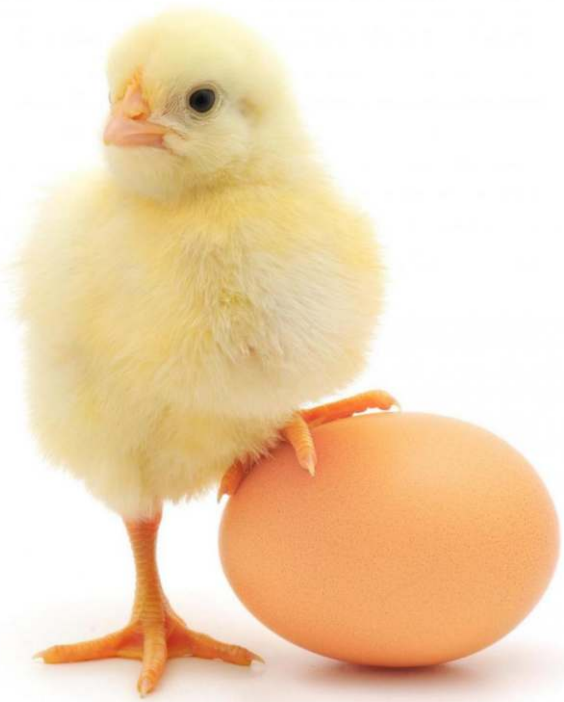
ISSN 1682-8356
ansinet.org/ijps



INTERNATIONAL JOURNAL OF
POULTRY SCIENCE

ANSInet
308 Lasani Town, Sargodha Road, Faisalabad - Pakistan
Mob: +92 300 3008585, Fax: +92 41 8815544
E-mail: editorijps@gmail.com

International Journal of Poultry Science 13 (6): 323-328, 2014
ISSN 1682-8356

Effects of Early Feed Restriction on Some Performance and Reproductive Parameters in Japanese Quail (*Coturnix coturnix japonica*)

Evrim Dereli Fidan and Mehmet Kaya
Department of Animal Science, Faculty of Veterinary Medicine,
Adnan Menderes University, 09016-Aydin, Turkey

Abstract: This study was carried out to investigate the effects of feed restriction on some performance and reproductive parameters in Japanese quails. Two weeks old birds were randomly allocated to three feed restriction groups with three replicates 7 males, 7 females. Body weight, live weight gain, feed conversion ratio were measured during growth period (between 2 to 5 week of age). In egg production period (from 6 to 15 week), body weight and age at first egg, egg production, fertility, hatchability, embryonic mortality, liveability, vitality and hatching chick weight were evaluated from replicates of one female and one male per treatment. In 3rd and 4th weeks of age, body weight was found higher *ad libitum* group than 15 and 30% restricted feed groups. No treatment differences were observed among body weight within sex groups from 2 to 5 week. In 5th week, average live weight gain of group *ad libitum*, 15 and 30% feed restriction, 5.18, 6.97 and 8.37 g, respectively. In 12 week of age, hatching chick weight was heavier for 30% feed restriction group than *ad libitum* group. Body weight and age at first egg, egg production, fertility, hatchability, embryonic mortality, liveability and vitality were unaffected by feed restriction. These data indicated that by 30% feed restriction can be practiced for 2 weeks (at 3 and 4 week) during growth period of quail. As a result, 15 and 30% restriction of *ad libitum* feed intake from 2 to 4 week of age without detrimentally affecting reproductive and hatchability parameters between 6 to 15 week of age.

Key words: Feed restriction, growth performance, hatchability, embryonic mortality, quail

INTRODUCTION

In the poultry industry, the selection and genetic studies was made in the direction of rapid growth and live weight gain, those are result of the rate of growth had increased and the highest point in terms of body weight had reached in animals. Unfortunately, as a negative effect of very fast growth rate is usually increased body fat deposition, high incidence of metabolic disorders, high mortality rate, high incidence of skeletal diseases, foot and leg problems and those are results of continuous genetic and improvement in nutrition (Altan *et al*., 1998; Bozkurt *et al*., 2001; Bilgili *et al*., 2009; Naeim Saber *et al*., 2011; Sahraei, 2012). Also, the negative correlations between body weight and reproduction traits (Siegel, 1980), the negative correlations between excess body fat and egg production, fertility and hatchability (Wilson and Harms, 1986) were found. These situations most commonly occur with broilers that consume feed *ad libitum* (Sahraei, 2012). Thus feed restriction has been proposed to reduce these problems. Early feed restriction is a common industry practice to control growth in meat-type birds used for breeding stock and to eliminate the adverse effects of these problems in poultry (Plavnik and Hurwitz, 1991; Crouch *et al*., 2002a,b; Tumova *et al*., 2002; Ocak and Erener, 2005; Hassan *et al*., 2003; Kalpak and Sogut, 2009). Limiting feed intake depresses growth during the period of feed restriction, but reduced growth can be later compensated by realimentation (compensatory growth) (Plavnik and Hurwitz, 1985, 1988; Altan *et al*., 1998; Govaerts *et al*., 2000; Tumova *et al*., 2002; Hassan *et al*., 2003). Thus, the skeletal system and vital organs development are given priority by depresses the rate of growth at an early age (Altan *et al*., 1998). During the period of compensatory growth live weight gain can be ensured (Plavnik and Hurwitz, 1985, 1988; Altan *et al*., 1998; Hassan *et al*., 2003; Kalpak and Sogut, 2009), feed efficiency can be improved (Plavnik and Hurwitz, 1985, 1988, 1991; Altan *et al*., 1998) and body fat can be reduced (Plavnik and Hurwitz, 1988; Ferket and Sell, 1990). Naeim Saber *et al*. (2011), Meyer *et al*. (1980), Owings and Sell (1980) suggested that early feed restricted has no significant effects on feed conversion ratio in broiler and turkey. Hassan *et al*. (2003) reported that feed restriction has no significant effects on hatchability, early age embryonic deaths in Japanese quails, but feed restriction has significant effect on body weight at first egg. However, it was determined that feed restriction has no significant effect on body weight at first egg (Zelenka *et al*., 1984). Bozkurt *et al*. (2001) reported that restricted chickens did not show a significant effect in body weight, egg production, hatching chick weight

Corresponding Author: Evrim Dereli Fidan, Department of Animal Science, Faculty of Veterinary Medicine, Adnan Menderes University, 09016-Aydin Turkey

and hatchability traits. Tumova *et al.* (2002), suggested that physical feed restriction at early age of birds for a short period stimulated compensatory growth and its depend on a number of factors such as intensity, time and duration of restriction, sex and strain.

The purpose of this study was to evaluate the effects of feed restriction on performance parameters (body weight, feed consumption, feed conversion ratios (FCR)), reproductive parameters (body weight and age at first egg, first egg weights, egg weight and egg production), hatchability traits (fertility, hatchability, embryonic mortality, liveability and vitality) and hatching chick weight in Japanese quail.

MATERIALS AND METHODS

This study was conducted out in the Poultry Research Unit of Faculty of Veterinary Medicine, University of Adnan Menderes. As animal material, total 126 (63 male, 63 female) two weeks old birds were randomly allocated to three feed restriction groups as three replication (in each replicate group; 7 males, 7 females). Birds were housed in quail brooding batteries with 40x48x38 cm pens from hatch until 5wk of age. In this study, the 1st group (G1) was control fed by *ad libitum,* the 2nd group (G2) was 15% feed restricted by control chicks fed *ad libitum* on the previous day and 3rd group (G3) was 30% feed restricted of the control. Quails were fed a starter diet containing 21.0% crude protein from 2 to 5 weeks of age and then fed 15% crude protein from 6 to 15 weeks of age (Table 1). Mean feed intake for *ad libitum* and 15 and 30% restricted intakes were 14.26, 12.24 and 10.38 g/d in females, 13.67, 11.76 and 10.44 g/d in males during week 3; 19.89, 17.24 and 15.05 g/d females, 20.23, 16.78 and 16.03 g/d males during week 4, respectively. All treatments were allowed water *ad libitum* and were provided continuous lighting (24L:0D) exposure to 5 week of age, while the lighting schedule was changed to 16L:8D from 6 to 15 week of age. Individual body weight was recorded weekly and feed conversion ratio was calculated for each group from 2 to 5 week of age. Body weight was weighted with a scale (sensitive to 0.1 g) individually.

In egg production period (from 6 to 15 week), the quails were placed as one female and one male at random in individual breeding cages (21 x 20 x 27 cm) having 5 floors with 5 divisions in each floor. The replicate groups was formed 17, 18 and 15 individual breeding cages for control group, 15 and 30% feed restriction groups. In this period, quails were used to study the effect of early feed restriction on subsequent reproductive and hatchability traits.

Individual female body weights were measured by a digital scales with a sensitivity of 0.1 g. Mortality was recorded daily. Age and body weight at first egg and weekly egg production were recorded from 6 to 15 week of age. Average egg weight were taken during the first 3 consecutive d of each week and individually weighed to the nearest 0.01 g. Hatchability traits were determined 8 and 12 weeks of age.

Table 1: Compositions of the experimental diets

	Ration	
Ingredient	Starter (%)	Breeder (%)
Calculated nutrient content		
Dry matter	88.00	88.00
ME (kcal/kg)	3250	2650
Crude protein	21.00	15.00
Lysine	1.35	0.70
Methionine+cystine	0.90	0.65
Methionine	0.50	0.35
Crude cellulose	6.00	7.00
Crude ash	7.00	13.00
Calcium	0.9-1.50	3.40-4.00
Available phosphorus	0.65	0.60
Sodium	0.15-0.30	0.16-0.30
NaCl	0.30	0.35

Daily collected quail eggs were stored in a storage room for 5 day at 16-18°C and 55-60% relative humidity (RH) and stored eggs were rotated 45°C regularly twice a day. The eggs grouped for feed restriction experiments were all placed in a cabinet incubator (Cimuka) at the same time and were transferred to the hatching trays at the 15th day of the incubation. The incubator was set to 37.7°C, 60% RH for the first 15 days and 37.5°C, 70% RH for the last period. Both eggs and hatched chicks were weighted with a scale (sensitive to 0.1 g) individually. All unhatched eggs were broken on a flat layer for determining fertility and stages of the embryonic growth. After this inspection eggs were determined as unfertile while embryonic deaths were classified as early age (between 0-6 days of the incubation) and late age (7-17 days of incubation) embryonic deaths.

Statistical analysis: SPSS version 15.0 (SPSS, 2006) was used for analysis and a General Linear Model (GLM) was designed to reveal the effects of the sex and feeding level on body weight in growth period. When a significant effect was noted ($p<0.05$), means were compared by Duncan's multiple range test (Duncan, 1955). Kruskal-Wallis ANOVA was used to determine the effect of feeding level on live weight gain, feed consumption and FCR data, also Mann-Withney U test was used to determine the effect of sex on live weight gain, feed consumption and FCR data (Tekin, 2010). In egg production period (6-15 weeks), the differences in hatching chick weight, age at first egg, body weight at the first egg, first egg weight, average egg weight parameters between feed restriction groups were compared with One-way ANOVA test (Ozdamar, 2004). Chi-square test was performed to analyze the egg production, fertility rate, hatchability, liveability and embryonic death parameters.

RESULTS

It was determined that body weight had increased in Japanese quail as parallel to increase in age for feed restriction and sex groups (Table 2). In 3 and 4 weeks of age, body weight was found higher *ad libitum* group than 15 and 30% restricted feed groups. At the end of the growth period (5 week of age), body weights were determined as 162.25, 158.77 and 154.59 g for control, 15 and 30% feed restriction groups, respectively. It was revealed that feed restriction has no statistically significant effect on body weight. No interactions were observed among feed restriction and sex groups at any age in the growth period. The highest live weight gain was found as 4.78 and 5.40 in control group, at 3rd and 4th weeks of age, respectively, but the lowest live weight gain was found as 5.18 in control group at 5 weeks of age (Table 3). The daily average feed consumption, except for 5th week, in the all weeks, the highest values were detected in the control group (Table 3). One week after termination of restricted feeding (5 week of age), FCR was the better (3.31 g feed/g live weight gain) in 30% feed restriction group than in control group (4.43 g feed/g live weight gain).

Ages at first egg were determined as 47.35, 50.22 and 50.69 day (F:1.061, p>0.05); body weights were determined as at first egg 217.08, 218.98 and 223.96 g (F:0.334, p>0.05); first egg weights were determined as 9.10, 8.97 and 9.49 g (F:0.526, p>0.05) for *ad libitum* group, 15 and 30% feed restriction groups, respectively. Hatchability traits and hatching chick weight in control group and different feed restriction groups were given in Table 4. Hatched chick weights were found higher 30% feed restriction group (8.23 g) than *ad libitum* group (7.76 g) in 12 week, (p<0.05).

DISCUSSION

In this study, significant decreases were observed in body weight and live weight gain in 15 and 30% feed limitation groups on the 3rd and the 4th weeks, however on the 5th week, similar body weight values were obtained among the groups. The results are similar to those of other studies on quails (Sabine *et al*., 1995; Hassan *et al*., 2003; Kalpak and Sogut, 2009) and on broiler chickens (Altan *et al*., 1998; Rahimi *et al*., 2005; Shaddel Telli *et al*., 2012). It can be said that feed restriction implementation had a negative effect on live weight gain and free feeding provided the compensatory growth. Altan *et al*. (1998) found that the growth retardation caused by feed limitation was compensated on the 6th week. In *ad libitum* fed group, feed conversion

Table 2: Least square means for body weight during 2 to 5 week of age[1]

			--- Feed restriction groups (F) ---			--- Sex groups (S) ---		------ F value and significant -----		
Age (week)	Expected mean (μ) (n = 126)	Sx	G_1 (n = 42)	G_2 (n = 42)	G_3 (n = 42)	Female (n = 63)	Male (n = 63)	F	S	F X S
2	53.43	1.04	54.49	53.40	52.41	53.94	52.93	0.333^{-}	0.237^{-}	0.151^{-}
3	79.01	1.61	87.80^{a}	76.41^{b}	72.83^{b}	80.82	77.21	7.846**	1.253^{-}	0.937^{-}
4	111.70	1.92	125.81^{a}	110.06^{b}	99.24^{c}	112.77	110.63	15.919***	0.311^{-}	0.461^{-}
5	158.54	1.74	162.25	158.77	154.59	161.52	155.55	1.583^{-}	2.965^{-}	0.003^{-}

^{a,b,c}Means with different superscript letters in the same row differ (p<0.05) $^{-}$: Not significant, **p<0.01, ***p<0.001

Table 3: Live weight gain, feed consumption and feed conversion ratios data in early feed restriction and sex groups

		------ Weeks ------			
		3	4	5	General
Growth parameters	Feed restriction groups (n = 6)	$\bar{X}\pm S\bar{x}$	$\bar{X}\pm S\bar{x}$	$\bar{X}\pm S\bar{x}$	$\bar{X}\pm S\bar{x}$
Daily average live weight gain (g)	G_1 (*Ad libitum* feeding)	4.78 ± 0.40^{a}	5.40 ± 0.33^{a}	5.18 ± 0.33^{b}	5.12±0.20
	G_2 (15% feed restriction)	3.28 ± 0.30^{b}	4.78 ± 0.12^{ab}	6.97 ± 0.32^{a}	5.01±0.38
	G_3 (30% feed restriction)	2.93 ± 0.28^{b}	3.90 ± 0.51^{b}	8.37 ± 0.69^{a}	5.07±0.64
	P	**	*	**	-
Daily average Feed consumption (g/quail/day)	G_1 (*Ad libitum* feeding)	13.98 ± 0.35^{a}	20.06 ± 0.13^{a}	22.68±0.52	18.90±0.90
	G_2 (15% feed restriction)	12.00 ± 0.15^{b}	17.01 ± 0.28^{b}	23.71±0.49	17.57±1.18
	G_3 (30% feed restriction)	10.42 ± 0.58^{c}	15.53 ± 0.56^{c}	24.76±1.08	16.90±1.50
	P	**	**	-	-
FCR (g feed/g live weight gain)	G_1 (*Ad libitum* feeding)	2.99 ± 0.16^{b}	3.80±0.27	4.43 ± 0.20^{a}	3.74±0.18
	G_2 (15% feed restriction)	3.68 ± 0.12^{a}	3.55±0.09	3.42 ± 0.11^{b}	3.55±0.63
	G_3 (30% feed restriction)	3.73 ± 0.45^{a}	4.23±0.40	3.31 ± 0.19^{b}	3.76±0.22
	P	*	-	**	-
	Sex groups (n = 9)				
Daily average live weight gain (g)	Female	3.87±0.42	4.56±0.40	6.91±0.63	5.11±0.38
	Male	3.47±0.28	4.83±0.29	6.77±0.55	5.02±0.34
	P	-	-	-	-
Daily average Feed consumption (g/quail/day)	Female	12.31±0.69	17.39±0.74	23.96±0.66	17.89±1.01
	Male	11.96±0.50	17.68±0.71	23.47±0.66	17.70±0.98
	P	-	-	-	-
FCR (g feed/g live weight gain)	Female	3.32±0.18	3.99±0.29	3.65±0.26	3.65±0.15
	Male	3.61±0.30	17.68±0.71	3.79±0.18	3.71±0.13
	P	-	-	-	-

^{a,b,c}Means with different superscript letters in the same colomn differ (p<0.05) -: Not significant *p<0.05 **p<0.01 ^{n}: Number of Repeat group

Table 4: Effect of early feed restriction on egg weight, hatchability traits and hatched chick weights in some week

	Weeks														
	8			10			12			14			General		
Parametreler	G_1	G_2	G_3	G_1	G_2	G_3	G_1	G_2	G_3	G_1	G_2	G_3	G_1	G_2	G_3
Egg weight (g)	10.27	9.92	10.38	10.83	10.52	11.04	11.11	11.21	11.38	11.66	11.40	11.24	11.07	10.91	10.99
F		2.449^{-}			2.440^{-}			0.618^{-}			1.742^{-}			1.684^{-}	
Egg production (%)	67.2	68.3	66.7	67.2	69.8	67.6	70.5	70.6	71.4	71.4	72.2	71.4	69.0	70.4	69.3
X^2		0.069^{-}			0.112^{-}			0.025^{-}			0.025^{-}			0.505^{-}	
Vitality (%)	100.0	100.0	100.0	100.0	100.0	100.0	94.1	100.0	100.0	100.0	100.0	100.0	98.5	100.0	100.0
X^2								1.981^{-}						1.951^{-}	
Fertility (%)	81.4	68.3	71.4	-	-	-	82.5	72.5	88.2	-	-	-	81.9	70.4	80.6
X^2		2.508^{-}		-	-	-		3.752^{-}		-	-	-		4.178^{-}	
Hatchability (%)	66.1	53.7	54.8	-	-	-	68.4	55.0	70.6	-	-	-	67.2	54.3	63.4
X^2		2.026^{-}		-	-	-		2.753^{-}		-	-	-		3.456^{-}	
EAED (%)	8.3	3.6	6.7	-	-	-	2.1	17.2	11.1	-	-	-	5.3	10.5	9.3
X^2		0.650^{-}		-	-	-		5.311^{-}		-	-	-		1.654^{-}	
LAED: (%)	10.4	17.9	16.7	-	-	-	14.9	6.9	8.9	-	-	-	12.6	12.3	12.0
X^2		1.024^{-}		-	-	-		1.453^{-}		-	-	-		0.016^{-}	
Liveability (%)	81.3	78.6	76.7	-	-	-	83.0	75.9	80.0				82.1	77.2	78.7
X^2		0.246^{-}		-	-	-		0.572^{-}						0.611^{-}	
Hatching chick weight (g)	7.43	7.03	7.30	-	-	-	7.76^{b}	8.02^{ab}	8.23^{a}	-	-	-	7.60	7.69	7.88
F		2.068^{-}		-	-	-		3.242^{*}		-	-	-		2.154^{-}	

a,b,c Means with different superscript letters in the same row differ ($p<0.05$)

-: Not significant EAED: Early age embryonic death LAED: Late age embryonic death

rates were found to be better than those of other groups on the 3rd week and a better feed conversion was determined on the 5th week in 30% feed limited group. It can be said that quails digest the feed better when their feed was limited and have a better feed conversion (Konca *et al.*, 2000; Shaddel Telli *et al.*, 2012). The general (3-5 weeks) average feed conversion rate showed no changes depending on feed limitation programs, however the best feed conversion rate was found in 15% feed limitation group. Similar to the results of this study, Hassan *et al.* (2003) on quails, Rahimi *et al.* (2005), Naeim Saber *et al.* (2011) and Shaddel Telli *et al.* (2012) have reported on broiler chickens that limited feeding has no significant effect on feed conversion. In addition to these researchers, Ocak and Erener (2005) determined that feed conversion rates on quails 3-5 weeks of age in 30% feed limitation and *ad libidum* groups were 5.98 and 5.69 g feed/g live weight, respectively ($p<0.05$). Evaluations on the examined weeks and in general evaluations (3-5 weeks), it was found that gender has no significant effect on feed consumption and feed conversion rates. This result shows similarity to those by Hassan *et al.* (2003). In 15 and 30% feed limitation groups, the first egg-laying age (day 50.22 and day 50.69, respectively) was delayed by approximately 3 days compared to the control group (day 47.35). However, in order to obtain the minimum live weight necessary for their sexual maturity, quails presented an accelerated growth following the early period feed limitation, the highest live weight value in the first egg was determined in 30% feed limitation group (223.96 g). Similar results were also reported by Sabine *et al.* (1995); Hassan *et al.* (2003), Ocak and Erener (2005). With this result, it can be said that the decrease in live weight at the end of the 5th week in quails in feed limitation groups may have delayed the egg efficiency starting age. Because, live weight and body fats of poultry animals are important factors in determining the egg-laying age. Kwakkel *et al.* (1995) reported that the delay in egg efficiency starting age may have an important role in continuation of egg peak efficiency and in the reduction of prolapse problems. It was found that the effect of early period feed limitation on the first egg weight, the general (8th-15th weeks) average egg weight and the egg efficiency was not statistically significant. These results show similarity to those reported by Ferket and Moran (1986), Hassan *et al.* (2003), Ocak and Erener (2005). In addition to these researchers, some researchers have reported that early stage feed limitation have reduced the egg efficiency in quails (Sabine *et al.*, 1995) and in turkeys (Miles and Lesson, 1990a). The effect of feed limitation on vitality was found to be non significant and this results was found to be similar to those reported by Lee (1981), Sabine *et al.* (1995) and Hassan *et al.* (2003). The effect of storage period statistically had no effect on the general (8-12th weeks) average fertility rate and hatching force and this result showed consistency with the study results on quails (Sabine *et al.*, 1995; Hassan *et al.*, 2003), in turkeys (Owing and Sell, 1980; Miles and Lesson, 1990b) and in broiler chickens (McCartney and Brown, 1980; Fattori *et al.*, 1991). The general average late period embryonic mortality rate value were statistically not significant in 30% feed limitation group, however it was found to be lower than those of control and 15% feed limitation groups. This result is consistent with the results of similar researches (Narahari *et al.*, 1988; Hassan *et al.*, 2003) in which feed limitation at early periods were used at certain levels. In the weeks that were examined, it was determined that early and late period embryonic deaths were not affected from feed limitation and this result was found to be consistent with the results reported by Bozkurt *et al.* (2001). Chick hatching weight as general average weight is found highest (7.88 g) in 30% feed limitation group quails and it was reported that feed limitation at early period implementation has no significant effect on chick hatching weight. These results are consistent with those by Bozkurt *et al.* (2001).

Consequently, 15 and 30% limited feed implementation to quails for two weeks have significantly reduced the live weight, live weight increase and feed consumption on the 3rd and the 4th weeks. The reductions in live weight, live weight increase and feed consumption as a result of feed limitation were found to be statistically not significant at the end of the growth period (35th day). At the end of the 5th week, it was demonstrated that feed conversion rates have given better results in 30% feed limitation group than those in other groups. It can be said that the compensatory growth rate provided by feed limitation implementation at early periods have reached the feed consumption and live weight increase rates and compensatory growth have role in obtaining similar live weights in groups. It can be said that feed limitation at early periods may be a practical method in quail farming for reducing the negative effects of *ad libitum* feeding on feedlot performance by delaying the growth. Gender statistically had no significant effect on live weight, live weight increase, feed consumption and feed conversion. Feed limitation implementation at early periods had no significant effect on the first egg-laying age, the live weight at the first egg, the weight of the first egg, the general average egg weight, egg efficiency, vitality, hatching properties and chick hatching weight.

REFERENCES

Altan, O., S. Ozkan and S. Yalcin, 1998. Etlik piliclerde gelismenin geciktirilmesi: Degiþik sinirli yemleme programlarinin etlik pilic performansi ve karkas ozelliklerine etkileri. Turk. J. Vet. Anim. Sci., 22: 231-236.

Bilgili, S.F., J.B. Hess, J.P. Blake, K.S. Macklin, B. Saenmahayak and J.L. Sibley, 2009. Influence of bedding material on footpad dermatitis in broiler chickens. J. Appl. Poult. Res., 18: 583-589.

Bozkurt, M., V. Ayhan and F. Kirksinar, 2001. Buyutme doneminde uygulanan farkli nicel ve nitel yem sinirlama yontemlerinin etlik damizlik tavuklarin verim donemi performansi uzerine etkileri. Turk. J. Vet. Anim. Sci., 25: 463-472.

Crouch, A.N., J.L. Grimes, V.L. Christensen and K.K. Krueger, 2002a. Effect of physical feed restriction during rearing on Large White turkey breeder hens: 2. Reproductive performance. Poult. Sci., 81: 16-22.

Crouch, A.N., J.L. Grimes, V.L. Christensen and K.K. Krueger, 2002b. Effect of physical feed restriction during rearing on Large White turkey breeder hens: 1. Growth performance. Poult. Sci., 81: 9-15.

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

Fattori, T.R., H.R. Wilson, R.H. Harms and R.D. Miles, 1991. Response of broiler breeder females to feed restriction below recommended levels. 1. Growth and reproductive performance. Poult. Sci., 70: 26-36.

Ferket, P.R. and E.T. Moran, 1986. Effect of plane of nutrition from starting to and through the breeder period on reproductive performance of hen turkeys. Poult. Sci., 65: 1581-1590.

Ferket, P.R. and J.L. Sell, 1990. Effect of early protein and energy restriction of large turkeys toms fed high-fat or low-fat realimentation diets. 1. Performance characteristics. Poult. Sci., 69: 1974-1981.

Govaerts, T., G. Room, J. Buyse, M. Lippens, G. Degroote and E. Decuypere, 2000. Early and temporary quantitative food restriction of broiler chickens. 2. Effect on allometric growth and growth hormone secretion. Br. Poult. Sci., 41: 355-362.

Hassan, S.M., M.E. Mady, A.L. Cartwright, H.M. Sabri and M.S. Mobarak, 2003. Effect of early feed restriction on reproductive performance in japanese quail (*Coturnix coturnix japonica*) Poult. Sci., 82: 1163-1169.

Kalpak, O. and B. Sogut, 2009. Effect of feed restriction on growth performance of Japanese quail (*Coturnix coturnix japonica*). J. Anim. Vet. Adv., 8: 1079-1082.

Konca, Y., O. Yazgan, Y. Bahtiyarca and T. Sengul, 2000. Sicak þartlarda kisitli yemleme yasi ve suresinin broyler piliclerde performans ve abdominal yaðlanmaya etkisi. Int. Anim. Nutr. Congress, Proceed. Book, 215-221.

Kwakkel, R.P., J.A.W. Vanesch, B.J. Ducro and W.J. Koops, 1995. Onset of lay related to multiphasic growth and bodycomposition in white leghorn pullets provided ad-libitum and restricted diets. Poult. Sci., 74: 821-832.

Lee, K., 1981. Performance of White Leghorn pullets subjected to restricted feeding during growing period. Poult. Sci., 60: 1682. (Abstr.)

McCartney, M.G. and H.B. Brown, 1980. Effects of feed restriction on reproductive performance of broiler-breeder males. Poult. Sci., 59: 2583-2585.

Meyer, G.B., C.F. Props, A.T. Leighton, Jr. H.P. Van Krey and L.M. Potter, 1980. Influence of dietary protein during the pre-breeder period on subsequent reproductive performance of large white turkey. 1-Growth, feed consumption and female sex-limited reproductive traits. Poult. Sci., 59: 352-357.

Miles, S.A. and S. Leeson, 1990a. Effects of feed restriction during the rearing period and age at photostimulation on the reproductive performance of turkey hens. Poult. Sci., 69: 1522-1528.

Miles, S.A. and S. Leeson, 1990b. Effects of feed restrictionduring the rearing period and age at photostimulation on the reproductive performance of turkey hens. Poult. Sci., 69: 1522-1528.

Naeim Saber, S., N. Maheri-Sis, A. Shaddel-Telli, K. Hatefinezhad, A. Gorbani and J. Yousefi, 2011. Effect of feed restriction on growth performance of broiler chickens. Ann. Biol. Res., 2: 247-252.

Narahari, D., K. Abdul Mujeer, A. Thangavel, N. Ramamurthy, S. Viswanathan, B. Mohan, B. Muruganandan and V. Sundararasu, 1988. Traits influencing the hatching performance of Japanese quail eggs. Br. Poult. Sci., 29: 101-112.

Ocak, N. and G. Erener, 2005. The effects of restricted feeding and feed form on growth, carcass characteristics and days to first egg of japanese quail (*Coturnix coturnix japonica*). Asian-Aust. J. Anim. Sci., 18: 1479-1484.

Owings, W.J. and J.L. Sell, 1980. Effect of restricted feeding from 6 to 20 weeks of age on reproductive performance of turkeys. Poult. Sci., 59: 77-81.

Ozdamar, K., 2004. Paket Programlar ile Ystatistiksel Veri Analizi, Kaan Kitabevi, Eskisehir.

Plavnik, I. and S. Hurwitz, 1985. The performance of broiler chicks during and following on severe feed restriction at an early age. Poult. Sci., 64: 348-355.

Plavnik, I. and S. Hurwitz, 1988. Early feed restriction in chicks effect of age, duration and sex. Poult. Sci., 67: 384-390.

Plavnik, I. and S. Hurwitz, 1991. Response of broiler chickens and turkey poults to food restriction of varied severity during early life. Br. Poult. Sci., 32: 343-352.

Rahimi, G., H. Rezaei, H. Haffzian and H. Saiyahzadeh, 2005. The effect of inter-mittent lighting schedule on broiler performance. Poult. Sci., 4: 396-398.

Sabine, G., G. Henrich and H.L. Marks, 1995. Effects of feed restriction on growth and reproduction in randombred and selected lines of Japanese quail. Poult. Sci., 74: 402-406.

Sahraei, M., 2012. Feed restriction in broiler chickens production. Biotechnol. in Anim. Husbandry, 28: 333-352.

Shaddel Telli, A.A., O.F. Alarslan, C. Altinsaat, N. Maheri Sis, K. Hatefi Nazhad and A. Ahmadzadeh, 2012. Etlik piliclerde kisitli yemlemenin performans ozelliklerine etkisi, Kafkas Univ. Vet. Fak. Derg., 18: 373-377.

Siegel, H.S., 1980. Physiological stress in birds. Biosci., 30: 529-534.

Statistical Packages for the Social Sciences, 2006. SPSS base 15.0 user's guide, SPSS, Chicago, IL.

Tekin, M.K., 2010. Orneklerle Bilgisayarda Ystatistik, II. Basim, Selcuk Universitesi Basýmevi, Konya.

Tumova, E., M. Skrivan, V. Skrivanova and L. Kacerovska, 2002. Effect of early feed restriction on growth in broiler chickens, turkeys and rabbits. Czech J. Anim. Sci., 47: 418-428.

Wilson, H.R. and R.H. Harms, 1986. Performance of broiler breeders as affected by body weight during the breeding season. Poult. Sci., 65: 1052-1057.

Zelenka, D.J., J.A. Cherry, I. Nir and P.B. Siegel, 1984. Body weight and composition of Japanese quail (*Coturnix coturnix japonica*) at sexual maturity. Growth, 48: 16-28.