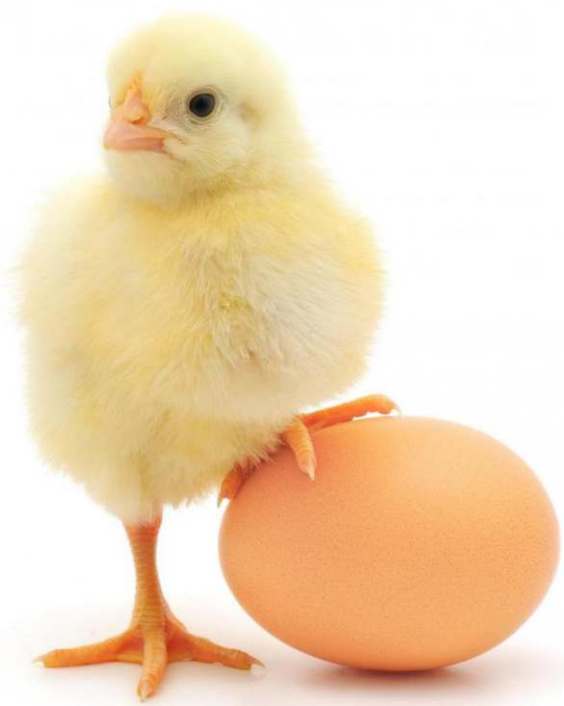
ISSN 1682-8356
ansinet.org/ijps



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 10 (8): 640-643, 2011
ISSN 1682-8356

Role of Body Weight on Reproductive and Physiological Traits in Japanese Quail Layers (*Coturnix japonica*)

Kashmiri L. Arora and Oreta Samples
Department of Veterinary Science, Fort Valley State University, Fort Valley, Georgia, USA

Abstract: The Japanese quail is a popular laboratory animal for scientific research. Its continued characterization is essential for attaining accurate and reliable results. This includes refining genetic and environmental variables that could affect its use in developmental biology, reproduction, physiology, nutrition, endocrinology and toxicology. The role of body weight as a means of assessing reproductive and physiological traits is presented here. Two groups of random bred Japanese quail layers of 240-days of age having a well-established production and fertility records but differing in body weights were used in the project. One group of birds (n = 10) weighed 120-130 grams (lighter birds) and the second group (n = 10) weighed 150-160 grams (heavier birds). The heavier birds had significantly higher weights of ovaries and oviducts as well as larger yellow-yolk containing ovarian follicles ($p<0.05$). The eggs laid by the heavier birds were also larger ($p>0.05$). Conversely, there was an increase in packed cell volume, plasma proteins and decrease in blood sugar levels ($p<0.05$) in the heavier birds as compared to the lighter birds. The body weight was found to have a distinct bearing on the weight of reproductive and physiological traits. One should be mindful of body weight when selecting Japanese quail for research projects.

Key words: Japanese quail, body weight, large yellow follicles

INTRODUCTION

A random breeding colony of Japanese quail has been maintained within our laboratory for the past seven years and has provided the subjects used in this project. Typically, the birds start laying eggs between d52 and d60 at 115-125 g body weight. While laying, the females continue to increase in weight and the majority of them maintain a stable weight of approximately 120-130 g, whereas, some females stabilize in weight gain at approximately 150-160 g. It was noted within our studies on growth and reproduction on Japanese quail that variances in body weight of the birds was causing significant anomalies within the collected data. Accordingly, this report was intended to: 1. Evaluate the relationship between body weight and the reproductive traits and 2. Evaluate the relationship between the body weight and physiological traits in the Japanese quail.

MATERIALS AND METHODS

Twenty random bred layers in production for 240-days were used. The birds were divided into two groups. Group I: weighing 120-130 grams and Group II weighing 150-160 grams; the difference was approximately 30 g (19.4%). All of the birds had excellent records of egg laying sequence and fertility. The birds were housed in wire cages, 3-4 birds per cage (15 x 12 x 15 inches) under a 16L:8D lighting system and provided free access to feed and fresh water. The birds were weighed and blood sampled from the brachial vein (0.5 mL) in EDTA coated hematocrit tubes with a lancet before being euthanized with carbon dioxide gas. The blood was processed for packed cell volume (PCV) using hematocrit centrifuge (14,000 RPM for 5 minutes). Plasma proteins were determined using lab refractometer (T2-NeAtago Co.) and blood sugar was determined using glucometer (Elite XL). After the oviducts and ovaries were removed and weighed to the nearest milligram (mg) using a Mettler balance. Each of the large ovarian follicles were removed from the ovaries and weighed to the nearest milligram (mg) and their diameters were measured across the stigma to the nearest millimeter (mm) using a vernier caliper. Follicles containing white yolk were not counted and measured. The data are given in means ± standard deviation. The mean values were compared using paired student t-test. The regression equation and correlation between follicular size and weights were also calculated. The significance was assessed using $p<0.05$.

RESULTS AND DISCUSSION

The birds used for this report came from a breeding colony being bred randomly in this laboratory for the past seven years. The birds were 240-days old hatch-mates in full production with a record of good fertility. They were housed in air-conditioned room (72-74°F), photoperiod of 16L:8D and had free access to feed and water. The only differences were the individual genotypes of the

Corresponding Author: Kashmiri L. Arora, Department of Veterinary Science, Fort Valley State University, Fort Valley, Georgia, USA

Table 1: Mean number, size and weight of follicles in hierarchy, ovary and oviduct (n = 10 birds)

Parameters	Group I	Group II	Sig.
Ovary (g)	5.02±0.89	7.32±1.04	*
Oviduct (g)	5.85±0.73	8.78±1.43	*
F-1 Follicles (g)	2.31	3.34	*
Weight of egg (g)	9.86	10.68	NS
PCV (%)	45.10±0.93	46.20±11.0	NS
Plasma proteins (g/dL)	4.72±0.21	6.22±0.18	*
Blood glucose (mg/dL)	267.80±15.7	195.30±11.3	*

Mean ± Standard deviation *Significant at p<0.05
Sig. = Significance NS = Not significant

Table 2: Mean weight and size of follicles containing yellow yolk in sequence (n = 10 birds)

	Group I		Group II		
	Wt. (g)	Size (mm)	Wt. (g)	Size (mm)	Sig.
F1	2.31*	16.3*	3.24*	19.8*	*
F2	1.35	11.6	1.68	14.7	NS
F3	0.63	7.3	0.59	8.0	NS
F4	0.21	6.5	0.51	7.4	NS
F5	-	-	0.18	4.4	-

NS = Non-significant, *Significant at p<0.05
F1 to F5 = Sequential follicles in the ovary
Sig. = Significance

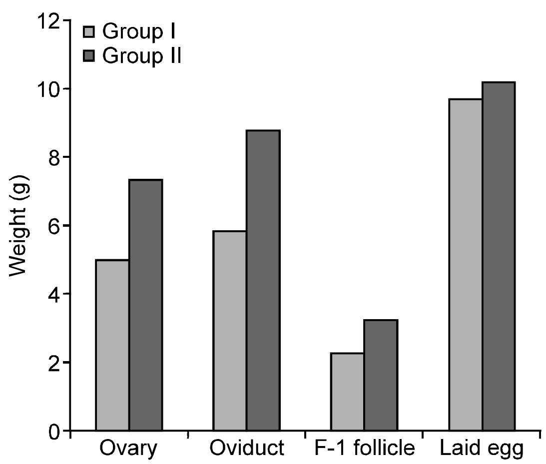


Fig. 1: Weight of ovaries, oviducts, F1 ovarian follicles and laid eggs in Group I and Group II birds

birds and a specified range of body weights; Group I weighing 120-130 g and Group II weighing 150-160 g, the difference of approximately 30 g (19.4%).

The ovaries weighed averagely 5.02g±0.89 (CV = 17.7%) in Group I birds and 7.32±1.04 g (CV = 14.2%) in Group II. The oviducts weighed averagely 5.85g±0.73 (CV = 12.5%) in Group I and 8.78±1.43 g (CV = 16.3%) in Group II. The data reflected that the heavier birds in Group II had relatively larger ovaries and oviducts compared to Group I birds of smaller body weight ($p<0.05$). The ovaries contained on average 4.2 and 5.4 large yellow-yolk containing follicles in Group I and Group II, respectively (Table 1, Fig. 1). The difference

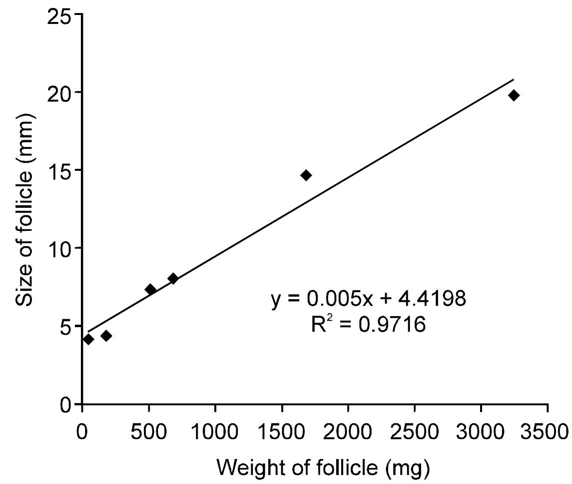


Fig. 2: Correlation coefficient and regression equation between follicle weight and size in Group I birds

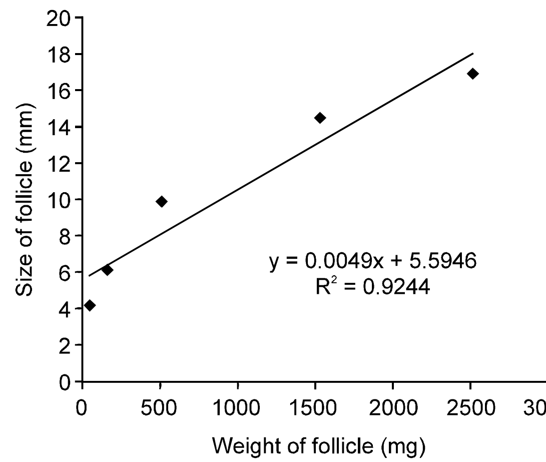


Fig. 3: Correlation coefficient and regression equation between follicle weight and size in Group II birds

was significant for the first (F1, the largest) follicles which were next in line for ovulation (3.34 vs. 2.31; $p<0.05$). Follicular hierarchy (F1 to F5) with respect to weight and size for both groups is presented in Table 2. Three out of ten heavy birds contained an additional yellow yolk follicle (measuring on average 4.45 mm and weighing 0.06 g). The correlation between weight and size of the follicles were highly significant ($p<0.01$); R^2 = 0.972 for heavy body weight and 0.924 for lighter body weight (Fig. 2 and Fig. 3). Furthermore, the eggs laid by the heavier birds (Group II) were relatively larger compared to Group I birds (10.2 g vs. 9.7 g; $p>0.05$). It seems reasonable to conclude that ovaries are more active in heavy weight birds compared to small body weight birds most likely due the availability of increased amount of gonadotropins and yolk constituents. With respect to body weight, Hocking (1996; 2004); Reddish *et al.* (2003) reported a linear relationship between body weight and the number of large yellow follicles in heavier birds compared to lighter birds at the onset of lay (sexual maturity). There was an increase of about 2.4 normal yellow follicles for every 1 kg increase in body weight and the age at egg lay had decreased.

There are several other factors known to cause increased body mass, reproductive traits and body composition which includes artificial selection over changes in several generations and feeding trials for improving meat and egg production in the Japanese quail. This has led to the development of heavier bird strains which are correlatively associated with higher proficiency with respect to body weight, egg production, hatchability, body fat deposition, body composition, skeletal mass and sexual maturity (Mark, 1993; El-Ibiary *et al.*, 1966; Bornsteins and Yule, 1984; Zelanka *et al.*, 1984 and a review by Vali, 2008). Photoperiods are also known to stimulate body growth and sexual organs (Wilson *et al.*, 1962; Chen *et al.*, 2007). It has also been demonstrated that exogenous hormone administration induced body growth, reproductive organs and the number of ovarian follicles in Japanese quail (Bennet, 2002; Prasad *et al.*, 2007). On the other hand, feed restriction or limited energy intake resulted in loss in body weight which, in turn, caused alterations in body composition and reduction in the number of ovarian follicles (Renema *et al.*, 1999a; 1999b; Hocking, 1993; Gebhardt-Henrich and Mark, 1995). It has also been reported that molting caused loss in body weight and regression of reproductive organs as well as correlative alterations in physiological parameters (Brake and Thaxton, 1979; Arora and Vatsalya, 2011). The birds used in this study did not receive any of the aforementioned treatments. Furthermore, the birds in this study, exhibited correlative responses in physiological parameters; the heavier birds (Group II) had higher plasma proteins (6.22 vs. 4.72 g/dl) when compared to the bird with lighter birds (Group I). Similarly, Packed Cell Volume (PCV) was higher in heavier birds (45.1 vs. 46.2%; $p>0.05$). This may be due to higher synthetic activity of the liver in the production of proteins and the bone marrow with respect to erythropoiesis. Interestingly, blood glucose level was lower in the heavy birds (267.8 vrs. 195.3 mg/dl; $p<0.05$). This probably resulted from hemodilution which normally accompanies ovulatory process from the secretion of increased level of estrogen hormone. Mark (1991) reported a direct relationship between plasma cholesterol level and body weight of the Japanese quail. Our data reflects clearly that body mass has a distinct bearing on body composition and physiological functions because of the fact that anatomy and physiology are intertwined to maintain body homeostasis.

Summary: The birds continued to gain weight after resuming egg production and became fixed at a set level of body weight of approximately 120-125 g (lighter body weight), whereas, some continued to gain weight and stabilized around 140-150 g, the body weights attributed by the complexity of individual inheritance (genetic make-up and timely expression of genes), energy consumption, metabolic rate, external environment and the level of gonadotropin and metabolic hormones. It should be noted, however, that both increases and decreases in body mass directly or indirectly influence body composition and reproductive and physiological traits. Our study clearly reflects that the body mass has a clear-cut bearing on body composition, reproductive organs and physiological functions. Accordingly, the weight of the bird should be given due consideration when planning an experiment using Japanese quail.

ACKNOWLEDGEMENT

The authors acknowledge the assistance of Ms. Urmil Marshall and Dr. Hari Singh in the preparation of this manuscript.

REFERENCES

Arora, K.L. and V. Vatsalya, 2011. Deleterious effects of molting on the morpho-physiology of Japanese quail layers (*Coturnix japonica*). Int. J. Poult. Sci., 10: 120-124.

Bennet Joan, E., 2002. Hormonal stimulation of ovarian development, ovulation and oviposition in Japanese quail: A thesis presented in partial fulfillment of the requirements for the degree of Doctor of Philosophy at Massey University, Palmerston North, New Zealand. http://hdl.handle.net/10179/1939.

Bornsteins, S. and P. Yule, 1984. Body weight and/or fatness as potential determinants of the onset of egg production in broiler breeder hens. Br. Poult. Sci., 25: 323-341.

Brake, J. and P. Thaxton, 1979. Physiological changes in caged layers during a forced molt. 1. Body temperature and blood constituents. Poult. Sci., 58: 699-706.

Chen, H., R.L. Huang, H.X. Zhang, K.Q. Di, D. Pan and Y.G. Hoa, 2007. Effects of photoperiod on ovarian morphology and carcass traits at sexual maturity in pullets. Poult. Sci., 86: 917-920.

El-Ibiary, E.F., Godfrey and C.S. Shaffner, 1966. Correlation between growth and reproductive traits in the Japanese quail. Poult. Sci., 45: 463-469.

Gebhardt-Henrich, S.G. and H.L. Mark, 1995. Effect of feed restriction on growth and reproduction in randombred and selected lines of Japanese quail. Poult. Sci., 74: 402-406.

Hocking, P.M., 1993. Effects of body weight at sexual maturity and the degree and age of feed restriction during rearing on the ovarian follicular hierarchy of broiler breeder females. Br. Poult. Sci., 34: 793-801.

Hocking, P.M., 1996. The role of body weight and food intake after photostimulation on ovarian function at first egg in broiler breeders females. Br. Poult. Sci., 3: 841-851.

Hocking, P.M., 2004. Role of body weight and feed intake in ovarian follicle dynamics broiler breeders at the onset of lay and after forced molt. Poult. Sci., 83: 2044-2060.

Mark, H.L., 1991. Body, abdominal fat and testes weight and line by sex interactions in Japanese quail divergently selected for plasma cholesterol in response to adrenocarticotropin. Poult. Sci., 70: 2395-2401.

Mark, H.L., 1993. Growth under different nutritional environments following selection in Japanese quail under specific environments. Poult. Sci., 72: 1841-1846.

Prasad, S.K., T.N. Qureshi, S. Saxena, S. Qureshi, M. Mehar and S.K. Thakur, 2007. L-Dopa feeding induces body growth and reproductive conditions in Japanese quail, *Coturnix coturnix japonica*. Int. J. Poult. Sci., 6: 560-566.

Reddish, J.M., K.E. Nestor and M.S. Lilburn, 2003. Effect of selection for growth on onset of sexual maturity in randombred and growth-selected lines of Japanese quail. Poult. Sci., 82: 187-191.

Renema, R.A., F.E. Robinson, M. Newcombe and R.I. Mickay, 1999a. Effects of body weight and feed allocation during sexual maturation in broiler breeder hens: 1. Growth and carcass characteristics. Poult. Sci., 78: 619-628.

Renema, R.A., F.E. Robinson, J.A. Proudman, M. Newcombe and R.I. Mckay, 1999b. Effect of body weight and feed allocation during sexual maturation in broiler breeder hens: 1. Ovarian morphology and plasma hormone profiles. Poult. Sci., pp: 629-636.

Vali, N., 2008. The Japanese quail: A review. Int. J. Poult. Sci., 7: 925-931.

Wilson, W.O., H. Abplanalp and L. Arrlington, 1962. Sexual development of coturnix as affected by changes in photoperiod. Poult. Sci., 41: 17-22.

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