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Research Article

Effect of Yolk Hormones and Egg Weight on the Sex of Hatch Chicks, Hatchability and Embryonic Mortality of Japanese Quail

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Abstract | This study was conducted to investigate the effect of yolk hormones and egg weight on the sex of hatch chick, hatchability traits, and embryonic mortality. Four hundred and fifty eggs were used in this study. The eggs were divided according to their weight into three groups A: 8-9 g, B: 10-11 g and C: 12-13 g. Each group had 150 eggs.Yolk testosterone and estradiol concentrations were assessed after 10 days of Incubation. The results significantly indicated more testosterone in small eggs, whereas concentrations of all yolk estradiol increased in large eggs. The results indicated a significant increase in males' rate hatching from small eggs, whereas highest females' rate were recorded in large eggs.There was a significant difference between groups in hatchability of fertile eggs and hatch weight of incubated eggs. The highest hatchability of fertile eggs and hatching weights were recorded in the C group, whereas highest embryonic mortality was recorded in A group. We can conclude that, the concentration of yolk testosterone and males' rate were increased in small eggs whereas concentrations of yolk estradiol and females' rate were increased in large eggs. In addition, the largesized eggs of Japanese quail are suitable for incubation for better hatchability, lower embryonic mortality and best chick's weight at hatch as compared to small sized eggs.

Keywords | Yolk hormones, Egg weight, Hatchability.

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INTRODUCTION

Birds can control posterity sex proportion under natural and experimental conditions and maternal hormones have been appeared to be engaged with this procedure (Aslam et al., 2013). Studies also provide indications for the presence of sex-specific levels of yolk hormones in birds eggs. These discoveries prompted the proposal that yolk hormones could impact hereditary sex determination in birds (Radder, 2007; Elf, 2003; Muller et al., 2005a). The impacts of pre-birth hormone presentation on the improvement and phenotype of the chick have now been inspected in a number of experimental studies, in which new eggs were injected with androgens. Manipulation of the androgen environment of an embryo induced a wide range of effects on physiology and behavior of the offspring (Al-Salhie, 2012; Lipar and Ketterson 2000). In short, maternal yolk androgens may quicken embryonic improvement, upgrade post-natal development rate and influence intensity in both the chicks and the chick's stage (Eising et al., 2001; Pilz et al., 2004; Groothuis et al., 2005). Aslam et al. (2013) showed that yolk hormones could impact hereditary sex determination in birds. As to egg weight, Cunningham and Russell (2001) detailed that female mallards lay bigger eggs for male incipient organisms and Muller et al. (2005b) revealed that extent of male eggs was emphatically connected with egg mass. Different investigations detailed an impact of egg mass on the sex of the egg in yellow legged gull (Rubolini et al., 2009). Maternal yolk estrogen levels did not impact the sex of eggs in the peafowl (Pike and Petrie, 2005). Yet it was related with sex of egg in turtles (Bowden et al., 2000). Egg weight is one of the most important factors affecting the success of hatching , there is a close relationship between the weight of eggs and the qualities of productive birds (Wilson, 1991). Schmidt et al. (2009) noted a significant correlation between egg weight, embryonic development, and chick weight. Where bird weights can rise according to the weight of the eggs (Brah et al., 2001; Kucukyilmaz et al., 2001). The consideration of various scientists' research has been centered around the relation between egg weight and the impact on hatching success and chick quality (Rashid et al., 2013).Various investigations have demonstrated a solid positive connection between pre-brooding egg weight, long of storage periods, chicks weight and growth performance in various types of poultry (Farooq et al., 2001, Petek et al., 2003). Precise information on hatchability and sex of hatch chick in relationship to yolk hormones and egg weight of a specific assortment of birds can be useful in consistent choice of fertile eggs. Therefore, the present study was designed to investigate the effect of yolk hormones and egg weight on the sex of hatch chick, hatchability traits and embryonic mortality of Japanese quail.

MATERIALS AND METHODS

The study was carried out at Quail's Field, College of Agriculture, University of Basrah, Iraq. A total 450 eggs of Japanese quails have obtained 250 female quails, at 10 weeks of age. The birds were housed as 1 male: 2 female per cage of 71 × 71 × 51 cm. Feed containing 20.60% crude protein and 2904 metabolizable energy (kcal/kg). Feed and water were allowed *ad libitum* and natural daylight was supplemented with artificial light to give an 18-hour photoperiod.

Eggs Collection

Eggs were collected every day during 10 days and weighted by using a digital scale and then according to their weight divided into three groups A: 8-9 g, B: 10-11 g and C: 12-13 g. Each group had 150 eggs with 50 eggs per replicate.

Eggs Hatching

Local hatcher with 1000 quail eggs capacity was used. The incubation temperature for the first 14 days of incubation was 37.8 °C, after which it was reduced to 37.5 °C for the end of the incubation period. The relative humidity of 60% for the first 14 days of incubation and 75 % for the end period. Automatic turning devices were used to turn the eggs 12 times in 24 hours up to the 14th day of incubation.

Eggs Hormones Assay

In 10th day of incubation, 15 eggs were taken from all groups to steroid assay (testosterone and estradiol) in yolk at this stage of embryonic development according (Pilz et al., 2005).

Hatchability and Embryonic Mortality

The eggs were transferred to the hatching boxes and arranged separately. Unhatched eggs were broken then dead embryos were weighted by using a digital scale. Hatchability and embryonic mortality rates from the fertile eggs were calculated in percent according (Patra et al., 2016; Al-Salhie, 2012).

Chicks Sexes

After 4th week of hatching, male and female rates from chicks hatching were calculated in percent by feathers color then females are characterised by light tan feathers with black speckling on the throat and upper breast whereas, males have rusty brown throat and breast feathers.

Statistical Analysis

Collected data were subjected to one-way analysis of variance (ANOVA) and differences were considered to be significant L.S.D if P was < 0.05. SPSS Statistics 18 .0 (2009) was used for statistical analysis.

RESULTS AND DISCUSSION

Yolk Hormones

The results of the effect of egg weight on yolk testosterone (ng/ml) and estradiol (pg/ml) concentrations after 10 days of incubation was presented in Table 1. The results were found significant ($P<0.05$) between groups. Group A has a significant increase in testosterone concentration (1.40 ng/ml) compared with groups B and C (1.20 and 0.99 ng/ml respectively), while group B has a significant higher level of testosterone concentration (1.20 ng/ml) compared with group C(0.99 ng/ml). On the other hand, the results indicate that Group C has a significant increase in estradiol concentration (1.60 pg/ml)compared with groups A and B (0.98 and 0.99 pg/ml respectively). May be due to the containment of small eggs higher amount of testosterone hormone to the fact that the females producing the eggs have a higher social ranking than others. Schwabl, (1997) noted that female sparrows which have a higher social ranking than others deposits larger amounts of testosterone in eggs. The results in our study agree with Aslam et al. (2013) who found a relationship between yolk and rogen and egg characteristics. The difference in the concentration of the yolk hormones may be due to the female's social and physical conditions (Eising et al., 2001; Schwabl, 1996a,b). On the other hand, yolk hormone levels are affected by the density of breeding (Schwabl, 1997), the attractiveness of males (Gil et al., 1999).

Hatchability and Sex of Hatching Chick

The results of the effect of egg weight and yolk hormones after 10 days of Incubationon hatchability and males' and females' rate are indicated in Table 2. The results were found significant ($P<0.05$) between groups. Group C has a significant increase in hatchability of fertile eggs (80.60%) compared with groups A and B (45.74 and 77.73% respectively), while group B has a significant increase in hatchability of fertile eggs (77.73%) compared with group A

(45.74%).The results on hatchability in our investigation concur with Anandh et al. (2012) who found that the fertile egg hatchability rate expanded according to the weight of turkey egg. Alabi et al. (2012) examining the impact of egg weight on hatchability and consequent performance of chicks from 1 to 7 weeks of age found that the weight of eggs affected all parameters estimated aside from the embryonic mortality, and furthermore asserted that chickens which hatch from biggest eggs had higher weight gain and live weight at 7 weeks than those incubated from medium and small eggs. The difference in hatchability between groups may be due to large eggs have nutrients higher than small eggs, so hatch chicks get his nutritional needs (Constantini and Panella, 1984). The results of Table 2 indicate a significant increase in males' rate which hatching from small eggs (66.66%), whereas highest females' rates were recorded in large eggs (66.26%). This results is agree with (Sturkie, 1986) who showed testosterone concentrations were higher for male eggs than for female eggs in eggs of prevailing females. Petrie et al. (2001) indicated the first explanation, avian embryos are known to produce levels of estradiol higher in female embryos and testosterone higher in male embryos by 7.5 days of incubation.On the other hand, the authors suggested that yolk maternal hormones could play an important role in sex determination at the early embryonic development in birds (Muller et al., 2005a). Muller et al. (2002) discovered contrasts in yolk levels of testosterone among male and female eggs and announced that hen social status was related with hen body weight.

Hatching Traits

The results of the effect of egg weight and yolk hormones after 10 days of incubation on the weight of hatch chick, the weight of dead embryos and embryonic mortality are shown in Table 3. The results significantly (P<0.05) influenced the weight of hatch chick and embryonic mortality. Large eggs (group C) had higher (P <0.05) weight of hatch chick (8.14g) compared with other groups (A and B). These findings were similar with that of Patra et al. (2016) who found similar results in poultry varieties, concluded that the higher weight of hatch chick is the result of higher nutrient content in larger eggs. On other hand, large eggs (group C) have lower (P<0.05) embryonic mortality (19.39%) compared with other groups (A and B). This result was similar with that of Farooq et al. (2001) who indicated the small eggs produced proportionately smaller chickens, which mostly suffer from subsequent growth and production performance than chicks hatched from larger eggs.The difference between groups may be due to large eggs have nutrients higher than small eggs, so hatch chicks get their nutritional needs (Constantini and Panella, 1984). Or maybe due to the large eggs contain most of yolk steroid hormones which increase the size and strength of the hatching muscle, which helps the chick as it breaks out of its shell (Lipar and Ketterson 2000, von Engelhardt et al., 2006). The results show no significant difference between groups in weight of embryos dead. From this study, we can conclude that, the concentration of yolk testosterone and male's rate was increased in small eggs whereas concentrations of yolk estradiol and female's rate were increased in large eggs. In addition, the large-sized eggs of Japanese quail are suitable for incubation for better hatchability, lower embryonic mortality and best chick's weight at hatch as compared to small sized eggs.

Table 1: Effect of egg weight on yolk testosterone (ng/ml) and estradiol (pg/ml) concentrations after 10 days of incubation (mean ± stander error)

Yolk hormones Groups	Testosterone concentrations (ng/ml)	Estradiol concentrations (pg/ml)
A	1.40 ± 0.057 a	.98 ± 0.005 b
B	1.20 ± 0.057 b	.99 ± 0.005 b
C	.99 ± 0.005 c	1.60 ± 0.057 a
Sig.	*	*

A: egg weight 8-9 g, B: egg weight 10-11 g, and C: egg weight 12-13 g.

* Means are significantlydifferent at p < 0.05.

Table 2: Effect of egg weight and yolk hormones after 10 days of incubation on hatchability and males, females' rate (mean ± stander error)

Traits Groups	Hatchability (%)	Males rate (%)	Females rate (%)
A	45.74 ± 0.26 c	66.66 ± 2.40 a	33.33 ± 2.40 c
B	77.73 ± 0.29 b	40.74 ± 0.15 b	59.26 ± 0.15 b
C	80.60 ± 0.28 a	33.73 ± 0.72 c	66.26 ± 0.72 a
Sig.	*	*	*

A: egg weight 8-9 g, contains 1.40 (ng/ml) testosterone and 0.98 (pg. /ml) estradiol, B: egg weight 10-11 g, contains 1.20 (ng/ml) testosterone and 0.99 (pg. /ml) estradiol and C: egg weight 12-13 g, contains 0.99 (ng/ml) testosterone and 1.60 (pg. /ml) estradiol.

* Means are a significantly different at p < 0.05

Table 3: Effect of egg weight and yolk hormones after 10 days of Incubation on the weight of hatch chick, the weight of dead embryos and embryonic mortality (mean ± stander error)

Traits Groups	The weight of hatch chick (g)	The weightof dead embryos (g)	Embryonic mortality (%)
A	6.73 ± 0.008 a	5.86 ± 0.637	54.26 ± 0.265 a
B	7.34 ± 0.230 b	6.36 ± 0.197	22.26 ± 0.297 b
C	8.14 ± 0.034 c	6.96 ± 0.035	19.39 ± 0.280 c
Sig.	*	N.S	*

A: egg weight 8-9 g, contains 1.40 (ng/ml) testosterone and 0.98

(pg./ml) estradiol , B: egg weight 10-11 g , contains 1.20 (ng/ml) testosterone and 0.99 (pg./ml) estradiol and C: egg weight 12-13 g, contains 0.99 (ng/ml) testosterone and 1.60 (pg./ml) estradiol. * Means are a significantly different at $p < 0.05$

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CONFLICT OF INTEREST

There is no conflict of interest.

REFERENCES

- Alabi OJ, Ngambi JW, Norris D, Mabelebele M (2012). Effects of egg weight on hatchability and subsequent performance of Potchefstroom Koekoek Chicks. Asian J. Anim. Vet. Adv. **7**: 718–725. https://doi.org/10.3923/ajava.2012.718.725
- Al-Salhie K Ch K (2012). Effect of in Ova Injection of Testosterone and Estrogen Hormones and Vitamin C on Some Reproductive, Physiological, Behavioral and Productive Traits of Japanese Quail (Coturnix japonica). Ph.D.Thesis, the University of Basrah.
- Anandh AM, Jagatheesan PNR, Kumar PS, Rajarajan G, Paramsivam A (2012). Effect of egg weight on egg traits and hatching performance of Turkey (*Meleagrisgallopavo*) eggs. Iranian J. Appl. Anim. Sci. **2**: 391–395.
- Aslam MA, Hulst M, Hoving-Bolink RA, Smits MA, De Vries B, Weites I, Groothuis TGG, Woelders H (2013). Yolk concentrations of hormones and glucose and egg weight and egg dimensions in unincubated chicken eggs, in relation to egg sex and hen body weight. Gen. Comp. Endocrinol. 15. 187:15-22. https://doi.org/10.1016/j.ygcen.2013.02.045
- Bowden RM, Ewert MA, Nelson CE (2000). Environmental sex determination in a reptile varies seasonally and with yolk hormones. Proceedings of the Royal Society B: Biolog. Sci. 267: 1745–1749.
- Brah GS, Chaudhary ML, Sandhu JS (2001). Direct and correlated responses to selection for 4-week body weight in two lines of Japanese quails. Arch. Tierz. Dummerstorf. 44 (1) 99-108. https://doi.org/10.5194/aab-44-99-2001
- Constantini F, Panella F (1984). Correlations between egg weight chick weight and broilers performance. Anim. Breed. 51: 35-40.
- Cunningham EJA, Russell AF (2001). Maternal investment – sex differences in avian yolk hormone levels – reply. Nature. 412. 498–499. https://doi.org/10.1038/35087655
- Eising CM, Eikenaar C, Schwabl H, Groothuis TGG (2001). Maternal androgens in black-headed gull (Larusridibundus) eggs: consequences for chick development. Proc. R. Soc. B 268" 839–846. https://doi.org/10.1098/rspb.2001.1594
- Elf PK (2003).Yolk steroid hormones and sex determination in reptiles with TSD**.** Rev. Gen. Comp. Endocrinol. 132: 349–355**.** https://doi.org/10.1016/S0016-6480(03)00098-4
- Farooq M, Aneela K, Durrani FR, Muqarrab AK, Chand N, Khurshid A (2001). Egg and shell weight, hatching and production performance of Japanese broiler quail. Sarhad J. Agric. **17**: 289–293.
- Gil D, Graves J, Hazon N, Wells A (1999). Male attractiveness and differential testosterone investment in zebra finch eggs. Sci. 286: 126–128. https://doi.org/10.1126/science.286.5437.126
- Groothuis TGG, Muller W, von Engelhardt N, Carere C, Eising CM (2005). Maternal hormones as a tool to adjust offspring phenotype in avian species. Neurosci. Biobehav. Rev. 29: 329–352. https://doi.org/10.1016/j.neubiorev.2004.12.002
- Kucukyilmaz K, Baser E, Erensayin C, Orhan H, Arat E (2001). Effect of egg weight on the hatchability, fattening performance and egg yield traits of Japanese quail. J. Central Anim. Res. Ins. 11: 6-12.
- Lipar JL, Ketterson ED (2000). Maternally derived yolk testosterone enhances the development of the hatching muscle in the red-winged blackbird Aegeliusphoeniceus. Proc. R. Soc. B 267. 2005–2010. (Doi: 10.1098/rspb.2000.1242.). https://doi.org/10.1098/rspb.2000.1242
- Muller W, Groothuis TGG, Kasprzik 1A, Dijkstra C, Alatalo RV, Siitari H (2005a)**.** Prenatal androgen exposure modulates cellular and humoral immune function of black-headed gull chicks**.** Proc. R. Soc. B. 272. 1971–1977**.** https://doi.org/10.1098/rspb.2005.3178
- Muller W, Eising CM, Dijkstra C, Groothuis TGG (2002). Sex differences in yolk hormones depend on maternal social status in Leghorn chickens (Gallus gallusdomesticus). Proceedings of the Royal Society B: Biolog. Sci. 269: 2249–2255.
- Muller W, Groothuis TGG, Eising CM, Daan S, Dijkstra C (2005b). Within clutch co-variation of egg mass and sex in the black-headed gull. J. Evol. Biol. 18: 661–668. https://doi.org/10.1111/j.1420-9101.2004.00859.x
- Patra MK, Sanchu V, Ngullie E, Hajra DK, Deka BC (2016). Influence of egg weight on fertility and hatchability of backyard poultry varieties maintained under institutional farm conditions. Indian J. Anim. Sci. 86(8): 869–872.
- Petek M, Baspinar H, Ogan M (2003). Effects of egg weight and length of storage on hatchability and subsequent growth performance of Quail. South African J. Anim. Sci. **33**: 242–247.
- Petrie M, Schwabl H, Brande-Lavridsen N, Burke T (2001). Sex differences in avian yolk hormone levels. Nature. 412. 498. https://doi.org/10.1038/35087652
- Pike TW, Petrie M (2005). Offspring sex ratio is related to paternal train elaboration and yolk corticosterone in peafowl. Biol. Lett. UK 1. 204–207. https://doi.org/10.1098/rsbl.2005.0295
- Pilz KM, Adkins-Regan E, Schwabl H (2005). No sex difference in yolk steroid concentrations of avian eggs at laying. Biol. Lett. 1: 318–321. https://doi.org/10.1098/rsbl.2005.0321
- Pilz KM, Quiroga M, Schwabl H, Adkins-Regan E (2004). European starling chicks benefit from high yolk testosterone levels during a drought year. Horm. Behav. 46: 179–192. https://doi.org/10.1016/j.yhbeh.2004.03.004
- Radder RS (2007). Maternally derived egg yolk steroid hormones and sex determination: Review of a paradox in reptiles, J. Biosci. 32(6): 1213–1220. https://doi.org/10.1007/s12038-007-0123-z
- Rashid A, Khan SH, Abbas G, Amer MY, Khan MJ, Iftikhar N (2013). Effect of egg weight on hatchability and hatchling weight in Fayoumi, Desi and crossbred (Rhode Island Red X Fayoumi) chickens, Vet. World. 6(9): 592-595. https://doi.

org/10.5455/vetworld.2013.592-595

- Rubolini D, Ambrosini R, Romano M, Caprioli M, Fasola M, Bonisoli-Alquati A, Saino N (2009). Within-clutch egg size asymmetry covaries with embryo sex in the yellow-legged gull Larusmichahellis. Behavioral Ecol. Sociobiol. 63: 1809–1819. https://doi.org/10.1007/s00265-009-0808-4
- Schmidt GS, Figueiredo EAP, Saatkamp MG, Bomm ER (2009). Effect of Storage Period and Egg Weight on Embryo Development and Incubation Results. Brazi. Jour. Poult. Sci. 11 (1) : 1-5. https://doi.org/10.1590/S1516-635X2009000100001
- Schwabl H (1997). The contents of maternal testosterone in the house sparrow *Passer domesticus* eggs vary with breeding conditions. Naturwissenschaften. 84: 1–3. https://doi.org/10.1007/s001140050418
- Schwabl H (1996a). Environment modifies the testosterone levels of a female bird and its eggs. J. Exper. Zool. 276: 157–163. https://doi.org/10.1007/s001140050418
- Schwabl H (1996b). Maternal testosterone in the avian eggenhances postnatal growth. Comparat. Biochem. Physiol. A. 114: 271–276. https://doi.org/10.1002/(SICI)1097-010X(19961001)276:2%3C157::AID-JEZ9%3E3.0.CO;2-N
- SPSS (2009). Statistical Packages of Social Sciences. Version 18.The USA.
- Sturkie PD (1986). Avian physiology. New York: Springer. Trivers R L, Willard DE (1973) Natural selection of parental ability to vary the sex ratio of offspring. Science. 179: 90–92 https://doi.org/10.1007/978-1-4612-4862-0.
- von Engelhardt N, Carere C, Dijkstra C, Groothuis TGG (2006). Sex-specific effects of yolk testosterone on survival, begging, and growth of zebra finches. Proc. R. Soc. Ser. B. 273. 65–70. https://doi.org/10.1098/rspb.2005.3274
- Wilson HR (1991). Interrelationship of egg size, chick size, post hatching growth and hatchability. World's Poult. Sci. J. 47: 5-20. https://doi.org/10.1079/WPS19910002