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ORIGINAL ARTICLE

# Morphometric Studies of Digestive System of Japanese Quail (*Coturnix Coturnix Japonica*) of Different Age Groups

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## SUMMARY

Eighteen birds (six 4-week-old, six 8-week-old and six 12-week-old Japanese quails) of both sexes were used in this study. Post acclimatization, the birds were slightly sedated, weighed (live weights) and subsequently euthanized, dissected and the different parts of the gastrointestinal tract located and eviscerated from which the comparative morphometric studies were carried out. The numerical data generated were subjected to statistical analyses using the Microsoft Office Excel 2007 and Graphpad Prism Instant statistical package 4.0, with values of $P \leq 0.05$ considered significant. The arithmetic means (MEAN) and coefficients of variation (CV) for the traits studied were determined and the significance of differences between mean values for Japanese quails of different ages within the same sex and between males and females of the same age were then determined using Student's *t*-test. As Japanese quails age their body weight increases and the males had significantly ($P \leq 0.05$) greater GIT length than the females whereas the small intestine and colon were shorter in older than in younger birds. As Japanese quails became older there was increase in the length of the esophagus plus crop as well as caeca with the caeca length of the males differing significantly ($P \leq 0.05$) when compared with the females. In addition, Proventriculus plus gizzard, liver and heart weight increases with age, with the males having greater proventriculus plus gizzard and liver weight which differed significantly ($P \leq 0.05$). The internal organs of Japanese quails of different sexes differed in terms of weight and percentage in total body weight.

**Key words:** Morphometric, digestive system and Japanese quails.

## INTRODUCTION

The Japanese quail is a member of the pheasant (*Phasianidae*) family and is considered to be a separate species from the common quail (Ainsworth *et al.,* 2010). The Japanese quail was first introduced into Nigeria at National Veterinary Research Institute Jos, Plateau state on the 18th of December, 1992 (Musa *et al.*, 2008). Japanese quail is widely being used as a model in research in a variety of disciplines

including physiology, nutrition, endocrinology, pathology, embryology, reproduction and immunology. physiological and anatomical parameters serve as valuable tools for predicting outcome consequences (Tilgar *et al.*, 2008; Vatsalya and Arora, 2011). Determination of age of juvenile quail is by primary feather molt and replacement, as well as proper record keeping [South Carolina Department of National Resources (SCDNR, 2002)]. The adult males weigh about 100 g to 140 g while the females are slightly heavier, weighing from 120 g to 160 g. The males have cloacal glands; a bulbous structure located at the upper edge of the vent, which secrets a white foamy material (Musa *et al*, 2008).

Some reports have been published on the morphology and morphometry of the small intestine of some species of birds (Cassotti, 2001; Lavin *et al.*, 2008; Igwebuike and Eze, 2010; Wang and Peng, 2008; Mobini, 2011). However, there is paucity of information on the morphology and morphometry of the digestive system of the Japanese quail.The aim of this study is to perform a morphometric analysis of the various parts of the digestive tract of the Japanese quail of different age group.

## MATERIALS AND METHODS

### Study Area

Faculty of Veterinary Medicine, Department of Veterinary Anatomy, Animal Research Laboratory, Ahmadu Bello University, Zaria (11° 04′N, 7° 42′E), Kaduna State, located in the Northern Guinea Savannah zone of Nigeria. (ABU, 2000).

### Experimental Animals

A total of eighteen birds (six 4-week-old, six 8-week-old and six 12-week-old English white variety Japanese quails) of both sexes were used for this study. The birds were purchased from a quail farm in Samaru - Zaria, Kaduna State, Nigeria. They were housed in metal cages in the animal research laboratory, and allowed to acclimatize. The animals were fed on finisher mash and water was given ad libitum.

### Organs Collection

The birds were sedated lightly using chloroform, and weighed using a weighing balance with a sensitivity of 0.01g. They were euthanized by an overdose of chloroform soaked in cotton wool with each bird put in an enclosed container. The birds were then placed on dorsal recumbency and a caudo-cranial incision was made, starting from the vent to the shoulder joint on the lateral surface. The keel bone and associated muscles were then reflected to the opposite side thereby giving access to the viscera. The organs (oesophagus, crop, proventriculus, gizzard, small intestine ceca and colon) were observed in situ and exteriorized.

### Morphometric Studies

Thelength and weight of the digestive organs were measured. Thelengths of the organs were measured using ruler and thread. The organs were weighed using a digital electronic balance (American partner in Technology, G & G measurement plant, size 329 x 263 x 133 mm, 2.5 Kg, d= 0.01g) with a sensitivity of 0.01g.

### Statistical Analysis

The data were expressed as arithmetic means (MEAN) and coefficients of variation (CV) for the traits. The significance of differences between mean values for Japanese quails of different ages within the same sex and between males and females of the same age were determined using One-way Anova and the Student's *t*-test respectively.

The statistical package used was Graphpad prism version 4.0 for windows (2003) from Graphpad software, San Diego, California, USA (www.graphpad.com). Values of $P < 0.05$ were considered significant.

**TABLE 1:** GIT length, body and GIT weight and their ratio in quails of different ages

| Traits | | 4 weeks | | 8 weeks | | 12 weeks | |
|---|---|---|---|---|---|---|---|
| | | Males[a] | Females[a] | Males[b] | Females[b] | Males[c] | Females[c] |
| Body weight (g) | mean | 40.82 | 39.13 | 101.70 | 96.33 | 109.00 | 93.72 |
| | CV | 9.25 | 3.63 | 14.33 | 18.29 | 13.97 | 7.50 |
| Weight of GIT (g) | mean | 8.36 | 8.23 | 17.33 | 19.33 | 20.51 | 20.78 |
| | CV | 10.58 | 7.50 | 3.33 | 19.58 | 13.32 | 21.30 |
| Length of GIT (cm) | Mean | 53.53 | 52.63 | 63.67 | 62.60 | 79.83 | 71.30 |
| | CV | 10.49 | 6.52 | 4.11 | 11.24 | 3.40 | 9.60 |
| Body : GIT weight ratio | Mean | 4.88 | 4.75 | 5.87 | 4.98 | 5.31 | 4.51 |

a, b and c - mean values of traits in rows with different letters separately for males and females differ significantly ($p \leq 0.05$)

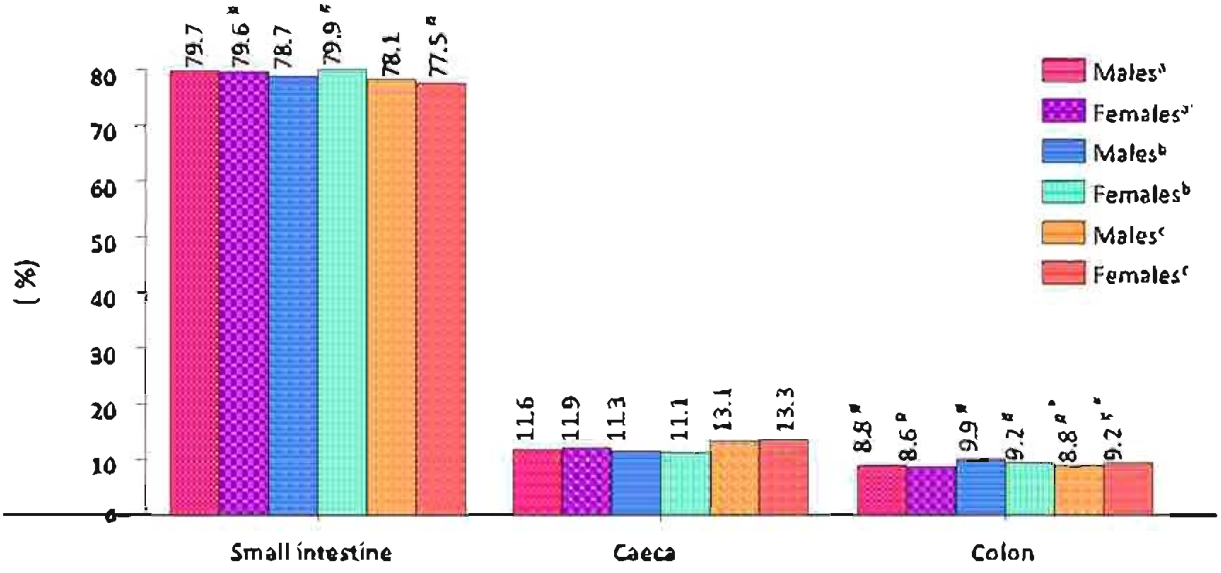


**FIGURE I:** Percentage length of intestinal segments in male and female Japanese quails aged 4, 8 and 12 weeks;
a, b, c – mean values of traits in rows with different letters, separately in males and females, differ significantly ($P \leq 0.05$) except in ($x^{a}$)
($X^{*}$) mean value for different sexes of birds of the same age differ significantly ($p \leq 0.05$)

## RESULTS

The means with their respective coefficient of variation (CV) for body weight, gastrointestinal tract (GIT) weight, GIT length and body weight to GIT weight ratios in Japanese quails of different age groups are summarized in Table I. Morphometrical data of weights and lengths of some parts of the GIT of Japanese quail were presented in Table II and Table III respectively.

The mean total length and weight with respective coefficient of variation of the intestine in Japanese quails of different age groups are summarized in Table IV.

The percentage length of intestinal segments in males and females Japanese quails of different age groups are represented in Figure 1.

**TABLE II:** Morphometrical data of weights of some parts of the GIT of Japanese quails

| Traits | | 4 weeks | | 8 weeks | | 12 weeks | |
|---|---|---|---|---|---|---|---|
| | | Males[a] | Females[a] | Males[b] | Females[b] | Males[c] | Females[c] |
| Esophagus and crop(g) | Mean | 0.47[#] | 0.46[#] | 2.00[#] | 2.67[#] | 1.42[#] | 1.51[#] |
| | CV | 14.27 | 20.74 | 50.00 | 57.28 | 21.93 | 4.89 |
| Proventriculus and Gizzard(g) | Mean | 2.15 | 2.47 | 4.32 | 3.00 | 5.98 | 4.74 |
| | CV | 6.76 | 8.13 | 13.32 | 33.33 | 17.57 | 9.55 |
| Small intestine(g) | Mean | 2.72 | 2.79[#] | 5.67 | 6.67[#] | 5.60 | 7.84[#] |
| | CV | 23.00 | 5.65 | 10.19 | 22.91 | 28.69 | 56.41 |
| Caeca (g) | Mean | 0.51 | 0.50 | 1.00 | 1.67 | 1.34 | 1.39 |
| | CV | 51.52 | 14.66 | 0.58 | 34.64 | 33.22 | 33.48 |
| Colon(g) | Mean | 0.82[#] | 0.43 | 1.67[#] | 2.00 | 1.40[#] | 1.66 |
| | CV | 54.77 | 21.01 | 34.64 | 50.00 | 23.42 | 8.43 |
| Liver(g) | Mean | 1.69 | 1.58 | 4.00 | 3.33 | 4.77 | 3.64 |
| | CV | 9.19 | 16.59 | 25.00 | 17.32 | 13.31 | 13.24 |

a, b and c - mean values of traits in rows with different letters separately for males and females differ significantly ($p \leq 0.05$) except in ($x^{\#}$)

**TABLE III**: Morphometrical data of lengths of some parts of the GIT of Japanese quails

| Traits | | **4 weeks** | | **8 weeks** | | **12 weeks** | |
|---|---|---|---|---|---|---|---|
| | | Males[a] | Females[a] | Males[b] | Females[b] | Males[c] | Females[c] |
| Esophagus and crop (cm) | Mean | 5.93 | 5.93 | 6.67 | 6.67 | 8.80 | 10.63 |
| | CV | 13.62 | 8.31 | 11.46 | 22.91 | 3.94 | 16.57 |
| Proventriculus and Gizzard (cm) | Mean | 2.83 | 2.30 | 3.70 | 3.76 | 4.10 | 4.04 |
| | CV | 5.39 | 35.59 | 7.87 | 17.07 | 4.88 | 11.18 |
| Small intestine (cm) | Mean | 35.67 | 35.33[#] | 41.97 | 41.67[#] | 52.30 | 43.90[#] |
| | CV | 16.61 | 11.78 | 5.33 | 9.70 | 6.89 | 18.18 |
| Cecum (cm) | Mean | 5.17 | 5.27 | 6.04 | 5.79 | 8.76 | 7.53 |
| | CV | 2.96 | 4.81 | 16.67 | 9.90 | 19.50 | 5.99 |
| Colon (cm) | Mean | 3.93 | 3.80 | 5.29 | 4.79 | 5.87* | 5.20* |
| | CV | 24.69 | 18.98 | 24.35 | 15.80 | 3.55 | 5.09 |
| Pancreas (cm) | Mean | 3.30 | 2.97 | 3.60 | 3.83 | 4.63 | 5.17 |
| | CV | 18.92 | 5.15 | 2.78 | 3.98 | 6.94 | 2.96 |

a, b and c- mean values of traits in rows with different letters separately for males and females differ significantly ($p \leq 0.05$ ) except in ($x^{\#}$)
($x^{\#}$) mean value for different sexes of birds of the same age differ significantly ($p \leq 0.05$ ).

## DISCUSSION

Table II showed that the mean weights of the small intestine in the quails were 2.72 g and 2.79 g, 5.67 g and 6.67 g, and 5.60 g and 7.84 g respectively for males and females in 4 week, 8 week and 12-week-old while their mean lengths were 35.67 cm and 35.33 cm, 41.97 cm and 41.67 cm and 52.30 cm and 43.90 cm respectively for males and females in 4 week, 8 week and 12-week-old (Table III). This finding is in contrast to the findings of Brugger (1991) who found out that the total small intestinal length was between 20.1 to 21.4 cm in the red winged blackbird; though the bird types used were not the same but they all belong to the same family

Figure 1 indicated that as the quail increased in age, the percentage length of the small

**TABLE IV:** Total length and weight of the intestine in Japanese quails of different ages

| Traits | | 4 weeks | | 8 weeks | | 12 weeks | |
|---|---|---|---|---|---|---|---|
| | | Males[a] | Females[a] | Males[b] | Females[b] | Males[c] | Females[c] |
| Total intestine weight | Mean | 4.05 | 3.72 | 8.33 | 10.33 | 8.34 | 10.89 |
| | CV | 14.81 | 3.92 | 7.53 | 20.15 | 17.63 | 39.25 |
| Total intestine length | Mean | 44.77 | 44.40[#] | 53.30 | 52.17[#] | 66.93 | 56.63[#] |
| | CV | 13.26 | 9.95 | 3.39 | 9.65 | 4.12 | 14.99 |

a, b and c - mean values of traits in rows with different letters separately for males and females differ significantly ($p \leq 0.05$) except in ($x^{\#}$)

intestine decreased, with significant difference ($P \leq 0.05$) only in males. While that of the caeca decreased between 4 week and 8 week of age with mean values separately for males and females differing significantly ($P \leq 0.05$) and the greatest variation was observed in 12 week of age. The colonic percentage length increased with coefficient of variation of 24.69% and 18.98% as well as 24.35% and 15.80% respectively for males and females in 4 weeks and 8 weeks of age. There were no significant differences ($P > 0.05$) in mean colon length separately within males and females, but there was significant difference ($P \leq 0.05$) in mean colonic length between males and females of 12 week of age. This finding was in agreement with that of Kokoszyñ-ski *et al.*, (2010) on 16-week-old game pheasants, in which he found that the total intestine and small intestine length was greater in males than in females.

## CONCLUSION

In this study we have attempted to present base-line data comprising the morphometric observation of the various parts of the digestive tract of the Japanese quails of different age groups to the best of our knowledge. This may be useful in comparative anatomy, and also pharmacologic and toxicological investigation.

## RECOMMENDATION

There is need to carry out studies on the morphometry of the entire length of the digestive system of day-old Japanese quail. Further morphometric studies on the digestive system of all the varieties of the Japanese quail to improve our knowledge about their biology is needed so as to provide base-line data for further research work.

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