Original article

Some aspects of the neurometrics and oculometrics of the japanese quail (*Coturnix coturnix japonica*) in Nigeria

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Abstract

A study of the neurometrics and oculometrics of the Nigerian Japanese quail (*Coturnix coturnix japonica*) was done using twenty (20) male and fifteen (15) female adult quails. The mean brain weight, relative eyeball weight, relative brain weight were 0.71 ± 0.07 g, 0.56%, 0.5% respectively. The values obtained for the mean brain weight, length and depth of the cerebrum, weights of right and left eyes were slightly higher in the females (0.75 ± 0.04 g, 0.94 ± 0.21 cm, 0.74 ± 0.08 cm, 0.42 ± 0.02 g, 0.43 ± 0.02 g respectively) relative to the males (0.70 ± 0.08 g, 0.81 ± 0.12 cm, 0.65 ± 0.08 cm, 0.40 ± 0.02 g, 0.39 ± 0.03 g respectively). This showed that the heavier head weights in the males (6.69 ± 0.56 g, females-6.4 ± 0.53 g) did not necessarily imply heavier brains or eyeballs. Results obtained provide added information to avian neuroanatomy and oculometrics, and can serve as baseline data in applied and comparative research.

Keywords: Japanese quail, ocular morphometry, neuro-morphometry, Nigeria.

1 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, STANLEY and EVANS, 2010). Most of the developing countries are presently at a stage of perpetual protein hunger. Poultry meat and eggs, though the major source of animal protein, is still now unable to meet up the protein hunger of the world. Nowadays, in some areas, quail farming is cropping up as a new venture of diversification of poultry farming, not only to diverse the choice of taste but also to strengthen the meat production unit for fulfilling the shortage of animal protein demands amongst the non-vegetarians (DEKA and BORAH, 2008).

The Japanese quail is easy to handle, is an excellent laboratory animal for research and it has a short generation period. It has been used widely as an experimental animal, but to the best of the authors' knowledge, no work has been reported about the neurometrics and oculometrics of those found in Nigeria.

The aim of this study is to provide a comparative baseline data on the neurometrics and oculometrics of the Japanese quail in Nigeria.

2 Materials and methods

Twenty male and fifteen female adult quails were used for this experiment. They were obtained from the breeder unit of the Nigerian Veterinary Research Institute (NVRI) substation, Ikire, Osun State, Nigeria. They were weighed prior to being sacrificed, anaesthesized with xylazine-ketamine combination and the heads severed at the atlanto-occipital junction. The brain and eyes were removed immediately. The weights were recorded in grams.

Neurometry: The brains were removed immediately after sacrifice according to the method described by Olopade and Onwuka (2002). They were weighed using My weigh i201® digital weighing balance and placed in phosphate buffered formalin, after which the following parameters were measured using a Draper® 115 mm vernier caliper: lengths of brain, cerebrum, cerebellum; depth of brain, cerebrum, cerebellum and the width of cerebellum and cerebrum. The measurements were taken to the nearest 0.05 cm. The linear measurements were taken according to the landmarks in Figures 1-3.

Oculometry: The eyeballs were removed according to the method described by Olopade, Kwari, Agbashe et al. (2005). They were weighed immediately after removal using My weigh i201® digital weighing balance; and the dorso-ventral (circumference from the upper to lower eyelid) and the medio-lateral circumferences were measured. The ocular dimensions were measured using a thin twine, which was measured against a meter rule to get the exact measurement which were taken to the nearest 0.05 cm.

Statistical analysis: All values were statistically analyzed using the Student's *t* test. Level of significance was at $p < 0.05$.

3 Results

The mean weight of head for this study was 6.64 ± 0.56 g (ranging from 5.6 to 7.85 g), with the males having a mean value of 6.69 ± 0.56 g and the females 6.4 ± 0.53 g (Tables 1 and 2), while the mean weights for the right and left eyeballs were 0.40 ± 0.02 and 0.40 ± 0.03 respectively.

The females had higher values for the mean brain weight, length and depth of the cerebrum, weights of right and left eyes (0.75 ± 0.04 g, 0.94 ± 0.21 cm, 0.74 ± 0.08 cm, 0.42 ± 0.02 g, 0.43 ± 0.02 g respectively) relative to the males (0.70 ± 0.08 g, 0.81 ± 0.12 cm, 0.65 ± 0.08 cm, 0.40 ± 0.02 g, 0.39 ± 0.03 g, respectively) (Tables 3 and 4).

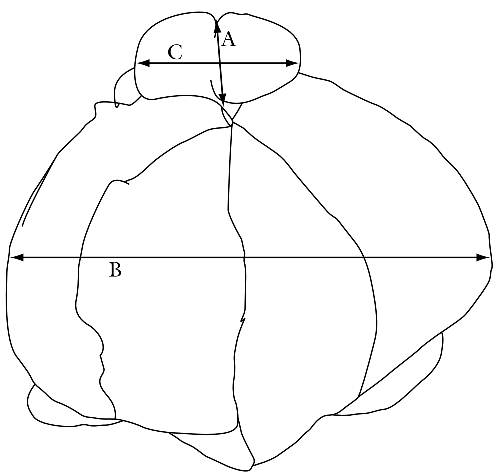

Figure 1. Schematic diagram of rostral view of the quail brain showing the landmarks for morphometry. A = Depth of cerebellum; B = Width of cerebrum; C = Width of cerebellum.

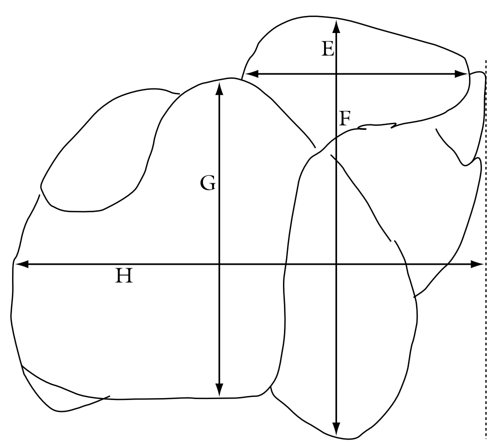

Figure 2. Schematic diagram of lateral view of the quail brain showing the landmarks for morphometry. E = Length of cerebellum; F = Depth of brain; G = Depth of cerebrum; H = Length of brain.

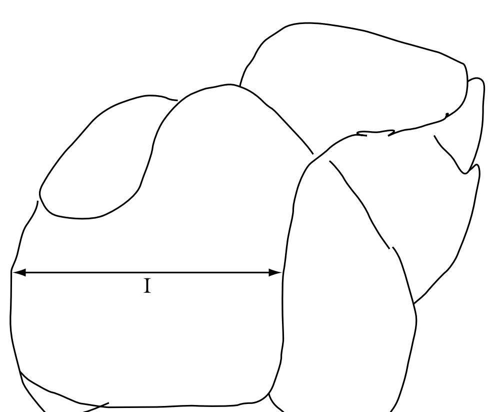

Figure 3. Schematic diagram of lateral view of the quail brain showing the landmarks for morphometry. I = Length of cerebrum.

There was a strong positive correlation between the body weight and the eyes (right eye, r = 0.953; left eye, r = 0.987) relative to the weight of the head (r = 0.026), and the brain (r = 0.141) also, there was strong positive correlation between the left and right eyeball weights of female quail (r = 0.807) relative to the males (r = 0.261).

No statistically significant difference was observed between the male and female parameters ($p > 0.05$).

4 Discussion

In this study, the brain accounted for about 0.5% of the body weight and 10.7% of the weight of the head. The brain/body relative weight obtained is similar to that reported in the Sahel, West African dwarf and the Red Sokoto breeds of goats found in Nigeria, lower than 2.5, 1.0, 0.8% of humans, cats and dogs respectively but higher than the 0.18, 0.178, 0.167% in the lion, elephant and horse respectively (KUHLENBECK, 1973).

The slightly higher values obtained for the cerebral and cerebellar lengths and depths in the females (0.94 ± 0.21 cm, 0.74 ± 0.08 cm, 0.6 ± 0.08 cm, 0.55 ± 0.12 cm respectively) relative to the males (0.81 ± 0.12 cm, 0.65 ± 0.08 cm, 0.56 ± 0.13 cm, 0.5 ± 0.06 cm respectively) may imply better and stronger muscular movement and also a response to a specialized motor activity in the females, since the cerebrum ensures that movements are executed as intended and the cerebellum is involved in motor learning and cognitive function in humans.

The two eyeballs account for about 0.56% of the body weight and 12.1% of the weight of the head. This differs greatly from the findings of Crile and Quiring (1940) who gave the eyeball to body weight percentage of the sparrow hawk as 2.946%. The percentage weight of the eyeballs to the brain is 112.68%, a value close to the 108.82% in chickens (LATIMER, 1951). This small difference could be due to the fact that small animals have relatively larger eyeballs. The mean eyeball weights obtained in this study ranged from 0.32 - 0.45 g, this is considerably smaller than the 3.00 g obtained in rabbits (OLOPADE, KWARI, AGBASHE et al., 2005). The empirical formula for determining the weight of the eyeball in guinea pigs using the body weight (LATIMER, 1951), when used in the Japanese quails in this study gave values that were very close to the actual values obtained.

$$Y = 0.0006X + 0.5966 \quad (1)$$

Where Y is the weight of the two eyeballs and X is the body weight, both in grams.

A slight asymmetry was observed in the oculometrics. This is consistent with asymmetries previously reported in vertebrates (MERCOLA and LEVIN, 2001; OLOPADE, KWARI, AGBASHE et al., 2005). This asymmetry could be due to differences in thickness of structures, or viscosity and weight of the eye fluids.

The fact that the females had higher values for most of the neurometric and oculometric parameters measured, although no statistically significant difference was observed ($p < 0.05$), could indicate gender-based variability.

Relative to the body weight, the eyes showed the highest variability (higher than the head and brain), showing that

Table 1. Neurometrical data of the Japanese quail, n = 35.

Parameters	WOA (g)	WOH (g)	WOB (g)	LOB (cm)	DOB (cm)	LOC (cm)
N = 35	143 ± 16.9	6.64 ± 0.56	0.71 ± 0.07	1.26 ± 0.13	1.01 ± 0.10	0.84 ± 0.15
Parameters	**DOC (cm)**	**WOC (cm)**	**LOCB (cm)**	**DOCB (cm)**	**WOCB (cm)**	
N = 35	0.67 ± 0.09	1.28 ± 0.07	0.58 ± 0.12	0.51 ± 0.08	0.53 ± 0.08	

Table 2. Neurometrical data based on sex.

Parameters	WOA (g)	WOH (g)	WOB (g)	LOB (cm)	DOB (cm)	LOC (cm)
Male; n = 20	136 ± 10.2	6.69 ± 0.56	0.70 ± 0.08	1.3 ± 0.13	1.02 ± 0.12	0.81 ± 0.12
Female; n = 15	163 ± 18	6.4 ± 0.53	0.75 ± 0.04	1.2 ± 0.07	1.0 ± 0.07	0.94 ± 0.21
Parameters	**DOC (cm)**	**WOC (cm)**	**LOCB (cm)**	**DOCB (cm)**	**WOCB (cm)**	
Male; n = 20	0.65 ± 0.08	1.28 ± 0.07	0.56 ± 0.13	0.5 ± 0.06	0.54 ± 0.09	
Female; n = 15	0.74 ± 0.08	1.3 ± 0.09	0.6 ± 0.08	0.55 ± 0.12	0.5 ± 0.04	

Key: WOA - weight of bird; WOH - weight of head; WOB - weight of brain; LOB - length of brain; DOB - depth of brain; LOC - length of cerebrum; DOC - depth of cerebrum; WOC - width of cerebrum; LOCB - length of cerebellum; DOCB - depth of cerebellum; WOCB - width of cerebellum.

Table 3. Ocular morphometric dimensions.

Parameters	RE wt (g)	LE wt (g)	REDV (cm)	REML (cm)	LEDV (cm)	LEML (cm)
N = 35	0.40 ± 0.02	0.40 ± 0.03	2.95 ± 0.20	3.23 ± 0.23	2.93 ± 0.19	3.19 ± 0.16

Table 4. Ocular morphometric dimensions based on sex.

Parameters	RE wt (g)	LE wt (g)	REDV (cm)	REML (cm)	LEDV (cm)	LEML (cm)
Male; n = 20	0.40 ± 0.02	0.39 ± 0.03	2.97 ± 0.22	3.22 ± 0.24	2.88 ± 0.17	3.15 ± 0.15
Female; n = 15	0.42 ± 0.02	0.43 ± 0.02	2.9 ± 0.14	3.3 ± 0.21	3.1 ± 0.21	3.3 ± 0.12

Key: RE wt - weight of right eyeball; LE wt - weight of left eyeball; REDV - dorsoventral circumference of the right eyeball; REML - mediolateral circumference of right eyeball; LEDV - dorsoventral circumference of the left eyeball; LEML - mediolateral circumference of left eyeball.

they were the most likely to increase in size when there is an increase in body weight.

These results obtained will provide baseline data for neuroanatomical and ocular dimensions in the Japanese quail and may also be valuable in comparative anatomy and assessment of gross neuro and ocular pathologies.

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