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Effects of cage systems and feeding time on the morphological structure of female genital organs in pharaoh quails (*Coturnix coturnix pharaoh*)

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ABSTRACT

The aim of this study was to investigate the effects of different cage systems and feeding time on female genital organs in 40 pharaoh quails (*Coturnix coturnix pharaoh*). The birds were randomly divided into 4 treatment groups (2 levels of feeding time × 2-cage system) consisting of 10 quails per treatment. Quails were trained on feeding time (09^{00} to 17^{00}, or continuous - full day), cage (multiple-bird cage or colony cage) conditions. Body mass, ovary and oviduct mass and their ratio to body mass and oviduct length was measured. Number of follicles was calculated and classified as small, medium and large, based on their diameter. The cage system did not significantly affect reproductive organs, but this was not the case for oviduct length ($P<0.01$). Feeding time also did not significantly affect follicle numbers, except medium follicle numbers ($P<0.05$). The medium number of follicles in the full day feeding was more than that of the 09^{00} to 17^{00} feeding. Total numbers of follicles in multiple-bird cage were higher than those of colony cage birds.

Key words: genital organs, anatomy, cage system, feeding time, pharaoh quail

Introduction

Multiple threshold traits associated with growth and body composition are critical for the onset of sexual maturity (ZELANKA et al., 1984). Optimal body mass and age may be required for the onset of lay in birds (BRODY et al., 1980).

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Numerous studies have been performed to determine the effect of different feeding times on broiler breeder performance and reproductive organs, with incongruous results. Feed intake should be restricted up to the onset of lay and then increased in relation to the rise in egg production (HOCKING, 1996). Feed restriction during the rearing period significantly delayed oviduct development and age at sexual maturity (YU et al., 1992) and reduces the growth rate of turkey breeder hens (MILES and LEESON, 1990). Daily restriction in feeding for a longer period (total 6 h or more) may also alter the reproductive function in wild birds (SIKDAR, 2002).

Whether feeding early or late during the day can be used as a means to improve body mass, genital organs and follicles number in Pharaoh quail, especially normal in circumstances, is unknown. Therefore, two feeding periods were studied to measure the impact of feeding time on reproductive organ morphology of Pharaoh quail (*Coturnix coturnix pharaoh*) cage multiple or colony.

Materials and methods

The experimental procedures employed in this study were in accordance with the principles and guidelines set out by the Committee of Faculty of Veterinary Medicine on Animal Care. Forty female pharaoh quails (*Coturnix coturnix pharaoh*) obtained from the Animal Production, Research and Application Centre of Veterinary Faculty of Uludag University were used in this study. After 5% egg production was reached, the birds were randomly divided into 4 treatment groups (2 levels of feeding time × 2-system cage) consisting of 10 quails per treatment based on feeding time (09^{00} to 17^{00}, or continuous – full day), cage (1 male and 1 female in multiple-bird or 5 male and 5 female in colony) conditions. The quails were reared in the same environmental conditions.

At age 42 weeks, all quails from each treatment group were killed humanely by decapitation (ANONYMOUS, 2003). The body mass of each bird was recorded prior to killing. The body cavity was opened and genital organs were determined. Oviduct and ovary masses were evaluated with digital balance (Densi DS-20 Turkey and Sartorius H110, USA, respectively). Relative masses of ovary and oviduct were calculated. Oviduct length was measured with a digital compass (Mitutuyo Corporation, Kawasaki, Japan). The ovarian follicles were separated by means of a magnifying glass from the ovaries and divided into three categories based on diameter as small (1.0-4.9 mm), medium (5.0-14.9 mm) and large (15 mm-above) according to RAHMAN et al. (1999). The number of follicles was then counted. A digital camera (Nikon D100, Nikon Corporation, Japan) was used to collect the image.

Statistical analysis was performed by Minitab statistical package (for Windows version 14). The ANOVA was to compare the means obtained in each group.

For the terminology, the Nomina Anatomica Avium (ANONYMOUS, 1993) was used.

Results

The main and interactive effects of different cage system and feeding time on body mass and reproductive organs are presented in Table1. The main effect: cage system did not significantly affect the reproductive organs and body mass, except oviduct length ($P<0.01$), in birds. Although the other main effect, feeding time, did not significantly affect the genital organs, body mass was significantly ($P<0.001$) affected. The interactive effect had no significant influence neither on the body mass nor reproductive system organs, except oviduct length ($P<0.05$).

Table 1. Measures of body mass and reproductive organs in different cage system and feeding time (mean ± SD).

	Cage density and feeding time		Body mass (g)	Ovary mass (g)	Relative mass of ovary	Oviduct mass (g)	Relative mass of oviduct	Oviduct length (cm)
Main effect	Cage system	Colony	255.97 ± 5.22	0.196 ± 0.43	0.0007 ± 0.00	5.37 ± 0.23	0.020 ± 0.00	218.31 ± 6.36
		Multiple	248.44 ± 5.22	0.146 ± 0.43	0.0005 ± 0.00	5.36 ± 0.23	0.021 ± 0.00	244.47 ± 6.36
		Significance	N.S.	N.S.	N.S.	N.S.	N.S.	P<0.01
	Feeding time	Full day	265.52 ± 5.22	0.173 ± 0.43	0.0006 ± 0.00	5.87 ± 0.23	0.022 ± 0.00	227.10 ± 6.36
		09^{00} to 17^{00}	238.89 ± 5.22	0.169 ± 0.43	0.0007 ± 0.00	5.21 ± 0.23	0.021 ± 0.00	235.68 ± 6.36
		Significance	P<0.001	N.S.	N.S.	N.S.	N.S.	N.S.
Interactive effect	Colony × full day		270.09 ± 7.38	0.176 ± 0.61	0.0006 ± 0.00	6.12 ± 0.33	0.022 ± 0.00	268.62 ± 8.99
	Colony × 09^{00} to 17^{00}		241.86 ± 7.38	0.215 ± 0.61	0.0008 ± 0.00	5.31 ± 0.33	0.021 ± 0.00	233.00 ± 8.99
	Multiple × full day		260.96 ± 7.38	0.170 ± 0.61	0.0006 ± 0.00	5.59 ± 0.33	0.021 ± 0.00	250.59 ± 8.99
	Multiple × 09^{00} to 17^{00}		235.92 ± 7.38	0.122 ± 0.61	0.0005 ± 0.00	5.12 ± 0.33	0.021 ± 0.00	238.36 ± 8.99
	Interaction		N.S.	N.S.	N.S.	N.S.	N.S.	P<0.05

N.S. - not significant

The main and interactive effects of different cage system and feeding time on follicle numbers are presented in Table 2. Although the main effect, cage system, had a significant effect on the number of small (P<0.001), medium (P<0.05) and total follicles (P<0.001), it had no effect on the number of large follicles. The multiple reared birds developed a greater number of small follicles (P<0.001). Feeding time, the other main effect, did not significantly affect the number of follicles, except that of the medium follicles (P<0.05). There was no remarkable change in the number of large follicles due to cage system and feeding time. The interactive effects were not significant on the numbers of medium and large follicles, except those of small follicles (P<0.05) (Fig. 1).

Table 2. Number of follicles in different cage system and feeding (mean ± SD)

	Cage density and feeding time		Small follicles N° (1.0 - 4.9 mm)	Medium follicles N° (5.0 - 14.9 mm)	Large follicles N° (15.0 mm - above)	Total N° of follicles
Main effect	Cage system	Colony	35.05 ± 2.53	1.56 ± 0.12	2.00 ± 0.11	36.27 ± 2.16
		Multiple	61.66 ± 2.53	1.16 ± 0.12	2.00 ± 0.11	64.38 ± 2.16
		Significance	P < 0.001	P < 0.05	N.S.	P < 0.001
	Feeding time	Full day	49.61 ± 2.53	1.55 ± 0.12	2.05 ± 0.11	53.05 ± 2.16
		09^{00} to 17^{00}	47.11 ± 2.53	1.16 ± 0.12	1.94 ± 0.11	47.61 ± 2.16
		Significance	N.S.	P < 0.05	N.S.	N.S.
Interactive effect	Colony × full day		32.44 ± 3.59	1.88 ± 0.17	2.11 ± 0.16	36.33 ± 3.05
	Colony × 09^{00} to 17^{00}		37.66 ± 3.59	1.22 ± 0.17	1.88 ± 0.16	40.25 ± 3.05
	Multiple × full day		66.77 ± 3.59	1.22 ± 0.17	2.00 ± 0.16	69.77 ± 3.05
	Multiple × 09^{00} to 17^{00}		56.55 ± 3.59	1.11 ± 0.17	2.00 ± 0.16	59.00 ± 3.05
	Interaction		P < 0.05	N.S.	N.S.	N.S.

N.S. - not significant

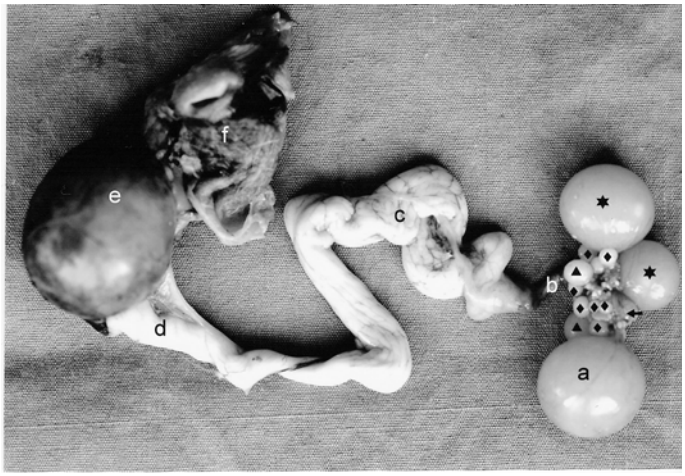

Fig. 1. Genital organs and follicles in 42-week-old pharaoh quails. The largest follicle in ovary (a), Infundibulum (b), Magnum (c), Istmus (d), Uterus with maturing egg (e), Vagina (f), Large follicles (✶), Medium follicles (▲), Small follicles (◆), Post-ovulatory follicle (🡐).

Discussion

There are many studies (GOODLING et al., 1984; MILES and LEESON, 1990; LILBURN and NESTOR, 1993; ROBINSON et al., 2001) about the morphological structure of genital organs in birds. This study presents some characteristics of these organs in pharaoh quails.

The body masses of the birds fed *ad libitum* were heavier by 46% than those fed a restricted diet (RENEMA et al., 1999a). Birds maintained at low mean body mass by continued restriction did not come into lay (BRODY et al., 1980). We observed that full day feeding was more effective than the 09^{00} to 17^{00} feeding, particularly on body mass gain in pharaoh quail. The body mass of birds feeding the full day was 11% heavier than those feeding from the 09^{00} to 17^{00}.

The effect of diet on the body masses of turkeys has been found to be insignificant (LILBURN and NESTOR, 1993). Feed restriction during the rearing period reduces growth rate of turkey breeder hens, and at 29 weeks of age, *ad libitum* birds were reported heavier ($P<0.05$) than restricted birds (MILES and LEESON, 1990). Increasing the number of hens from 4 to 5 hens per cage resulted in a significant reduction in feed intake and body mass gain (GOODLING et al., 1984). In this study, while the cage system did not affect body mass, the feeding time had a significant effect ($P<0.001$). While these results are consistent with data obtained by MILES and LEESON (1990), they are not in full agreement with those obtained by GOODLING et al. (1984) and LILBURN and NESTOR (1993). This could be explained by the well ordered feeding system.

Birds fed *ad libitum* showed accelerated development of comb ovary and oviduct (BRODY et al., 1980). It was shown that the early strain birds appeared to allocate a greater proportion of nutrients to reproductive development than the late group (ROBINSON et al., 2001). Feed restriction during rearing has been shown to significantly delay oviduct development and age at sexual maturity, compared with feed restriction during both rearing and breeding. *Ad libitum* feeding beginning at 18 weeks of age significantly increased the mass of the ovary (YU et al., 1992). Long-term feed restriction may not be necessary in order to attain good reproductive performance (BRUGGEMAN et al., 1999). In broilers, increases in ovarian and oviduct masses were observed in both those fed restricted diet alone and those fed a restricted diet diluted with maize oil (DUNN et al., 1990). In our study, the cage system and feeding time did not have a significant effect on ovary and oviduct masses in both main and interactive groups. These findings are important since they are inconsistent with observations made by BRODY et al. (1980), DUNN et al. (1990), YU et al. (1992), BRUGGEMAN et al. (1999) and ROBINSON et al. (2001).

The birds fed restricted diet from 7 to 15 weeks of age had higher proportional masses of ovary (> or = 1.7%) and oviduct (> or = 1.58%) at age of sexual maturity (BRUGGEMAN et al., 1999). At 36 weeks of age ISA Brown laying hen, the proportion of ovary and oviduct mass to body mass was 2.285% and 2.079%, respectively. During that period, while the length of oviduct was 73.45 cm, the mass of ovary was 41.89 g (RAHMAN et al., 1999). In this study, relative mass ovary in interactive effects, colony × 09^{00} to 17^{00} was 0.08% and relative mass oviduct, colony × full day was 2.2% at 42 weeks of age for pharaoh quail. The length of oviduct in interactive effects, colony × full day, was 268 cm. These data are not in agreement with observation made by RAHMAN et al. (1999). The results for the proportional masses of ovaries in all groups were found to be inferior to the findings of BRUGGEMAN et al. (1999) and RAHMAN et al. (1999). However, the proportional masses of oviducts were found to be similar to the findings of (BRUGGEMAN et al., 1999; RAHMAN et al., 1999). The result for the oviduct length in all groups was found to be superior to findings by RAHMAN et al. (1999).

Ad libitum feeding beginning at 18 weeks of age significantly increased the number of large follicles at sexual maturity (YU et al., 1992). Birds fed *ad libitum* had a large increase in the numbers of yellow follicles (HOCKING, 1996). The *ad libitum* birds reached sexual maturity with 11.0 large yellow follicles (> 10 mm diameter) compared to 7.1 in restricted feeding birds. Small follicle atresia (< 5 mm diameter) was low in *ad libitum* birds (10.3) compared to restricted feeding birds (32.3), (RENEMA et al., 1999b). There were 3.6 small, 18.3 medium and 64.0 large follicles (85.3 in total) in 36-week-of-age ISA Brown laying hens (RAHMAN et al., 1999). In this study, the number of small follicles in colony cage 42-weeks-of-age pharaoh quails was 35. This data is inconsistent with the observations made by YU et al. (1992), RAHMAN et al. (1999) and RENEMA et al. (1999b). We observed that the cage system had a significant effect ($P<0.001$) on the number of small follicles,

whereas feeding time did not. The interactive effect, multiple × full day feeding, was significant ($P<0.05$) on the number of small follicles. But no similar effect was seen on the number of medium and large follicles. The number of medium follicles in colony cage 42-weeks-of-age pharaoh quail was 1.56. Contrary to the finding obtained by RAHMAN et al. (1999) the number of medium follicles was larger in the quails. We observed that both cage system and feeding time had a significant effect ($P<0.05$) on the number of medium follicles. The number of medium follicles in full day feeding was more than the 09^{00} to 17^{00} feeding. The same correlation was seen between the colony and multiple cage quails. The number of large follicles in colony cage 42-weeks-of-age pharaoh quail was 2. The result for the number of large follicles was found to be inferior to the findings by YU et al. (1992) and RAHMAN et al. (1999). Cage system and feeding time had no significant effect on the number of large follicles. Total number of follicles in multiple cage quails was more than colony-cage ones. This difference might be due to the particular conditions of each system, e.g. multiple-cage quails might have had a more comfortable microclimate compared to the colony-cage ones, which, as an environmental factor, could affect follicle numbers. The cage system was of significant importance ($P<0.001$) for total number of follicles, whereas feeding time had no effect. The results for the total number of follicles in all groups were found to be inferior to the findings of RAHMAN et al. (1999).

It can be concluded that both cage system and feeding time had an influence on the female reproductive organs, except for diameter and number of follicles in pharaoh quails.

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YILDIZ, H., B. YILMAZ, I. ARICAN, M. PETEK, A. BAHADIR: Učinci kaveznog sustava držanja i vremena hranjenja na morfološku građu spolnih organa faraonskih prepelica (*Coturnix coturnix pharaoh*). Vet. arhiv 76, 381-389, 2006.

SAŽETAK

Cilj istraživanja bio je utvrditi učinke različitih sustava kaveznog držanja i vremena hranjenja na ženske spolne organe u 40 faraonskih prepelica. Ptice su metodom slučajnog izbora bile podijeljene u 4 skupine (2 vremena hranjenja × 2 kavezna sustava), po 10 prepelica u skupini. Prepelice su uvježbane za vrijeme hranjenja (od 09^{00} do 17^{00} ili kontinuirano tijekom cijelog dana), a držane su u kavezima za koloniju ptica. Mjerena je tjelesna masa, masa jajnika i jajovoda te odnos mase jajnika i jajovoda prema masi tijela i dužini jajovoda. Utvrđivan je broj folikula i provedeno je njihovo razvrstavanje na osnovi promjera na male, srednje i velike. Tip kaveznog sustava nije imao značajan utjecaj na spolne organe, osim na dužinu jajovoda ($P<0,01$). Vrijeme hranjenja također nije imalo značajan utjecaj na broj folikula s iznimkom onih srednje veličine promjera ($P<0,05$). Broj srednjih folikula bio je veći pri neprekidnom hranjenju cijeli dan nego pri hranjenju od 09^{00} do 17^{00} sati. Ukupni broj folikula bio je veći pri držanju u kavezu za više ptica nego kod držanja u kavezu za koloniju.

Ključne riječi: spolni organi, anatomija, kavezni sustav, vrijeme hranjenja