rabbits

Ingredient (g/kg)	Diet 1[1]	Diet 2	Berseem
Maize	300	300	—
Deoiled rice polish	250	250	—
Soybean meal	200	200	—
Groundnut cake	140	140	—
Gram	100	100	—
Nutriyeast[2]	—	20	—
Iodized salt	5	5	—
Mineral mixture[3]	5	5	—
Spectromix powder premix[4]	1	1	—
Spectro BE: powder premix[5]	1	1	—
Chemical composition (% DM basis)			
Dry matter	86.2	85.1	14.25
Crude protein	23.7	24.5	15.12
Ether extract	4.0	4.8	3.26
Crude fibre	12.0	11.7	19.62
Nitrogen free extract	52.5	49.9	45.39
Ash	7.6	8.9	16.61

[1]Diet 1 was fed to T_1 and T_3 treatment groups while Diet 2 was fed to T_2 and T_4 treatment groups.
[2]Nutriyeast contained 10^{13} billion cfu/kg of *Saccharomyces cerevisiae* and *Candida rugosa* each.
[3]Mineral mixture (salt free)-Ca (32%), Cu (100 ppm), Zn (0.26%), Iodine (0.01%), P (6%), Mn (0.27%), Fe (1000 ppm) and Co (50 ppm).
[4]Spectromix powder premix (Ranbaxy Animal Health, New Delhi) - Each gm contained vitamin A (82,500 IU), vit. D3 (12,000 IU), vit. B2 (50 mg) and vit.K (10mg).
[5]Spectro BE powder premix (Ranbaxy Animal Health, New Delhi) - Each gm contained vit. B1 (8 mg), vit. B6 (16 mg), vit. B12 (80 mg), niacin (120mg), calcium pentothenate (80mg), vit. E (160 mg), lysine hydrochloride (10 mg), DL-methionine (10 mg) and calcium (260mg).

(RC), which include the meat, bones and fat depots only. The reference carcass were then cut between the 7th and 8th thoracic vertebrae and between the 6th and 7th lumbar vertebrae to obtain the fore, intermediate and hind parts, which were weighed separately. The fore leg and hind leg were cut at shoulder and hip joint, respectively and weighed separately. The dressing %/ slaughter yield (CC weighed as % of slaughter weight) was calculated and the weight of the organs and carcass parts was recorded. The data were analyzed by applying ANOVA and Duncan analysis tests using IBM SPSS statistics 21 software package for windows.

RESULTS AND DISCUSSION

The chemical composition of concentrate mixture indicated that proximate constituents were similar between T_1 and T_3; and between T_2 and T_4. The crude protein content was 23.7 in concentrate mixture of T_1 and T_3 and 24.5% in T_2 and T_4 (Table 1). There was slight increase in protein content due to yeast supplementation.

Average body weight gains during the experiment were 940.63, 973.63, 916.23 and 953.75 g in groups T_1, T_2, T_3 and T_4, respectively. It indicated that body weight gain was significantly ($P<0.05$) higher in yeast supplemented groups as compared to non-supplemented groups. The body weight gain was higher under cage system as compared to pen system that might be due to variations in locomotor activity. Metzger *et al.* (2003) also found that slaughter weight of rabbits in pens was 4.9% lower than the cage-housed rabbits. The growth rate of the rabbits fed yeast supplemented diet was significantly ($P<0.05$) higher as compared to non-supplemented group irrespective of the housing systems. These findings are in accordance with earlier studies of Onifade *et al.* (1998) and Lambertini *et al.* (2004) who also reported significant increase in body weight and body weight gain of rabbits when their diet was fortified with 3% yeast. On the contrary, many workers (Omole, 1977; Deshpande *et al.*, 1993; Chaudhary *et al.*, 1995; Das *et al.*, 1999; Onifade *et al.;* 1998; Fekete *et al.*, 2001) reported that yeast had no significant effect on growth in rabbit. However, Soliman *et al.* (2000) reported that rabbits fed on diet supplemented with yeast culture attained significantly higher final body weight, had more daily weight gain and the best feed conversion efficiency.

The mean values of total dry matter intake per day were 105.76, 106.39, 100.47 and 103.79 g/day in groups T_1, T_2, T_3 and T_4, respectively. The dry matter intake was not affected due to yeast supplementation but it was significantly ($P<0.05$) lower in rabbits reared under pen system as compared to cage system. Further, feed conversion ratio of the rabbits reared under different housing systems and dietary treatments did not differ significantly. However, Lambertini *et al.* (2004) also reported that rabbits housed in cage had a significant higher weight gain and better feed conversion ratio than rabbits housed in litter system.

After slaughtering, the average values of weight of inedible offals were 415.25, 398.96, 387.19 and 438.30 g in groups T_1, T_2, T_3 and T_4, respectively. The inedible offals' weight was found significantly ($P<0.05$) lower in T_3 and T_2 as compared to T_4 (Table 2). Further, it was observed that hot carcass weight, cold carcass weight, dressing %, weight of blood and weight of skin (g) of rabbits under different groups did not differ significantly (Table 2). Paryad and Mahmoudi (2008) also reported that dietary probiotics could improve the performance and decrease the weight of inedible offals. The yeast in feed might have decreased the inedible offals weight by improving the edible offals and fur yield due to better-feed effect on rabbit growth rate as also obtained by Al-bar *et al.* (1991). On the contrary, Chumpawadee *et al.* (2008) reported that probiotic had no beneficial effect on carcass characteristics of broilers chicken.

The means of weight of fore and hind part of the rabbit carcass were found to be significantly ($P<0.05$) heavier in T_3 (251.92, 309.06 g) and T_4 (255.40, 314.77) as compared to T_1 (222.94, 287.75) and T_2 (237.81, 298.12). This could be due to higher exercise in the pen system as compared to cage system. While mean weight of intermediate part of rabbit carcass were found to be 267.66, 277.36, 236.28 and 240.23 in T_1, T_2, T_3 and T_4, respectively; which indicated that cage housed rabbits had significantly ($P<0.05$) higher weight than pen housed rabbits. The fore and hind parts of carcass closely related to locomotor activity and so increased at the expense of the intermediate part in the pen system rabbits. Metzger *et al.* (2003) also reported similar findings in pen-housed and cage-housed rabbits. Dal Bosco *et al.* (2000, 2002) found an increase only in the portion of hind part in pen-housed rabbits. Yalcin *et al.*

Table 2

Growth performance and carcass characteristics of rabbits under different treatments*

Parameters	Treatment groups			
	T_1	T_2	T_3	T_4
Growth performance				
Initial body weight (g)	614.37^a±22.34	620.00^a±21.54	617.50^a±19.43	622.50^a±21.44
Final body weight (g)	1571.25^a±24.95	1590.00^a±27.32	1531.25^a±38.80	1576.25^a±22.43
Body weight gain	940.63^a± 12.90	973.63^b± 18.82	916.23^a± 20.34	953.75^b±47.49
Av. daily wt. gain (g)	20.79^a±0.31	21.62^b±0.41	20.36^a±0.45	21.19^b±0.37
Total dry matter intake (g)	4759.24^a±96.68	4787.67^a±89.34	4521.34^a±52.29	4670.72^a±6.76
Dry matter intake (g)/day	105.76^a±2.14	106.39^a±2.00	100.47^a±2.33	103.79^a±0.30
Feed conversion ratio	5.06^a±0.08	4.92^a±0.00	4.93^a±0.00	4.89^a±0.01
Carcass characteristics (n=4)				
Pre slaughter wt. (g)	1612.50^a±0.56	1622.50^a±20.15	1602.50^a±24.62	1625.00^a±22.54
Hot carcass wt. (g)	847.46^a±9.06	871.50^a±8.63	866.29^a±13.58	880.39^a±16.04
Cold carcass wt. (g)	820.42^a±8.14	834.93^a±9.55	838.65^a±13.15	854.15^a±11.90
Dressing %	54.05^a±0.08	54.29^a±0.20	52.51^a±1.20	53.77^a±0.08
Wt. of blood (g)	34.32^a±5.87	34.25^a±4.42	32.15^a±5.56	33.65^a±3.98
Wt. of inedible offals (head, leg, viscera) (g)	415.25^{ab}±13.83	389.96^a±12.94	387.19^a±13.65	438.30^b±11.35
Fore part (g)	222.94^a±6.84	237.81^a±3.03	251.92^b±3.75	255.40^b±10.21
Intermediate part (g)	267.66^b±9.64	277.36^b±3.15	236.28^a±3.90	240.23^a±3.24
Hind part (g)	287.75^a±11.49	298.12^a±3.76	309.06^b±4.65	314.77^b±3.87
Liver (g)	47.15^a±0.87	45.47^a±1.64	46.57^a±0.70	47.54^a±0.56
Kidney (g)	11.34^a±0.30	11.22^a±0.37	11.12^a±0.25	11.34^a±0.32
Heart and lungs (g)	10.62^a±0.69	11.25^a±0.60	11.32^a±0.54	11.25^a±0.29
Skin/pelt (g)	137.65^a±5.53	142.65^a±1.81	139.73^a±2.24	142.00^a±1.86
Meat bone ratio-fore part	3.68^a±0.28	3.74^a±0.23	3.80^a±0.17	3.73^a±0.09
Meat bone ratio-intermediate part	11.64^a±0.31	11.58^a±0.58	11.60^a±0.39	11.85^a±0.00
Meat bone ratio-hind part	5.13^a±0.18	5.04^a±0.17	5.24^a±0.22	5.28±0.17

Means with different superscripts row-wise differ significantly ($P<0.05$)

*No. of rabbits was eight in each treatment group

(2006) and Paryad and Mahmoudi (2008) also concluded the similar findings.

The means of meat bone ratio of fore part, intermediate part and hind part of rabbit carcass under different treatment groups were found to be statistically similar. Metzger *et al.* (2003) and Dal Bosco *et al.* (2000, 2002) also reported similar findings in cage and pen housed rabbits.

The rabbits reared under cage system irrespective of yeast supplementation had significantly lower portion of fore, hind part, and significantly higher portion of intermediate part than the rabbits reared under pen system. With yeast supplementation, body weight gain increased without affecting FCR which is a desirable finding. Better carcass traits were obtained in cage system than pen system of rearing. Therefore, cage housing of rabbits with yeast supplementation could prove more fruitful in rabbit farming.

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