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GENITALIA MORPHOMETRY OF WHITE FEMALE JAPANESE QUAILS AT THREE DIFFERENT AGE GROUPS

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ABSTRACT

An experiment was conducted to evaluate the genitalia morphometry of white female Japanese quails at three age groups. Twenty-seven (27) female Japanese quails were allotted to 3 treatment groups - pubertal (7-10weeks), mature (15-20weeks) and adults (≥ 24weeks) in a Completely Randomized Design. The initial weight of the female quails was taken and all quails were fed same diet for 7-8 weeks prior to the time of assessment. The birds were sacrificed when their ages were within the physiological age range for each group and their reproductive organs were carefully removed and weighed. Also, the reproductive organ was separated into its various parts and weighed using a sensitive laboratory scale. Morphometric parameters which include weights and lengths of ovary and the oviduct: infundibulum, magnum, isthmus, uterus and vagina, were recorded to the nearest 0.01g. The result of the study showed that live weight, length and weight of the ovary and oviducts were significantly ($p<0.05$) higher in pubertal quails than the other age groups except for the relative weight of magnum, isthmus and shell gland. It was observed that a positive correlation exist between weight of reproductive tracts and the three age groups of the female quails. It was observed that weight of total genital tract was positively and significantly correlated with ovary weight ($r=0.91$) and magnum weight ($r=0.87$), while magnum weight significantly correlated with ovary weight ($r=0.72$). This study suggests that the Morphometric traits and body weight from pubertal state declined with post pubertal age and that weight of the ovary, genital tract and body weight in white Japanese quails are positively correlated.

Keywords: Genital morphometry, White Japanese quails, Quail age group.

INTRODUCTION

The poultry industry predominated by the domestic fowl, is a major source of poultry meat and eggs. In a bid to expand the scope of meat and egg supply, relatively underutilized poultry species such as the quail, guinea fowl, duck and ostrich are now in focus (Akinola and Sese 2011). The Japanese quail commonly known as the Asian Migratory, Coturnix, Stubble, or Pharaoh quail originates from eastern Asia and was historically spread throughout Europe and Africa (Grimmett *et al*., 1999; Grewel, 2000). The Japanese quail was introduced into Nigeria in 1992 and has since gained tremendous interest among the Nigerian populace especially because of its highly prolific nature, short generation interval, fast growth rate and less susceptibility to common poultry diseases (Haruna *et al*., 1997).

Quails come into lay between 5 – 6 weeks of age (Anon, 1991) with 200 – 300 eggs laid in their first year of lay (NRC, 1991; Smith, 2001). The meat is lean and the egg is low in cholesterol with high quality protein value and low caloric content (Olubaniwa *et al*., 1999; Okon *et al*., 2007). Quail rearing is attractive due to their rapid growth and early onset of lay, high reproduction rates, and low feed intake (Albino and Barreto, 2003). The entire reproductive systems of the birds are necessary for breeding. The avian oviduct is a complex organ that undergoes a series of changes during the formation of an egg. Any alteration or deviation in the function of the oviduct can directly affect egg and egg shell quality. The avian oviduct has five segments namely infundibulum, magnum, isthmus, uterus and vagina with different function in the process of egg formation. Differentiation of oviduct segments can be used as a measure of maturation (Lucy and Harshan, 1999).

The female bird's reproductive tract consists of the left ovary and the left oviduct. The left and right ovary and oviduct develop embryonically as paired structures, but after hatching the right ovary and oviduct degenerate. In most species, the right ovary does not develop (Perrin *et al*., 1995). Pageaux *et al*. (1984) reported that rapid growth of the oviduct of Japanese quail began between 21 and 28 days of age and reach adult weight by 45 days while Lucy and Harshan (1999) reported 30 and 40 days of age and attains adult weight and functional maturity between 50 and 60 days of age.

Zelenka *et al.* (1984) reported that multiple threshold traits associated with growth and body composition are critical for the onset of sexual maturity. Wariboko and George (2015) reported that feed intake level and body weight were determinants for sexual maturity. The nutrient levels of the diets affect the gonad development, thus, the attainment of sexual maturity in Japanese quail (Akinola *et al*., 2012). Mean weights of ovaries and oviducts were influenced by molting in quails (Arora and Vatsalya, 2011). Increase and decrease in body mass of birds directly or indirectly influence body composition, reproductive and physiological traits (Arora and Oreta, 2011). 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 (Arora and Vatsalya, 2011).

Oladehinde (2014) reported that reproductive tract morphometry can be used to evaluate oviparous quality of Japanese quail layers. Histological, morphometric, ultra-structural and immunohistochemical studies in the male Japanese quail, domestic fowl, turkey and duck have been carried out (Aire and Ozegbe, 2007, Kouatcho *et al*. 2015). However, not many studies have been documented on the genitalia morphometry of female Japanese quails. Knowledge of the genitalia morphometry of female specie is very important as this can be applied to enhance increased production of quails. This study aims at grossly observing the morphometry of female reproductive organs of the Japanese quail, describe the development of the organs with their length and weight, and evaluate how it is influenced by age.

MATERIALS AND METHODS

Experimental site

The experiment was carried out at the quail section of the poultry unit of the Teaching and Research farm, and the Animal Physiology Laboratory, Department of Animal Science, University of Ibadan, Oyo state, Nigeria. The Research farm lies between latitude 7'27^{0}N and longitude 3'54^{0}E. It is about 200 – 300 meters above sea level.

Experimental animals and their management

Twenty-seven female Japanese quails used for the experiment were purchased from Teaching and Research Farm, University of Ibadan, Ibadan and raised in floor pens. The quails were divided into 3 treatment groups of nine birds per group based on their age as follows: Group 1: Pubertal (7-10 weeks old), Group 2: Mature (15-20 weeks old) and Group 3: Adults (≥ 24 weeks old). Each group was further divided into 3 replicates with 3 birds per replicate.

Throughout the experimental period, feed and water were provided for the quails *ad libitum.* The diet was formulated to contain 22% crude protein and 2500kcal/kg Metabolizable energy for 7-8 weeks prior to the time of assessment. The birds were sacrificed when their ages were within the physiological age range for each group and their reproductive organs carefully removed. The organs were labeled and subjected to morphometric assessment using appropriate procedures.

Genitalia morphometry assessment

The female Japanese quails from each age group were tagged and weighed using an analytical weighing balance. They were sacrificed, eviscerated and the reproductive organs were carefully removed. The total weight and length of the reproductive tract was taken. The reproductive organ was separated into its various parts and tagged for easy identification. The length of the various parts of the reproductive organs was also measured using a measuring ruler and recorded to the nearest 0.01g.

Statistical analysis

Data collected were analysed using the Pearson correlation analysis and One-Way Analysis of Variance (ANOVA) procedure of SAS (2003) and means were separated using Duncan Multiple Range Test procedure of the same software.

RESULTS

Length of reproductive tracts and its segments in the white female Japanese quails at different age groups

The length of various sections of the reproductive tract of female white quails at different age groups is presented in Table 1. The total tract length and length of the various segment of the reproductive tract were significantly ($P<0.05$) influenced by age group except the isthmus length. There was no significant difference in the total tract length of the mature female Japanese quails (20.9±9.19 cm) and that of the adult group but both were significantly lower than that of the pubertal group. The ovary length was significantly ($P<0.05$) higher in the pubertal group (6.08±2.36 cm) than that of birds in the mature (3.22±0.66 cm) and adult group (2.72±0.47 cm). It was however observed that there was no significant difference in the ovary length of the mature group and that of the adult group. The length of the isthmus was not significantly influenced by the age of the quails. Birds in the mature group had significantly ($P<0.05$) higher shell gland length (4.98±2.07 cm) than the adult group (3.02±0.64 cm). However, the shell gland length of the pubertal group (4.04±0.60 cm) was not significantly different from that of the mature and adult group.

Table 1: Length of reproductive tracts and its segments in the white female Japanese quails at different age groups

PARAMETERS	Pubertal 7-10 weeks	Mature 15-20 weeks	Adult ≥24 weeks
Whole tract (cm)	28.89±6.76[a]	20.90±9.19[b]	19.92±2.25[b]
Ovary (cm)	6.08±2.3s6[a]	3.22±0.66[b]	2.72±0.47[b]
Magnum (cm)	14.48±3.8[a]	11.14±4.20[b]	10.13±1.40[b]
Isthmus (cm)	4.43±0.31	4.24±1.00	3.56±1.13
Shell gland (cm)	4.04±0.60[ab]	4.98±2.07[a]	3.02±0.64[b]

a, b – Means in the same row with different superscript are significantly (p<0.05) different

Weight of the organs of the reproductive tracts of female Japanese quails

The relative weight of the reproductive tracts and its segments in the female white Japanese quails at different age groups is shown in Table 2. Live weight of the birds decreased significantly (p<0.05) with age of the birds. Pubertal female Japanese quails had significantly (p<0.05) higher weight of total tract (11.3±3.85%) than the mature (9.12±4.40%) and adult female Japanese quails (4.63±1.57 %). Ovary weights in pubertal (58.38±29.20 %) and adult (53.37±9.34%) female white Japanese Quails were not significantly different, however, the weights were significantly (P<0.05) higher than for those in the adult group (35.11±8.15 %). It was observed that there was no significant difference in the relative weight of magnum, isthmus and shell gland among the age groups.

Table 2: Relative weight of reproductive tracts and its segments in the white female Japanese quails at different age groups

PARAMETERS	Pubertal 7-10 weeks	Mature 15-20 weeks	Adult ≥24 weeks
Live Weight (g)	179.75±16.59[a]	152.32±7.73[b]	127.51±11.96[c]
Whole Tract (%)	11.3±3.85[a]	9.12±4.40[b]	4.63±1.57 [b]
Ovary (%)	58.38±29.20[a]	53.37±9.34[a]	35.11±8.15[b]
Magnum (%)	25.65±5.00	27.4±8.65	25.67±3.50
Isthmus (%)	5.92±4.19	6.94±5.29	4.74±1.96
Shell gland (%)	22.90±7.48	75.99±1.59	28.66±7.11

a, b, c – Means in the same row with different superscript are significantly (p<0.05) different

Correlation of lengths of the reproductive tracts and its segments in the white female Japanese quails at different age groups

The correlation analysis of the lengths of female reproductive organs of white Japanese quails is shown in Table 3. A negative but strong significant correlation exist between isthmus length and relative magnum length (r = -0.61). The relative isthmus length correlated significantly but negatively with magnum length (r = -0.69), while it significantly and positively correlated with the relative magnum length (r = 0.70). A significant and negative correlation was observed between relative shell gland length and magnum length (r = -0.503), isthmus length (r = -0.436) while it had a significantly strong and positive correlation with relative magnum length (r = 0.85) and relative isthmus length (r = 0.87). The ovary length had a significantly positive correlation with magnum length (r = 0.69), but a positive non-significant correlation with isthmus length (r = 0.18) and shell gland length (r= 0.09). A significant and positive correlation exits between the

relative ovary length and relative magnum (r= 0.74), isthmus (0.778) and shell gland (0.845) lengths while it had a significant but negative correlation with magnum (-0.392) and isthmus (-0.488) lengths.

Table 3: The correlation between lengths of reproductive organs and its sections in female white quails

PARAMETERS	Magnum length (cm)	Relative magnum length (cm)	Isthmus length (cm)	Relative Isthmus length (cm)	Shell gland length (cm)	Relative shell gland length (cm)	Ovary length (cm)	Relative ovary length (cm)
Magnum length (cm)	1							
Relative magnum length (cm)	-0.262	1						
Isthmus length (cm)	0.282	-0.610**	1					
Relative isthmus length (cm)	-0.690**	0.700**	-0.242	1				
Shell gland length (cm)	0.347	-0.011	0.249	-0.147	1			
Relative shell gland length (cm)	-0.503**	0.851**	-0.436*	0.865**	0.182	1		
Ovary length (cm)	0.536**	-0.337	0.186	-0.361	0.090	-0.299	1	
Relative ovary length (cm)	-0.392*	0.740**	-0.488**	0.778**	-0.097	0.845**	0.131	1

* - Significant (P< 0.05), ** - very significant (P< 0.01)

Correlation of weights of the reproductive tracts and its segments in the white female Japanese quails at different age groups

The correlation analysis of the weight of female reproductive organs of the white Japanese quails as shown in Table 4. It was observed that the ovary weight had a very significant, strong and positive correlation with the total tract weight (r = 0.91). A very strong, positive correlation exist between magnum weight and the total tract weight (r = 0.873) and ovary weight (r = 0.716) of the female quails. The relative magnum weight had a significant but negative correlation with the total tract length (-0.534), while it had a positive non-significant correlation with the relative ovary weight (r = 0.232). The weight of the isthmus had a significant and positive correlation with total tract weight (r=0.387) and magnum weight (r=0.506). A significant and positive correlation exist between the relative weight of the isthmus and the relative weight of the ovary (r=0.56) and magnum (r=0.654). However, a significant but negative correlation exist between the relative isthmus weight (r=-0.487) and magnum weight (r=-0.387).It was observed that a significant, positive correlation exist between shell gland weight and total tract (r=0.686), ovary (r=0.579) and magnum (r=0.705) weights. The relative shell gland weight had a significant and positive correlation with relative magnum weight (r=0.495) and relative isthmus weight (0.722). However, it had a negative, significant correlation with total tract weight (r=0.429) and magnum weight (r=-0.448). It was observed that the live weight of the female quails had positive and significant correlation with total tract (r=0.754), ovary (r=733), magnum (r=0.786) and shell gland (r=0.581) weights.

Table 4: The correlation between weights of reproductive organs and its sections in female white quails

PARAMETERS	Total tract weight (g)	Ovary weight (g)	Relative ovary weight (g)	Magnum weight (g)	Relative magnum weight (g)	Isthmus weight (g)	Relative isthmus weight (g)	Shell gland weight (g)	Relative shell gland weight (g)	Live Weight (g)
Total tract weight (g)	1									
Ovary weight (g)	0.916**	1								
Relative ovary weight (g)	0.033	0.357	1							
Magnum weight (g)	0.873**	0.716**	-0.026	1						
Relative magnum weight (g)	-0.534**	-0.469*	0.232	-0.235	1					
Isthmus(g)	0.387*	0.288	-0.027	0.506**	0.035	1				
Relative weight isthmus weight(g)	-0.487*	-0.329	0.560**	-0.387*	0.654**	0.042	1			
Shell gland weight (g)	0.686**	0.579**	0.044	0.705**	-0.172	0.275	-0.122	1		
Relative shell gland weight (g)	-0.429*	-0.362	0.121	-0.448*	0.495**	-0.122	0.722**	0.036	1	
Live Weight (g)	0.754**	0.733**	0.344	0.786**	-0.068	0.379	-0.011	0.581**	-0.119	1

* - Significant (P< 0.05), ** - very significant (P< 0.01)

DISCUSSION

Japanese quails reach sexual maturity in about 6 weeks and the females are able to produce about 200-300 eggs in the first year of lay, after having reached full egg production in 50 days (NRC, 1991; Smith, 2001). In this study, it was observed that the total tract length and length of the various segment of the reproductive tract were significantly influenced by age group of the female Japanese quail except the isthmus length. Several reports have been documented (Miclea *et al*., 2002; Li *et al*., 2006) establishing varying weights of reproductive organs in relation to age at sexual maturity. The significantly higher organ weight recorded in the pubertal group may be attributed to the higher level of circulating LH and FSH that may be present in the birds at this stage providing stimulation of steroid production and regulation of factors that modulate growth, development, and finally ovulation of the follicle (Ottinger and Bakst, 1995). Egg size increases with advancement of age in birds (Juliank and Christians, 2002), which could be influenced by changes in reproductive organ. A decline in female sex hormone profile such as LH and FSH could possibly result in decreased sexual and reproductive capacity in older animals.

Physiological age group significantly influenced the live weight of the birds which might be as a result of higher metabolic activities in the quails. The weight and length of some segments of the genital tract of the quails were not significantly influenced by the physiological age groups. This is in contrast to the findings of Ipek *et al*. (2003) who observed that breeder pairs distributed under 3 lighting conditions with respect to age did not affect organ morphometry in the experimental birds.

Positive, strong and very significant correlation between ovary weight and total tract weight suggests an efficient reproductive capacity of the female. Miclea *et al*. (2002) and Li *et al*. (2006) have reported that a close relationship exists between ovary-oviduct weight in females and age at sexual maturity, as controlled by factors such as genetics, body weight (Broody *et al*., 1980), chronological age, environmental and chemical composition of the animals (Zelanka *et al*., 1984) and nutrition (Hashiguishi *et al*., 1998). Gross morphometric analysis indicated that the ovary weight was significantly and strongly, positively correlated with oviduct parameters (Oladehinde, 2014). The positive and strong correlation observed between live weight and total tract weight suggests that the weight of the birds has a direct relationship with the development of the reproductive tract of the female supporting earlier reports (Osinowo *et al*., 1981; Sezer *et al.,* 2006; Ewuola and Egbunike, 2010).

CONCLUSION

In this study, age group did not influence the weight and length of the genitalia tract of the quails. However, ovary dimensions were highest at puberty compared to the mature and adult age groups. Pubertal female quails had better reproductive tract development than others. Based on these finding, it can be concluded that pubertal quail have well developed reproductive tracts and thus could have potential for high reproductive ability compared to other age groups. Farmers can do more breeding activity when the birds are at the pubertal stage.

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