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Effects of Group Size on Fattening Performance, Mortality Rate, Slaughter and Carcass Characteristics in Japanese Quails (*Coturnix coturnix japonica*)

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Abstract: This study was conducted to determine the effects of different group sizes upon fattening performance, mortality rate and slaughter and carcass characteristics in Japanese quails (*Coturnix coturnix japonica*). A total of 150 quails were used in the study. The quails were kept in cages with a stocking density of 125 cm^2 $quail^{-1}$ and in group sizes of 3 and 10 and were fed *ad libitum*. The effect of group size on live weight gain and cumulative live weight gain was found to be statistically significant in general, while its effect on live weight was insignificant. It was determined that mortality rate increased with increasing group size; however, the difference was not significant ($p>0.05$). The effect of group size was found to be statistically significant for feed intake between the 29-35 days ($p<0.05$) and between the 36-42 days ($p<0.01$), for cumulative feed intake only between 14-42 days ($p<0.01$) and for feed conversion rate between the 29-35 days, the 36-42 days and 14-42 days ($p<0.05$). The effect of group size was found insignificant on slaughter and carcass characteristics (except for the liver weight ($p<0.05$)). Consequently, it was concluded that quail breeding in cages with a stocking density of 125 cm^2 $quail^{-1}$ might yield better results with a group size of 10, when compared to a group size of 3, in terms of live weight and in particular, feed intake and feed conversion rate.

Key words: Group size, fattening performance, mortality rate, slaughter and carcass, Japanese quail

INTRODUCTION

Quail breeding is increasingly becoming more widespread since it is possible to achieve yields in much more limited spaces, without substantial investments and within shorter periods of time when compared to other types of poultry breeding and since quails are much more resistant to environmental factors (Nagarajan *et al*., 1991). In order to attain success in quail breeding, as in all other livestock breeding, environmental conditions should be maintained at an optimum level. Cage system is used in quail breeding not only because it helps increase production per unit area but also because the reductions in carcass quality due to cage breeding of broilers are much less commonly observed in quails since, their live body weight is lower. Stocking density and group size are significant environmental factors that affect the amount and quality of production in cage breeding of quails.

Studies that investigate the effects of group size on slaughter and carcass characteristics in cage breeding of quails are rather limited in number. A group of researchers reported for egg-laying quails when they were kept at stocking densities of 150, 175 and 200 cm^2 $quail^{-1}$ and in group sizes of 6 and 9 quails, the lower the group size, the higher the egg-production and feed conversion efficiency (Waheda *et al*., 1999).

In studies concerning quails bred at similar stocking densities (125 cm^2 $quail^{-1}$) and various group sizes, different LW and FI, CFI and FCR values have been reported (Das *et al*., 1990; Ahuja *et al*., 1992; Erensayin, 2001; Kul *et al*., 2006; Seker *et al*., 2007).

In some studies, on cage-bred hens and quails, it was reported that the effect of stocking densities and group sizes on LW and LWG is significant; the smallest group (of 4) reached to the highest level of LW at the end of the 6 week (Erensayin, 2001), the group size did not significantly affect mortality rate (Ahuja *et al*., 1992; Sengul and Tas, 1997; Erensayin, 2001; Ipek *et al*., 2002), feed intake decreased (Ipek *et al*., 2002) or increased (Erensayin, 2001) and the feed conversion rate decreased (Erensayin, 2001; Ipek *et al*., 2002) with increasing group size.

The present study, was conducted to determine the effects of different group sizes in Japanese quails on live weight, live weight gains, feed intake, feed conversion rate, mortality rate and slaughter and carcass characteristics.

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Table 1: The experimental design and animal materials used in the study

Groups	No. cage	No. quails per cage	Cage numbers x numbers of quails	Total numbers of quails per replicate	Total numbers of quails for 3 replicates
1	5	3 (1 female, 2 males)	5×3 = 15	30	90
	5	3 (2 females, 1 male)	5×3 = 15		
2	2	10 (5 females, 5 males)	2×10 = 20	20	60
Total				50	150

MATERIALS AND METHODS

This study was conducted in the Quail Breeding Unit of the Department of Zootechny at the Faculty of Veterinary Medicine at Firat University.

The quail chicks to be used in the present study hatched out from the incubator and were placed to the mother machine. The temperature of the room where the quail chicks were maintained at 32-36°C on the first 3-4 days, which was then gradually reduced to room temperature at the end of the 10th day after hatching. No warming practice was employed after the 14 day. In addition to natural daylight, the quail chicks were exposed to 24 h light through artificial lighting. In the meantime, it was ensured that the quail chicks continuously drank potable water. On the 14 day, all quail chicks were weighted and differentiated in terms of sex by examining their feathering characteristics and cloacae. The quails were fed *ad libitum* on quail fattening feed containing 24% CP and 2900 kcal kg^{-1} ME for 14-42 days in cage. The given and remaining fattening feed were weighted and recorded on a daily basis.

In order to investigate, the effect of group size on fattening performance, mortality rate and on slaughter and carcass properties of quails (*Coturnix coturnix japonica*), 2 groups were formed provided that the same stocking density (125 cm^2 $quail^{-1}$) was established. In the first group, 3 quails were stocked per cage. A total of 10 cages (30 quails) were used. In the second group, 10 quails $cage^{-1}$ were stocked. A total of 2 cages (20 quails) were used. The experiment consisted of 3 independent trials. Total numbers of quails used for the study was 150 (90 for the 1st group and 60 for the 2nd group). The details of the study plan are provided in Table 1. While, forming the groups, sex was primarily taken into consideration, ensuring that each group within itself contained an equal number of male and female quails in total and that they were kept mixed in terms of sex. Furthermore, it was sought to organize well-balanced groups in terms of average live weights and prevent any considerable difference between the initial average live weights of the groups.

The records kept during the study included weekly Live Weights (LW), weekly Live body Weight Gains (LWG), Cumulative Live Weight Gains (CLWG), weekly Feed Intakes (FI), Cumulative Feed Intakes (CFI) were calculated in g and the weekly Feed Conversion Rate (FCR) in g feed g^{-1} live weight. In addition to these data, quail deaths and Mortality Rates (MR) in the groups were recorded on a weekly basis.

By the end of the 42 day of the study, in order to determine the slaughter and carcass characteristics of the quails in the groups, 20 quails from each group with equal numbers in terms of sex (5 male and 5 female), reflecting the average live weights were selected and a total of 60 quails were slaughtered for 3 repetitions. Then, the slaughter weights, hot carcass weights, hot carcass yields as well as heart, liver and giblet weights of the slaughtered quails were recorded.

Employing the data obtained from the study, in order to demonstrate the effect of different group sizes upon fattening performance, slaughter and carcass characteristics, significance test (student's t test) was used for the difference between two independent means. In the analysis of the data pertaining mortality rates, Chi-square (χ^2) test was used (Snedecor and Cochran, 1980). The analyses were conducted using SAS (1999) software.

RESULTS AND DISCUSSION

Average LW, LWG and CLWG values of Japanese quails kept at different group sizes are presented in Table 2.

In terms of group size, the highest live weight was observed in the 1st group (183.93±2.35 g) by the end of the 42 day; however, the differences between the groups were not significant ($p>0.05$). In the study, in which they investigated the effects on feed and carcass characteristics of keeping Japanese quails in cages (19×20×22 cm) as separate and mixed in terms of sex, Kul *et al.* (2006) placed 4 quails in each cage. In the mixed-sex group at the end of the 6th week, average LW was determined to be 178.71±3.13 g, while between the

Table 2: Mean values of weekly Live Weight (LW) (g), weekly Live Weight Gain (LWG) (g) and Cumulative Live Weight Gain (CLWG) (g) of quails raised in different group sizes and Mortality Rates (MR) (%)

	14 days		21 days		28 days		35 days		42 days		14-42 days	
Groups	n	$\bar{X} \pm S_{\bar{x}}$	n	$\bar{X} \pm S_{\bar{x}}$	n	$\bar{X} \pm S_{\bar{x}}$	n	$\bar{X} \pm S_{\bar{x}}$	n	$\bar{X} \pm S_{\bar{x}}$	Mortality number	MR (%)
Group 1(3)												
LW		61.62±1.02		102.39±1.36		136.60±1.41		160.10±1.36		183.93±2.35		
LWG	90		87	40.77±0.610	84	34.21±0.510	84	23.50±0.620	84	23.83±1.560	6	6.67
CLWG						74.98±0.730		98.48±0.780		122.31±1.82		
Group 2(10)												
LW		60.59±0.84		102.81±1.10		139.82±1.10		163.41±1.20		181.03±1.79		
LWG	60		57	42.22±0.360	55	37.01±0.300	55	23.59±0.550	55	17.62±1.120	5	8.33
CLWG						79.23±0.45 0		102.82±0.77		120.44±1.25		
P_1 (LW)		-		-		-		-		-		
P_2 (LWG)				*		**		-		**		
P_3 (CLWG)						**		**		-		
P_4 (MR)											-	

-: Not significant ($p>0.05$), *$p<0.05$, **$p<0.01$

14-42 days, average LWG per quail was 119.28±2.88 g. The lowest LWG was detected between the 36-42 days and the highest LWG was between the 22-28 days. A comparison of the findings of the above-mentioned study and the findings of the present study revealed very similar results. On the other hand, Erensayin (2001) investigated the effect of group size (4, 8, 12 and 16 quails) in quails kept at a stocking density of 150 cm^2 $quail^{-1}$ and determined significant ($p<0.05$) differences between groups in terms of LW from the first week onwards. The smallest group (of 4) of the study reached the highest LW by the end of the 6th week and average LWs in the groups were found to be 216.50±0.67, 212.41±0.71, 200.83±0.89 and 191.85±1.81 g, respectively. The LW values obtained in the present study by the end of the 6th week were observed to be quite lower than those of Erensayin (2001). Nevertheless, average LW values obtained in this study were found to be higher than the average live weight values -100.46 and 98.97 g, respectively-reported by Ahuja *et al*. (1992) by the end of the 6 week of their study, for which they kept Japanese quails at stocking densities of 100 and 125 cm^2 $quail^{-1}$. In their study, in which they investigated the effects of slaughter age in Japanese quails on the feed, slaughter and carcass characteristics, Seker *et al*. (2007) kept male quails in cages (19×20×22 cm) in groups of 4 and determined the average LW by the 42 day as 173.56±1.59 g. The authors believe that the higher average LW values obtained in this study when compared to those of Seker *et al*. (2007) could be attributed to the fact that the researchers used exclusively male quails in their study.

In the study, the effect of group size on live weight gain (except for the 28-35 days) was statistically significant ($p<0.05$, $p<0.01$), while, its effect on cumulative live weight gain was significant for the 14-28 and 14-35 days ($p<0.01$) and insignificant for the 14-42 days. The highest LWG occurred in both groups in the third week of the study. Similar, results have been reported in other studies as well (Ayasan *et al*., 2000; Okan and Uluocak, 1992). It is believed that lower LWG values for the 1st group than the 2nd until the end of the last week could be attributed to the fact that due to the small group size in this group, some part of the consumed feed was used for this purpose instead of LW since, they had more opportunity for free movement. It was concluded that the case might have changed on the last week due to decreased opportunity for free movement for the quails in the 1st group since, the growth of their bodies and to the stress caused by crowdedness in the 2nd group.

Seker *et al*. (2007) reported that decreases in LWG in Japanese quails are observed beginning from the 28 day onwards and become more noticeable from the 35 day. Likewise, in the present study, LWG begin to decline from the 28 day onwards, which became sharper after the 35 day. It could be suggested that the decreases in question might have occurred as a result of the performance of male quails. Because 35 days of age is the period when sexual activity starts at male quails and thus, the hormonal changes might have adversely affected this process.

During the study, mortality cases occurred only between the 14-28 days. The number of deaths in the groups (the 1st and 2nd group) was 3 and 3 between the 14-21 days and 3 and 2 between the 22-28 days, respectively. It was determined that mortality rate was higher in the larger group; yet, this difference was not significant ($p>0.05$). Ahuja *et al*. (1992) determined the mortality rates for Japanese quails at the end of the 6th week as 11.4 and 6.3%. An examination of the findings of the present study in terms of mortality rates reveals that deaths similar to the findings of Sengul and Tas (1997) occurred only in the first 2 weeks; the differences among groups were insignificant and mortality rate increased with increasing group size. On the other hand, in their

Table 3: Mean values of weekly Feed Intake (FI) (g), Cumulative Feed Intake (CFI) (g) and Feed Conversion Rates (FCR) (g feed live^{-1} weight quail^{-1}) of quails raised in different group sizes

	14-21 days		22-28 days		29-35 days		36-42 days		14-42 days	
Groups	n	$\bar{X} \pm S_{\bar{x}}$	n	$\bar{X} \pm S_{\bar{x}}$	n	$\bar{X} \pm S_{\bar{x}}$	n	$\bar{X} \pm S_{\bar{x}}$	n	$\bar{X} \pm S_{\bar{x}}$
Group 1(3)										
FI		102.42±2.96		134.17±5.98		158.59±5.14		167.53±5.80		
CFI	90		87	236.59±8.18	84	395.18±12.68	84	562.71±17.80	84	
FCR		2.52±0.07		3.92±0.23		6.75±0.22		7.03±0.42		4.60±0.15
Group 2(10)										
FI		102.98±8.92		127.38±1.57		124.28±12.17		105.57±3.29		
CFI	60		57	230.36±7.50	55	354.64±19.47	55	460.21±21.10	55	
FCR		2.43±0.17		3.44±0.02		5.27±0.76		5.99±1.07		3.82±0.39
P_1 (FI)		-		-		*		**		
P_2 (CFI)				-		-		**		
P_3 (FCR)		-		-		*		*		*

-: Not significant ($p>0.05$), *$p<0.05$, **$p<0.01$

study on egg-laying hens in cages with group sizes of 3-5 hens Ipek *et al.* (2002) reported that differences in mortality rates among groups were not significant. Erensayin (2001) determined the mortality rates for 4-6 weeks in groups of quails (4, 8, 12 and 16 quails) to be 2.08, 0.00, 1.04 and 1.56%, respectively ($p>0.05$). A comparison between Erensayin's (2001) findings and the findings of the present study reveals that mortality rates are high, but they are similar in that they were found to be statistically insignificant. An examination of the mortality rates in this study reveals that overcrowding and space per quail might cause stress in quails; however, this factor does not lead to a statistically significant difference with group sizes of 10.

Average FI, CFI and FCR values of the quails in this study in terms of different group sizes are given in Table 3.

Between the 29-35th and 36-42nd days of the study, differences between the groups in terms of FI were statistically significant ($p<0.05$, $p<0.01$). During the study period, the highest levels of feed intake were detected in the 2nd group between the 22-28 days and in the 1st group between the 36-42 days. In terms of feed intake, the 2nd group was determined as possessing the best performance (with the least feed intake), a fact similarly demonstrated by Erensayin (2001), who reported that, among quails, the smallest group (of 4) had the highest feed intake and average weekly feed intake values for a period of 4-6 weeks were observed as 460.74±1.27, 440.92±2.07, 397.13±4.16 and 370.26±1.00 g feed quail^{-1} ($p<0.05$). Furthermore, another study indicates that the body temperatures of hens kept in cages in groups of three is higher than those of four, which is possibly related to the fact that hens under lower stocking density have higher feed intakes (Cheng *et al.*, 1990). In the present study as well, the highest observed feed intake was observed in quails with smaller group sizes. In addition, a higher FI value observed in the 1st group from the 21st day onwards could be attributed to the fact that, because the body sizes of quails are smaller in the initial weeks, stocking density and group size do not constitute a significant problem, but in time, become much more evident due to the crowding problems arising from the growth of their bodies.

As for the cumulative feed intake, when the period between the 14-42 days is considered, the highest level of feed intake was observed in the 1st group ($p<0.01$).

For the feed conversion rate, the effect of group size was statistically significant between the 29-35, 36-42 and 14-42 days ($p<0.05$); however, insignificant between the 14-21 and 22-28 days ($p>0.05$). The lowest FCR was detected in the group of 10 birds in all weeks during the course of the study. For each week, the lowest FCR was detected between the 14-21 days in the group of 3 as 2.52±0.07 and in the group of 10 as 2.43±0.17 g feed g^{-1} live weight. In the period between the 14-42 days during the study, FCR was 4.60±0.15 and 3.82±0.39 g feed g^{-1} live weight in groups of 3 and 10, respectively.

The effect of group size upon feed conversion rate (except for the 14-21 and 22-28 days) was found to be statistically significant ($p<0.05$). It was ascertained that the group with the larger size had the best feed conversion rate. It was further determined that the FCR values for the 14-42 days are compatible with the cumulative feed conversion rate values reported by Ahuja *et al.* (1992) at the 6th week for the Japanese quails bred under stocking densities of 100 and 125 cm^2 quail^{-1}, which were 4.7 and 4.8, respectively. Likewise, it was identified that the FCR values obtained for the 2nd group of the present study are similar to the feed conversion rate of 3.89, which was reported by Das *et al.* (1990) for the quails kept under 125 cm^2 quail^{-1}. Similarly, Erensayin (2001) determined feed conversion rates (g feed g^{-1} live weight) for groups of 4, 8, 12 and 16 as 3.59±0.01, 3.54±0.01, 3.56±0.01 and 3.59±0.01 ($p<0.05$), respectively.

In the study by Kul *et al.* (2006), the average FI and FCR values per quail by the end of 6th week for mixed-sex group of Japanese quails were calculated as 562.26±13.59

Table 4: Mean values for slaughter and carcass characteristics of quails bred in different groups sizes

		Slaughter and carcass characteristics					
Groups	n	Slaughter weight (g) $\bar{X} \pm S_{\bar{x}}$	Hot carcass weight (g) $\bar{X} \pm S_{\bar{x}}$	Hot carcass yield (%) $\bar{X} \pm S_{\bar{x}}$	Heart weight (g) $\bar{X} \pm S_{\bar{x}}$	Liver weight (g) $\bar{X} \pm S_{\bar{x}}$	Giblet weight (g) $\bar{X} \pm S_{\bar{x}}$
Group 1(3)	30	181.40±2.27	128.04±1.15	70.58±0.46	1.85±0.05	4.20±0.14	4.10±0.21
Group 2(10)	30	180.67±2.02	127.68±1.27	70.67±0.58	1.83±0.03	3.55±0.06	3.87±0.11
Total	60	181.04 1.51	127.86 0.85	70.63 0.37	1.84 0.03	3.88 0.09	3.98 0.12
P		-	-	-	-	*	-

-: Not significant (p>0.05), *p<0.05

and 4.51±0.17 g feed g^{-1} live weight, respectively. The lowest FI and FCR values were observed between the 14-21 and 22-28. days, respectively, whereas the highest values for both between the 29 and 35 days. Similarly, in the present study, the cumulative feed intake for the groups of 3 between the 14 and 42 days were obtained as 562.71±17.80 g and the FCR as 4.60±0.15 g feed g^{-1} live weight.

Average values of slaughter and carcass characteristics of quails bred in different group sizes in this study are presented in Table 4.

The effect of group size in terms of slaughter and carcass characteristics was only determined to be statistically significant on liver weight ($p<0.05$). Average slaughter weights in groups (1 and 2) were determined to be 181.40±2.27 and 180.67±2.02 g, respectively. Hot carcass weight was higher in the 1st group (128.04±1.15 g), while hot carcass yield was determined to be higher in the 2nd group (70.67%).

In the present study, it was determined that the differences between groups in terms of carcass weight and carcass yields were statistically insignificant and similar results have been reported by other researchers as well (Sengul and Tas, 1997; Sengul *et al*., 2000). Seker *et al.* (2007) calculated, in the slaughtered quails at the end of the 49th day, hot carcass yield as 70.44% and average heart, giblet and liver weights as 1.85, 4.67 and 4.75 g, respectively.

Kul *et al.* (2006), on the other hand, found for the Japanese quails, which they slaughtered on the 42nd day the average slaughter weight; hot carcass weight and yield; heart, giblet and liver weights as 179.63±2.89 g, 119.68±1.7 g, 67.23%, 1.84 g, 4.27 g and 4.93 g, respectively. A comparison of the findings of the present study and those of other researchers reveals that there are differences between hot carcass weight and hot carcass yield and the other characteristics are in accordance with each other. It is believed that the discrepancy in the results of present study and those of cited study is mainly due to differences in breeding period and sex of the birds.

CONCLUSION

It was determined that; the effect of different group sizes on live weight is insignificant during the study period, the highest live weight gain was observed in the 3rd week in both groups, though there are no significant differences between groups in terms of mortality rates, mortality rate increased with increasing group size, the effect of group size on feed intake and feed conversion rates was particularly important from the 28th day onwards, feed intake decreased and feed conversion efficiency increased with increasing group size, there are no significant differences-except for liver weight-between groups in terms of slaughter and carcass characteristics. Thus, it was concluded that quail breeding in cages with a stocking density of 125 cm^2 $quail^{-1}$ might be more appropriate in group sizes of 10, when compared to those of 3, in terms of live body weight and in particular, feed intake and feed conversion rates.

REFERENCES

Ahuja, S.D., U.K. Bandyopadhyay, A. Kundu and R. Gopal, 1992. Influence of stocking density and system of housing growth characters in Japanese quail. Indian J. Poult. Sci., 27 (4): 193-197.

Ayasan, T., M. Baylan, A.N. Uluocak and O. Karasu, 2000. Effects of sex and different stocking densities on the fattening characteristics of Japanese quails. J. Poult. Res., 2 (1): 47-50. http://www.tae.gov.tr/uploadimg/dergiler/cilt2sayi1.pdf.

Cheng, T.K., C.N. Coon and M.L. Hamre, 1990. Effects of environmental stress on the ascorbic acid requirement of laying hens. Poult. Sci., 69: 774-780. PMID: 2367269.

Das, K., S.K. Roy, D.N. Maitra and S.C. Majumder, 1990. Effect of stocking density and length of rearing on the growth performance of Japanese quail broilers. Indian J. Anim. Prod. Manag., 6 (1): 38-42.

Erensayin, C., 2001. Effects of the group size on fattening performance in quails. S.D. University. J. Institute of Natural and Applied Sci., 5 (3): 85-89. http://fenbilimleri.sdu.edu.tr/dergi/index.html.

Ipek, A., U. Sahan and B. Yilmaz, 2002. The effect of cage position and stock density on the egg production and quality characteristics. J. Poult. Res., 4 (1, 2): 8-12. http://www.tae.gov.tr/uploadimg/dergiler/cilt4sayi1_2.pdf.

Kul, S., I. Seker and O. Yildirim, 2006. Effect of separate and mixed rearing according to sex on fattening performance and carcass characteristics in Japanese quails (*Coturnix coturnix japonica*). Arch. Tierz., 49 (6): 607-614. www.fbn-dummerstorf.de/AAB/pdf/pdfkeyless/2006/heft6-06/12SEKER066.pdf.

Nagarajan, S., D. Narahari, L.A. Jayaprasad and D. Thyagrajan, 1991. Influence of stocking density and layer age on production traits and egg quality in Japanese quail. Br. Poult. Sci., 32 (2): 243-248. DOI: 10.1080/00071669108417347.

Okan, F. and A.N. Uluocak, 1992. Effects of diet with different crude protein levels on growth performance and carcass characteristics in quail. Turk. J. Vet. Anim. Sci., 16: 557-568.

SAS, 1999. Version 6.1. SAS Institute, Cary, North Caroline, USA.

Seker, I., M. Bayraktar, S. Kul and O. Ozmen, 2007. Effect of slaughter age on fattening performance and carcass characteristics of Japanese quails (*Coturnix coturnix japonica*). J. Applied Anim. Res., 31: 193-195.

Sengul, T. and N. Tas, 1997. Influence on growth performance and carcass characteristics of different cage densities in Japanese quail (*Coturnix coturnix japonica*). J. Poult. Res., 2 (1): 33-39.

Sengul, T., A. Yildiz and Y. Konca, 2000. Effect of stocking density on the growth performance and carcass characteristics in bronze turkeys. J. Poult. Res., 2 (1): 33-39. http://www.tae.gov.tr/uploadimg/dergiler/cilt2sayi1.pdf.

Snedecor, G.W. and W.G. Cochran, 1980. Statistical Method. 7th Edn. The Iowa State University Press, Ames, Iowa, USA. ISBN: 0813815606.

Waheda, P., M.G. Rabbani, M.A.R. Howlider and M.A. Wahid, 1999. Interaction of group size and stocking density on egg production performance of Japanese quail. Bangladesh Veterinarian, 16 (1): 29-33.