J.Animal and Poultry Prod., Mansoura Univ., Vol.4 (5): 285 - 295, 2013

EFFECT OF REARING STOCKING DENSITY ON GROWTH PERFORMANCE AND SOME BLOOD PARAMETERS OF GROWING RABBITS

Aboegla, El-Samra H. A. ; Z. M. Kalaba ; Lamiaa Y. Y. El-Bnawy
Dept. of Poultry Production, Fac. of Agric., Mans. University

ABSTRACT

A total of 90 unsexed 30 days weaned (New Zealand White (NZW)) rabbits were used in this experiment to study the effects of stocking density on growth performance and some blood parameters of growing rabbits, the animals were housed in wire cages (50x60x30cm) in groups of 1, 2, 3 and 4 rabbits/ cage (represented 6.6, 13.33, 20 and 26.67kg/m^2). A significantly higher ($p \le 0.05$) body condition score with better feed conversion was observed in rabbits stocked in groups having 1, 2 and 3 rabbits/ cage than those of 4 rabbits/ cage. No statistical difference was observed in average carcass weight under different placement densities. However, a significantly higher weight of liver and kidney was observed in rabbits stocked in group having 1 rabbits /cage than other groups. Animals housed in group having 2 rabbits/ cage had the highest red blood cell counts and the lowest serum level of Platelets, while the highest white blood cell counts ($p \le 0.05$) was in rabbits stocked in group having 4 rabbits/ cage. Concentration of total protein, globulin and creatinine were higher ($p \le 0.05$) in rabbits stocked in groups having 1 and 2 rabbits/cage than other groups. Aspartate transaminase and alkaline phosphatase activities were higher ($p \le 0.05$) in rabbits stocked in groups having 3 and 4 rabbits/cage than the others. Albumin concentration, activity of alanine transaminase, High density lipoprotein and Lowe density lipoprotein were not affected. These results indicate that increasing density up to 4 rabbits per cage with floor area of 3000cm^2, corresponding to a stocking density of 13.33 rabbits/m^2 (26.67 kg/m^2 at 12 week of age) adversely affect rabbit performance.

Keywords: Rabbits, growing rabbits, stocking density, carcass yield, growth performance, blood parameters

INTRODUCTION

There is increasing demand for domestic rabbits in the tropics involving the production of meat, pelts and as live animals for breeding and laboratory stock. To gain competitiveness in the animal agriculture arena, the rabbit subsector of the livestock industry must focus on increasing kit survivability and growth maximization. One of the most crucial ways of achieving this is to create a conductive rearing environment among which is appropriate stocking rate.

High stocking densities have adversely effect on the performance of rabbits (Aubret and Duperray, 1992; Morrise and Maurice, 1997). Several authors studied the effect of cage density and housing system on welfare and production of rabbits (Verga *et al*., 2006; Jordan *et al*., 2006; Szendro and Luzi, 2006). Cage size should allow each growing rabbit at all age intervals to stretch full length along one side of the cage and to sit up straight the high of the cage, Onbasilar and Onbasilar (2007). In intensive conditions, biological and ethological needs have to be taken into consideration in rabbits, Morisse and Maurice (1994). Minimum space allowance for rabbits according to Home

Office, Animal Welfare, Rabbit Welfare Code, 1987 being fatteners 12 weeks of age (700cm^2 per rabbit). The aim of this study was to investigate the effect of cage density on growth performance, carcass yield and some blood parameters of growing New Zealand White rabbits under commercial condition in Egypt.

MATERIALS AND METHODS

The fieldwork of the present study was conducted at a private farm on Zian village, located at the north eastern part of the Nile Delta, Dakahlia Governorate, Egypt, in October 2009 and lasted 8 weeks. It aimed to evaluate the effects of cage density on rabbit's performance. Some blood parameters were determined in the Laboratory of Poultry Production, Faculty of Agriculture, Mansoura University, Egypt, using commercial kits.

Experimental groups: Ninety unsexed (N Z W), weaned at 30 days, with an average weight of 551.1± 1.59g were randomly allotted to four stocking densities of 1, 2, 3 and 4 rabbits/cage (represented 6.6, 13.33, 20 and 26.67kg/m^2) in a completely randomized design. Each treatment group was replicated nine times. The animals were housed in galvanized wire flat- deck cages measuring 50x60x30cm. Each cage was equipped with a nipple for drinking and feeder of total length 0.50cm outside the cage. Photoperiod was (18L: 6D), farm temperature ranged between 23.8 and 25.9ºC and relative humidity ranged from 58 to 65% during the experimental period.

Feeding system: Rabbits were fed a basal diet formulated in pelleted form and contained 18.49% crude protein, 2.64% crude fat, 12.49% crude fiber and 48% nitrogen free extract. Chemical composition of the experimental diet is shown in Table (1).

Table 1: Composition and calculated analysis of the basal diet.

Ingredients	**(%)**
Yellow Corn	6.4
Soybean meal, 44%	19.5
Wheat bran	24.0
Barley	15.0
Alfalfa hay	32.1
Ground limestone	1.0
Di-calcium phosphate	1.2
Common slat	0.5
Premix	0.3
Total	100.0
Calculated analysis	**(%)**
Dry matter	89.98
Crude fiber	12.49
Ether extract	2.64
Nitrogen free extract	48.00
Crude protein	18.49
Organic matter	81.64
ASH	8.34

Premix: 3Kg contains Vit. A: 12,000,000 IU, Vit. D3: 3,000,000 IU, Vit. E: 10 mg, Vit, K3: 3mg, Vit. B1: 200 mg, Vit. B2: 5 mg, Vit. B6: 3 mg, Vit. B12: 15 mg, Biotion: 50 mg, Folic acid: 1 mg, Nicotinic acid: 35 mg, Pantothenic acid: 10 mg, Mn: 80 mg, Cu: 8.8 mg, Zn: 70 mg, Fe: 35 mg, I:1 mg, Co: 0.15mg, Se:0.3 mg.

Rabbits of all groups were fed *ad libitum* and water was available throughout the experimental time.

Experimental performance: Live body weight and total feed intake were weekly recorded, then body weight gain and feed conversion ratio (g/g) were calculated. Also, viability rate was calculated at the end of the experimental period.

Carcass yield: At the end of the experimental period (12 weeks old) three rabbits per treatment group, were randomly chosen near the average of their respective treatment, prior to slaughter the animal were held 12 hours without feed, and slaughtered between 9.30 and 11.00h. After wards, they were dissected according to Blasco *et al.* (1993).

Blood sampling: At the end of the experimental period (12 weeks of age) blood samples were collected from 3 rabbits per treatment. Blood samples were drawn just before slaughter into two ethylene diamine tetra-acetic acid (EDTA) tubes. The 1st tube was centrifuged at 4000 rpm for 15 minutes to separate blood plasma, and stored at –20^{o}C for determining the concentrations of plasma total protein, albumin, total cholesterol, high density lipoprotein (HDL), glucose, creatinine, triglycerides and total lipids, activity of aspartate (AST), alanine (ALT) transaminases and alkaline phosphatase (ALP); using commercial Kits, according to the methods described by Gornall *et al.* (1949), Doumas *et al*. (1971), Allain *et al.* (1974), Myers *et.al* (1994), Trinder (1969), Bauch and Seitz (1985), Fossati and Prencipe (1982). Frings and Dunn (1970), Reitman and Frankel (1957), Kind and King (1954), respectively. Meanwhile, concentration of globulin was calculated by subtracting albumin concentration from total protein, while concentration of LDL was calculated by subtracting total cholesterol from HDL concentration.

The second tube was used for blood hematology analysing. Count of red blood cells (RBCs), white blood cells (WBCs) blood platelets (PLT) were

Statistical analysis: The obtained data were statistically analyzed by one way complete design using SAS (2004). The significant differences among groups were tested using Multiple Range Test according to Duncan (1955).

RESULTS AND DISCUSSION

Live body weight: Significantly higher (p≤0.05) total body weight was observed in rabbits stocked at 2 rabbits/ cage 2103.9g, followed by those at 1,3 and 4 rabbits/cage2083.3, 1997.4 and 1916.1g, respectively (Table2). Total body weight reduction in the group with 4 rabbits/ cage may be explained by lower fed intake and lower physical activity due to the crowding stress, as observed by Morisse and Maurice (1997) also they reported that reducing stocking density from 20-23 to 15-16 rabbits/m^2 significantly improved growth performance. Nieves *et al*. (1996); Andrea *et al.* (2004) and Mbanya *et al.* (2004) recommend 5-16 rabbits/m^2 as an adequate range for tropical condition. While, Ebru and Ilyas (2007) showed that there were no significant differences among groups in total body weight with groups having 1, 3 and 5 rabbits/ cage (70x40x60cm). Also, no differences were observed among the densities of (4.16, 8.33, 12.5 and 16.67 NZW rabbits/ m^2) regard to final weight Neto *et al.* (2007)

Table 2: Effect of cage density on average live body weight of growing rabbits at different experimental ages.

Body weight(g)					
Cage density (rabbits/ cage)					
Age (week)	**1**	**2**	**3**	**4**	**±SEM**
4th **(Initial)**	551.1	550.0	548.7	550.3	1.59
5th	701.7a	693.1a	676.2b	678.3b	4.75
6th	916.1b	975.8a	833.5c	846.9c	6.22
7th	1141.7b	1205.0a	1135.6b	1078.1c	7.93
8th	1364.4a	1361.9a	1308.9b	1241.1c	8.38
9th	1570.0a	1573.3a	1536.1b	1448.6c	7.34
10th	1750.0a	1743.3a	1738.5a	1630.8b	9.54
11th	1924.4b	1952.8a	1846.1c	1740.8b	5.86
12th**(Final)**	2083.3b	2103.9a	1997.4c	1916.1d	6.69

Values within the same row having different superscripts are significantly different at p≤0.05

Body weight gain: Data in Table (3) show that total body weight gain at the period from 4-12 weeks of age was significantly (p≤0.05) affected by housing density, where it was better for group with 2 rabbits/ cage 1581.7g than that of groups with 1 and 3 rabbits/ cage 1532.2g, 1467.2g, respectively. Meanwhile, group with 4 rabbits/ cage showed the lowest gain 1365.8g. In agreement with the present results, Paci *et al*. (2008) found that rabbits in group of 4 animals/ m^2 showed significantly higher weight gain than groups of 8 or 16 animals/ m^2. Significant decrease in daily weight gain of rabbits was observed by increasing number of animals from 2 to 4 in a cage (5 and 10 rabbits per m^2) Mbanya *et al*. (2004), and from 1 to 3 or 5 rabbits /cage (Onbasilar and Onbasilar, 2007).

Table 3: Effect of cage density on average weekly body weight gain of growing rabbits at different experimental intervals.

Weekly body weight gain (g)					
Cage density (rabbits/ cage)					
Age (intervals) (wks)	**1**	**2**	**3**	**4**	**±SEM**
4-5	150.6	170.8	146.0	128.1	18.05
5-6	214.4b	282.8a	157.3c	168.6c	7.28
6-7	225.6b	229.2b	302.0a	231.1b	9.28
7-8	222.8a	156.9b	173.3b	163.1b	8.35
8-9	205.6	211.4	227.2	207.5	6.84
9-10	180.0b	170.0b	202.4a	182.2b	6.71
10-11	174.4b	209.4a	107.6c	109.9c	8.06
11-12	158.9ab	151.1b	151.3b	175.4a	6.88
4-8(wks)	813.3ab	839.7a	778.7b	690.8c	19.81
4-12(wks)	1532.2a	1581.7a	1467.2b	1365.8c	18.96

Values within the same row having different superscripts are significantly different at p≤0.05

The gradual reduction in total body weight gain by increasing cage density in the present study may be explained by lower feed intake and lower physical activity due to the crowding stress, as observed by (Morisse and Maurice, 1997) for rabbits caged at 5 animals/cage.

Feed intake: Data in Table (4) show that, there were no significant differences in feed intake for groups housed with 1, 2 and 3 rabbits/ cage. While the groups housed with 4 rabbits/cage significantly decreased ($p \le 0.05$) than other groups. Average total feed intake, were significantly ($p \le 0.05$) inflounced under the varying stocking rates, during the interval from 4 up to 12 weeks of age, feed intake was significantly ($p \le 0.05$) lower in group with 4 rabbits/ cage 6057.22g than other groups with 1, 2 and 3 rabbits/cage 6266.67, 6343.89 and 6202.22g, respectively.

In accordance with the present results (Neto *et al*., 2007) found that increasing stocking density from 4.16 to 8.33, 12.5 and 16.67 NZW rabbits/m^2 reduced the daily feed consumption. Also, (Villalobos *et al*., 2008) reported that average feed intake decreased when the density increased from 6 to 12, 18 and 24 rabbits/ m^2. On the other hand, (Whary *et al*., 1993) reported that feed intake during the experimental period was significantly higher in group housed than in single housed rabbits. However, some authors found no effect of stocking densities on feed intake (Oliveira and Almeida, 2002) or stocking rate (5 or 10/m^2) as reported by Mbanya *et al*. (2004).

Table 4: Effect of cage density on average weekly feed intake of growing rabbits at different experimental intervals.

Weekly feed intake (g)					
	Cage density (rabbits/ cage)				
Age (intervals) (wks)	**1**	**2**	**3**	**4**	**±SEM**
4-5	780.00^{b}	713.89^{b}	726.30^{b}	906.67^{a}	28.51
5-6	937.78^{a}	984.44^{a}	837.78^{b}	808.33^{b}	25.55
6-7	1168.89^{bc}	1247.22^{ab}	1343.33^{a}	1120.00^{c}	39.33
7-8	993.33^{a}	847.22^{b}	677.78^{c}	706.11^{c}	23.66
8-9	697.78^{c}	793.33^{b}	911.11^{a}	838.33^{ab}	26.69
9-10	557.78^{b}	617.78^{a}	611.85^{a}	613.89^{a}	11.55
10-11	633.33^{a}	591.11^{b}	593.33^{b}	582.22^{b}	7.29
11-12	497.78^{b}	548.89^{a}	500.74^{b}	481.67^{b}	8.62
4-8(wks)	3880.00^{a}	3792.78^{a}	3585.19^{b}	3541.11^{b}	40.73
4-12(wks)	6266.67^{ab}	6343.89^{a}	6202.22^{a}	6057.22^{c}	41.57

Values within the same row having different superscripts are significantly different at $p \le 0.05$

Feed conversion: Data in Table (5) show that, group with 1 rabbit/ cage showed significantly ($p \le 0.05$) the best conversion ratio 3.84, compared with groups having 2, 3 and 4 rabbits/ cage 4.03, 4.34 and 4.63, respectively. Similarly, (Grace and Olounja, 2005) found that feed conversion ratio was poorer at higher densities than at lower densities. High cage density may decrease the possibilities for movement and had measurable adverse effects on the welfare of young rabbits (Onbasilar and Onbasilar, 2007).

Table 5: Effect of cage density on feed conversion ratio of growing rabbits at different experimental intervals.

Weekly feed conversion ratio					
Cage density (rabbits/ cage)					
Age (intervals) (wks)	**1**	**2**	**3**	**4**	**±SEM**
4-5	5.19^{c}	4.97^{c}	5.80^{b}	6.21^{a}	0.07
5-6	4.40^{a}	4.84^{ab}	5.18^{a}	5.29^{a}	0.16
6-7	3.91^{c}	4.08^{c}	4.51^{b}	4.86^{a}	0.07
7-8	3.68^{d}	3.90^{c}	4.10^{b}	4.32^{a}	0.04
8-9	3.47^{b}	3.83^{a}	3.89^{a}	4.05^{a}	0.08
9-10	3.45^{d}	3.53^{c}	3.85^{b}	4.11^{a}	0.02
10-11	3.44^{d}	3.60^{c}	3.94^{b}	4.11^{a}	0.05
11-12	3.40^{d}	3.51^{c}	3.85^{b}	4.07^{a}	0.03
4-8(wks)	4.15^{d}	4.35^{c}	4.76^{b}	5.12^{a}	0.04
4-12(wks)	3.84^{d}	4.03^{c}	4.34^{b}	4.63^{a}	0.03

Values within the same row having different superscripts are significantly different at p≤0.05

Carcass yield: Data in Table (6)show that there were no significant (p>0.05) effect of cage density on carcass weight of rabbits under the investigated four stocking densities, except liver weight, was higher weight in group having 2 rabbits/cage 0.083g than other groups having 3, 4 and 1 rabbits/cage 0.048, 0.052, 0.062 g, respectively. Similarly, kidney weight was higher in group having 2 rabbits/ cage 0.020g than other groups having 3, 4 and 1 rabbits/ cage 0.011, 0.017, 0.015 g, respectively. In agreement with these findings (Trocino *et al*., 2004) showed that dressing percentage was not influenced by stocking density. (Trocino *et al*., 2008) found that stocking density did not modify carcass traits. Also, (Villalobos *et al*., 2008) found that cage density had minor influence on carcass compared to growth traits, and this is in agreement with previous works (Aubret and Duperray, 1992; Combes and lebas, 2003). In contrast, (Xiccato *et al*., 1999) observed a small increase on carcass yield with the increase of animal density.

Table 6: Effect of cage density on carcass yield of growing rabbits at the end of the experiment.

Carcass yield (g)					
Cage density (rabbits/ cage)					
Age (intervals) (wks)	**1**	**2**	**3**	**4**	**±SEM**
Live body wt(g)	2158	2040	1752	1760	0.11
Fur wt(g)	310	340	290	270	0.18
Empty carcass wt(g)	1110	1128	958	922	0.06
Fore leg wt(g)	17	20	18	20	0.11
Hind leg wt(g)	47	48	45	47	0.04
Liver wt(g)	62^{b}	83^{a}	48^{b}	52^{b}	0.06
Lung wt(g)	12	17	12	10	0.18
Kidney wt(g)	15^{ab}	20^{a}	11^{b}	17^{ab}	0.07

Values within the same row having different superscripts are significantly different at p≤0.05

Hematological parameters: Data in Table (7) show that RBCs for all groups are in the normal range of rabbits, being significantly (p<0.05) the heights in group having 2 rabbits/cage 5.65 $X10^{6}/mm^{2}$ among groups having 1, 3 and 4 rabbits /cage 5.01, 4.70, 5.30 $X10^6/mm^2$, respectively, while PLT being significantly the lowest in group having 2 rabbits/cage 54.66 $X10^3/mm^2$ compared with rabbits stocked at 1, 3 and 4 rabbits/cage 513.00, 105.33 and 354.33 $X10^3/mm^2$, respectively. Interestingly to note that group having 4 rabbits /cage showed significantly ($p<0.05$) the highest WBCs 16.43 $X10^3/mm^3$ as compared to other groups, being higher than the normal range of WBCs in rabbits.

Table 7: Effect of cage density on hematological parameters of growing rabbits at the end of the experiment .

Hematological parameters					
Cage density (rabbits/ cage)					
Parameters	**1**	**2**	**3**	**4**	**±SEM**
RBCs($X10^6/mm^2$)	5.01^c	5.65^a	4.70^d	5.30^b	0.07
WBCs($X10^3/ mm^3$)	7.83^b	6.10^c	7.60^b	16.43^a	0.07
PLT($X10^3/ mm^2$)	315.00^b	54.66^d	105.33^c	354.33^a	3.45

Values within the same row having different superscripts are significantly different at $p \leq 0.05$

Although, Yakubu *et al*., (2008) found no significant differences in WBCs count of rabbits kept under four stocking densities, the high WBCs count noticed in this study by increasing density more than 3 rabbits /cage could be indicative of stress which elicits a defense response. The present study showed marked improvement in RBCs for group having 2 rabbits /cage. Similarly, Yakubu *et al*. (2008) found higher average RBCs for rabbits stocked at 10 and 14.3 compared to their counterparts raised at 20 and 25 rabbits $/m^2$.

Biochemical parameters: Data in Table 8 show that concentration of total protein and globulin were the highest in group having 1 rabbit/ cage, and the lowest values were recorded in group having 4 rabbits /cage. However, albumin concentration was not significantly affected by cage density. These results indicated normal protein metabolism and liver function of rabbits in all groups. There was no significant differences in creatinine concentration in groups 1, 2 and 3 rabbits/ cage, but lowest concentration in rabbits were housed in 4 rabbits/ cage.

The observed decrease in cholesterol level by increasing cage density may suggest a general decreased in lipid mobilization in the other groups (Table8). In contrast to the present results, Perez *et al*., (1997) found that there were no significant differences in total cholesterol values of isolated and grouped rats. Also, Onbasilar and Onbasilar (2007) observed that serum cholesterol level was similar among groups having 1, 3 and 5 rabbits/cage.

The triglycerides level decreased by increasing cage density than 3 rabbits/ cage (Table8). On the other hand, Onbasilar and Onbasilar (2007) observed that serum triglyceride levels were similar for groups having 1, 3 and 5 rabbits/cage. The present results indicated that levels of total lipids, HDL and LDL were not significantly affected by cage density. While, the serum glucose level was higher in group having 1 rabbit/cage than other groups. The activity values of AST and ALP were significantly higher in groups having 3 and 4 rabbits/cage than in groups having 1 and 2 rabbits/cage. However, activity of ALT was not significantly affected by cage density.

Table 8: Effect of cage density on concentration of some blood constituents and enzyme activity of growing rabbits at the end of the experiment.

Concentration of some biochemical values in blood plasma					
	Cage density (rabbits/ cage)				
Parameters					
Protein metabolism	**1**	**2**	**3**	**4**	**±SEM**
Total protein (mg/L)	6.69[a]	6.47[a]	6.26[ab]	5.76[c]	0.12
Albumin(AL) (mg/L)	3.57	3.52	3.59	3.42	0.07
Globulin(GL) (mg/L)	3.12[a]	2.95[a]	2.67[ab]	2.34[b]	0.14
AL:GL ratio	1.14[b]	1.21[ab]	1.34[ab]	1.46[a]	0.08
Creatinine (mmol/L)	36.37[a]	36.81[a]	31.66[a]	23.26[b]	1.55
Lipid metabolism					
Total cholesterol (mg/dL)	46.50[a]	43.96[ab]	40.54[b]	40.34[b]	1.48
Triglycerides (mg/dL)	328.95[a]	243.72[b]	227.84[bc]	208.25[c]	9.62
Total lipids (mg/dL)	20.15	16.72	18.45	19.59	1.24
HDL (mg/dL)	25.59	27.63	25.15	25.53	2.44
LDL (mg/dL)	20.91	16.33	15.39	14.81	2.54
Carbohydrate metabolism					
Glucose (mg/dL)	173.71[a]	138.49[b]	118.01[b]	117.85[b]	7.61
Enzyme activity					
AST(Iu/L)	32.66[b]	31.00[b]	48.33[a]	46.66[a]	4.16
ALT (Iu/L)	37.00	41.00	42.00	40.33	1.98
ALP (Iu/L)	103.71[b]	123.89[b]	160.70[a]	180.53[a]	11.08

Values within the same row having different superscripts are significantly different at p≤0.05

CONCLUSION

Based on the obtained results, increasing cage density up to 4 rabbits per cage with floor area of 3000cm^2, corresponding to a stocking density of 13.33 rabbits/m^2 (i.e 26.67 kg/m^2 at 12 weeks of age) could induce stress effect, in term of increasing levels of enzyme activity (AST, ALT and ALP) and decreasing level of carbohydrate metabolism (Glucose) and protein metabolism (total protein, albumin, globuline and creatinine levels) as well as some disturbances in performance of rabbits.

REFERENCES

Allain, C.C., L.S. Poon, C.S. Chan, W.S. Richmond and P.C. Fu, 1974. Enzymatic determination of total serum cholesterol. Clin. Chem., 20: 470-475.

Andréa, M. V.; de Carvalho, G. J. L.; Nunes, S. C.; Costa, C. N. and Barbosa, R. P., 2004. Desidade populacional no desempenho produtivode coleos. Arch. Zootec., 53, 391-394.

Aubret J. M., Duperray J. 1992. Effect of cage density on the performance and health of the growing rabbit. Journal of Applied Rabbit Research, 15: 656-660.

Bauch, K. and W. Seitz, 1985. Determination of creatinine in the urine as a reference value of substances excreted by the kidney. Z Gesamte Inn. Med., 40: 201-205.

Blasco A., Ouhayoun J., Masoero G. 1993. Harmonization of criteria and terminology in rabbit meat research. World Rabbit Sci., 1, 3-10.

Combes S., Lebas F. 2003. Les modes de logement du lapin en engraissement: influence sur les qualities des carcasses et de viands. In: Proc. 10émes J. Recherche Cunicole, 2003 November, Paris, France, 185-200.

Doumas, B.T., W.A. Watson and H.G. Biggs, 1971. Albumin standards and measurement of serum albumin with bromocresol green. Clin. Chim. Acta., 31: 87-96.

Duncan, D.B., 1955. Multiple range and multiple F tests. Biometrics, 11: 1-42.

Ebru Onbasılar, E. and İlyas Onbasılar, 2007. Effect of cage density and sex on growth, food utilization and some stress parameters of young rabbits. Scand . J. Lab. Anim. Sci. Vol. 34 No. 3.

Fossati, P. and L. Prencipe, 1982. Serum triglycerides determined colorimetrically with an enzyme that produces hydrogen peroxide. Clin. Chem., 28: 2077-2080.

Frings, C.S. and R.T. Dunn, 1970. A colorimetric method for determination of total serum lipids based on the sulfophospho-vanillin reaction. Am. J. Clin. Pathol., 53: 89-91.

Gornall, A.G., C.J. Bardawill and M.M. David, 1949. Determination of serum protein by means of the biuret reagent. J. Biol. Chem., 177: 751-766.

Grace, T.I.E. and S.A.S. Olorunju, 2005. Effect of stocking density on performance of growing rabbits in semi-humid tropics. Tropicultura, 23: 19-23.

Home Office, Animal Welfare, Rabbit Welfare Code, 1987. (http://www.science.homeoffice.gov.uk.)

Jordan, D., F. Luzi, M. Verga and I. Stuhec, 2006. Environmental Enrichment in Growing Rabbits. In: Recent Advances in Rabbit Sciences, Maertens, L. and P. Coudert (Eds.). ILVO, UK., ISBN: 9789289800303, pp: 113-119.

Kind, P.R. and E.J. King, 1954. Estimation of plasma phosphatase by determination of hydrolysed phenol with amino-antipyrine. J. Clin. Pathol., 7: 322-326.

Mbanya, J.N., B.N. Ndoping, R.T. Fomunyam, A. Noumbissi, E.S. Mbomi, E.N. Fai and A. Teguia, 2004. The effect of stocking density and feeder types on the performance of growing rabbits under conditions prevailing in Cameroon. World Rabbit Sci., 12: 259-268.

Morisse, J.P. and R. Maurice, 1994. Welfare and the intensive production of rabbits. Rev. Sci. Technol., 13: 131-152.

Morisse, J.P. and R. Maurice, 1997. Influence of stocking density or group size on the behaviour in fattening rabbits kept in intensive conditions. Applied Anim. Behav. Sci., 54: 351-357.

Myers, G.L., G.R. Cooper, L.O. Henderson, D.J. Hassemer and M. Kimberly, 1994. Standardization of Lipid and Lipoprotein Measurements. In: Laboratory Measurement of Lipids, Lipoproteins and Apolipoproteins, Rifai, N.and G.R. Warnick (Eds.). AACC Press, Washington, DC., USA., pp: 177-205.

Neto, A.C., J.F. Lui, L.R.B. Dourado, J.A.F. Zanato, E.P. Filho, N.C. Garrafoni and L.P.G. da Silva, 2007. Effect of stocking density on the performance of growing rabbits. Biotemas, 20: 75-79.

Nieves, D.; Farinas, S.; Munoz, A.; Torrealba, E. and Rodriguez, N., 1996. Use of Arachis pintoi and ennisetum purpureum in the feeding of fattening rabbits. Revista Unellez de Cencia y Tecnologia, Produccion Agricola 14:82-91.

Oliveira, M.C. and C.V. Almeida, 2002. Performance of growing rabbits reared under different stocking ensities. Arquivo Brasileiro Med. Vet. Zootech., 54: 530-533.

Onbasilar, E.E. and I. Onbasilar, 2007. Effect of cage density and sex on growth, food utilization and ome stress parameters of young rabbits. Scand. J. Lab. Anim. Sci., 34: 189-195.

Paci, G., C. Mozzoni, G. Preziuso, M. D'Agata and C. Russo, 2008. Outdoor Rearing System for Fattening Rabbits: Effect of Group Size. Proceedings 9th World Rabbit Congress, June 10-13, 2008, Verona, Italy, 1603-1607.

Perez, C., J.R. Canal, E. Dominguez, J.E. Campillo, M. Guillen and M.D. Torres, 1997. Individual housing influences certain biochemical parameters in the rat. Lab Anim., 31: 357-361.

Reitman, S. and S. Frankel, 1957. A colorimetric method for the determination of serum glutamic oxalacetic and glutamic pyruvic transaminases. Am. J. Clin. Pathol., 28: 56-63.

SAS, 2004. SAS/STAT User's Guide: Version 9.1.3. SAS Institute Inc., Cary, NC., USA.

Szendro, Z. and F. Luzi, 2006. Group Size and Stocking Density. In: Recent Advances in Rabbit Sciences, Maertens, L. and P. Coudert (Eds.). ILVO, UK., ISBN: 9789289800303, pp: 121-126.

Trinder, P., 1969. Determination of glucose in blood using glucose oxidase with an alternative oxygen acceptor. Ann. Clin. Biochem., 6: 24-27.

Trocino, A., G. Xiccato, P.I. Queaque and A. Sartori, 2004. Group housing of growing rabbits: effect of space allowance and cage floor on performance, welfare and meat quality. Proceedings of the 8th World Rabbit Congress, Septembre 7-10, 2004, Puebla, Mexico, pp: 1277-1282.

Trocino, A., Xiccato, G., Majolini, D. and Fragkiadakis, M. 2008. Effect of cage floor and stocking density on growth performance and welfare of group-housed rabbits. 9th World Rabbit Congress – June 10-13, 2008 – Verona – Italy.

Verga, M., F. Luzi and Z. Szendro, 2006. Behaviour of Growing Rabbits. In: Maertens, L., Couddert, p. (EDS.), Recent Advances in Rabbit Sciences. ILVO, pp. 91-97.

Villalobos, O., O. Guillen and J. Garcia, 2008. Effect of cage density on performance of fattening rabbits under heat stress. Proceedings of the 9th World Rabbit Congress, June 10-13, 2008, Verona, Italy, pp: 1631-1639.

Whary, M., R. Peper, G. Borkowski, W. Lawrence and F. Ferguson, 1993. The effects of group housing on the research use of the laboratory rabbit. Lab. Anim., 27: 330-341.

Xiccato, G., M. Verga, A. Trocino, V. Ferrante, P.I. Queaque and A. Sartori, 1999. Influence of the number and density per cage on productive performance, carcass quality and behavior in rabbits. Proceedings of the 8th Days of Search Cunicole, June 9-10, 1999, Paris, France, pp: 59-62.

Yakubu, A., M.M. Adua and H. Adamude, 2008. Welfare and haematological indices of weaner rabbits as affected by stocking density. Proceedings of the 9th World Rabbit Congress, June 10-13, 2008, Verona, Italy, pp: 1269- 1273.

تأثير كثافة الاسكان على بعض صفات الدم والاداء فى الارانب النامية

السمره حسن ابوعجله، زياد محمد قلبه و لمياء يوسف يوسف البناوى
قسم انتاج الدواجن - كلية الزراعة - جامعة المنصورة - مصر

بهدف دراسة تاثير كثافة الاسكان على بعض مكونات الدم والاداء فى الارانب النامية حيث استخدم ٩٠ ارنب نيوزيلاند ابيض عند عمر الفطام ٣٠ يوم وزعت عشوائى فى اقفاص مساحتها (٥٠×٦٠×٣٠سم) الى ٤ مجموعات بكثافات مختلفة ١،٢،٣،٤ ارانب/ قفص. حيث لوحظ افضل معدلات لوزن الجسم والزياده الوزنيه ومعدل التحويل الغذائى فى المجموعات التى تحتوى على ٣،١،٢ ارنب / قفص بالمقارنة بالمجموعات التى تحتوى على ٤ ارانب / قفص بينما لم يلاحظ اى تاثير على مواصفات الزبيحة فيما عدا وزن الكبد والكلى كانت اعلى فى المجموعات التى تحتوى على ١ ارنب/ قفص وكذلك لوحظ ان اعلى معدل لكرات الدم الحمراء واقل معدل للصفائح الدمويه فى المجموعة التى تحتوى على ٢ ارنب / قفص ، بينما لوحظ ان اعلى معدل لكرات الدم البيضاء فى المجموعة التى تحتوى على ٤ ارانب/ قفص و كان محتوى البلازما من البروتين والجلوبيولين والكرياتنين اعلى فى المجموعة التى تحتوى على ١، ٢ ارنب /ققفص بينما محتوى البلازما من اسبرتيت امينوترانسفيريز ونشاط انزيمات الفوسفاتيزالقاعدى اعلى فى المجموعة التى تحتوى على ٣،٤ ارانب /قفص فى كان محتوى البلازما من الالبيومين واللانين امينوترانسفيريز والكولستيرول ذو الكثافة المنخفضة والمرتفعة لم يتاثر. اوضحت نتائج هذه الدراسة ان معدل كثافة اسكان الارانب بالاقفاص بمعدل ٤ ارانب/ قفص (١٣.٣٣ ارنب/م^{٢} ٢٦.٦٧ كجم/م^{٢}) يمكن ان يكون الحد المقبول من حيث كفاءة الاداء الانتاجى.

قام بتحكيم البحث

أ.د / فوزى صديق عبد الفتاح اسمعيل	**كلية الزراعة – جامعة المنصورة**
أ.د /تاج الدين حسن تا ج الدين	**كلية الزراعة – جامعة دمياط**