# GROSS MORPHOMETRIC STUDIES ON THE EYEBALL OF THREE NIGERIAN GENOTYPES OF CHICKEN WITH REFERENCE TO SEXUAL DIMORPHISM

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## ABSTRACT

Thirty apparently healthy adult Normal feathered (NC), naked neck (NN) and frizzle feather (FF) genotypes of Nigeria indigenous chickens (fifteen males and fifteen females all above one year of age) were purchased from local market in Mokwa and slaughtered. The heads were collected for gross morphometric studies. Both right and left eye balls were collected and their gross morphometric measurements were recorded for all the birds. The weight of the eyeball (WOE) was determined by electronic weighing balance. The Medio-lateral circumference of the eyeball (MLC; the circumference of the eyeball along the mediolateral plane; equatorial), Antero-posterior circumference of the eyeball (APC; the circumference of the eyeball, around the median plane from the anterior to the posterior pole; polar), iris diameter (IR), corneal diameter (CD) and sclera diameter (SD) were measured with the help of a digital Vernier caliper. The eye balls data obtained were expressed as mean $\pm$ SD (Standard Deviation) and subjected to Multivariate Analysis of Variance (MANOVA) using SPSS. The results have provided eye ball morphometrics of the chicken genotypes in Nigeria. There was significant difference in eye ball morphometric parameters among the genotypes. The WOE, APC, MLC and SD are significantly ($p<0.05$) different between the male and the female chicken genotypes. It was observed that males had wider circumferences of eyeball than the females in all genotypes. The results are valuable in clinical comparative avian ocular anatomy and in the assessment of avian ocular pathologies

**Key words: Morphometric studies, Eyeball, genotype, Chicken**

## INTRODUCTION

In Nigeria, indigenous chickens were characterized along genetics line of feather and plumage colour (such as normal or frizzle feathered), body structure (such as Naked neck, dwarf type) and colour variants (such as Black, white, brown etc.). The indigenous poultry species represent valuable resources for livestock development because their extensive genetic diversity allows for rearing of poultry under varied environmental conditions, providing a range of product and functions. Thus, great genetic resources embedded in the indigenous poultry await full exploitation that will provide basis for genetic improvement and diversification to provide breeds that adapted to local condition for the benefit of farmers in developing countries (Horst, 1988; Sonaiya *et al.*, 1999). The vertebrate organ of vision comprises a number of structures: the globe of the eye (bulbus oculi), the optic nerve, the eyelids (palpebrae), lacrimal gland and nictitating gland, ocular and extra-ocular muscles and the bones that form the orbit (Dyce *et al*. 2010). The eye is like a camera; light let on by the cornea is controlled by the pupil and is charged into electrical signals by the retina and sent to the brain where the signals are interpreted into visual images (Guyton, 1989). Important ocular morphometric indices include, body weight, eye ball weight, equatorial, polar and corneal diameters. Some of these indices had been reported in domestic fowl in general (Venkatesan and Ramesh, 2006). While increasing number of studies is being done in Nigerian chicken genotypes, the ocular anatomy suffers relatively from lack of research attention; thus, there is still a dearth of information on the gross morphometry of the eyeball in these chickens. This study aims to determine and compare the measurements of the eyeball in the Nigerian chicken genotypes.

## MATERIALS AND METHODS

The present study was conducted in the Anatomy Laboratory, Department of Animal Health and Production Technology, Niger State College of Agriculture, Mokwa, North central, Nigeria. Mokwa is located at the Latitude $9^0$19'38' North and Longitude $5^0$3'16' East (Google map, 2022). Thirty apparently healthy adult Normal feathered (NC), naked neck (NN) and frizzle feather (FF) genotypes of Nigeria indigenous chickens (5 males and five females per genotype, all above one year of age) were purchased from local market in Mokwa. They were quarantined for two weeks and stabilized for another two weeks in a pen at poultry unit, livestock farm of the college. They were fed commercial grower diet (Animal care(R) feed); within these periods and water *ad libitum* under a good management practice. At the end of these periods, all birds were fasted for 12 hours, live body weights were recorded and then all of them were slaughtered using *Halal* method (Willson, 2005) of slaughtering. They were allowed to bleed for two (2) minutes before been de-feathered. The heads were collected for gross morphometric studies. Both right and left eye balls were collected and their gross morphometrical measurements were recorded for all the birds. The weight of the eye ball was determined by electronic weighing balance. The Medio-lateral circumference of the eyeball (MLC) (The circumference of the eyeball along the mediolateral plane; equatorial)**,** Antero-posterior circumference of the eyeball (APC) (The circumference of the eyeball, around the median plane from the anterior to the posterior pole; polar), iris diameter (IR), corneal diameter (CD) and sclera diameter (SD) were measured with the help of a digital Vernier caliper. The eye data obtained were expressed as mean ± SEM (Standard Error of Mean) and subjected to statistical analysis using Statistical Package for the Social Science (SPSS) version 26.0. Multivariate Analysis of Variance (MANOVA) at 95% Confidence Interval (CI) was used to determine the level of significant difference in mean values among the three genotypes as well as their sexual dimorphism. Values of [$P \leq 0.5$] were considered significant. Where there were differences in means, they were separated with Tukey's HSD.

## RESULTS

The means ± SD of eyeball parameters of the Nigerian indigenous chickens are presented in table 1. There was significant difference in parameters among the genotypes, Wilks' $\Lambda = 0.40$, $F$ (12, 66) = 3.198, $p = 0.001$; multivariate $\eta^2$=0.368. The Tests of Between-Subjects Effects, showed that the significance ($p$<0.05) lies in the SD. On further separation using the Tukey-HSD, the SD of NN is significantly ($p$<0.05) different from those of FF and NC. There was significant difference in parameters between the male and the female, Wilks' $\Lambda = 0.378$, $F$ (6, 33) = 9.062, $p = 0.000$; multivariate $\eta^2$=0.622. The Tests of Between-Subjects Effects, showed that the WOE, APC, MLC and SD are significantly ($p$<0.05) different between the male and the female chicken genotypes. There was no significant (p>0.05) difference between the right and the left eye balls of the chicken genotypes, Wilks' $\Lambda = 0.836$, $F$ (6, 33) = 1.082, $p$ = 0.393; multivariate $\eta^2$=0.164. There was significant ($p$<0.05) interaction between genotype and sex on the combined dependent variables, Wilks' $\Lambda = 0.492$, $F$ (12, 66) = 2.340, $p = 0.014$; multivariate $\eta^2$=0.298. The Tests of Between-Subjects Effects, showed that the significant interaction lies in APC. The was no significant ($p$>0.05) interaction in genotype verses right and left eye balls, sex verses right and left eye balls and the genotype verses sex verses right and left eye balls in the indigenous chickens. This indicates that the linear composite of the combined dependent variables does not differ across these interactions. It was observed that males had wider circumferences of eyeball than the females in all genotypes.

## DISCUSSION

The present results on the WOE in the males of the studied genotypes to be 2.10 – 2.32 gm is similar to the reports (2.3 gm) of Venkatesan and Ramesh (2006) as the average weight of the eyeball in the adult broilers and layers. This result is however contrary to 16.577gm obtained as weight of the eyeball by Shehan (2012) in local chickens of Basrah city. This difference could be due to genetic or/and environmental influences. The present result did not show much variation between the weights of right and left eyeballs within the group. However, the values were slightly higher in the males than the females in all the genotype groups. This result was similarly obtained by Venkatesan and Ramesh (2006) in the

broilers and layers. This is also similar to earlier reports in other domestic animals (Getty, 1975; Olopade *et al*., 2005; Igado, 2011).

**Table 1: Gross Morphometry of the eyeball in Three Genotypes of Chicken in Nigeria with reference to sexual dimorphism**

| Parameters | NC | | | | NN | | | | FF | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Male | | Female | | Male | | Female | | Male | | Female | |
| | R | L | R | L | R | L | R | L | R | L | R | L |
| **WOE (gm)** | 2.32 ± 0.20 | 2.10 ± 0.57 | 1.87 ± 0.16 | 1.83 ± 00.16 | 2.26 ± 0.24 | 2.19 ± 0.28 | 1.67 ± 0.29 | 1.68 ± 0.26 | 2.23 ± 0.19 | 2.18 ± 0.44 | 1.93 ± 0.02 | 1.89 ± 0.08 |
| **APC (mm)** | 9.95 ±0.59 | 9.83 ± 0.81 | 8.14 ± 0.81 | 7.82 ± 0.88 | 8.83 ± 0.76 | 9.00 ± 1.55 | 8.34 ± 0.97 | 9.18 ± 0.78 | 9.87 ± 1.50 | 9.20 ± 1.51 | 7.40 ± 1.06 | 8.35 ± 1.19 |
| **MLC (mm)** | 16.6 ± 0.88 | 15.78 ± 0.26 | 14.16 ± 1.47 | 14.58 ± 0.43 | 15.03 ± 1.04 | 15.20 ± 0.96 | 15.60 ± 0.96 | 14.40 ± 0.87 | 15.53 ± 1.35 | 16.20 ± 0.20 | 14.65± 0.72 | 14.45 ± 0.24 |
| **RD (mm)** | 3.63 ± 0.50 | 3.85 ± 0.37 | 3.44 ± 0.58 | 3.02 ± 0.65 | 3.70 ± 0.67 | 3.23 ± 0.61 | 3.52 ± 0.67 | 3.48 ± 0.29 | 2.73 ± 0.38 | 3.50 ± 0.50 | 3.43 ± 0.43 | 3.28 ± 0.36 |
| **CD (mm)** | 7.13 ± 0.31 | 7.35 ± 0.68 | 6.52 ± 0.36 | 6.86 ± 1.20 | 6.73 ± 1.23 | 6.38 ± 0.51 | 6.72 ± 0.70 | 6.70 ± 0.16 | 7.07 ± 0.99 | 7.47 ± 0.58 | 6.93 ± 0.50 | 7.02 ± 0.34 |
| **SD (mm)** | 14.37 ±0.53 | 15.35 ±0.70 | 14.66± 0.57 | 14.50± 0.48 | 13.20 ± 0.77 | 13.43 ± 1.39 | 13.16 ± 0.96 | 12.98 ± 1.13 | 14.47 ± 1.01 | 15.80 ± 0.70 | 13.25 ± 0.69 | 73.93 ± 0.95 |

**NC**= Normal Feathered chicken, **NN**= Naked-Neck chicken, **FF**=Frizzled feathered chicken, **R**= Right eye ball, **L**= Left eye ball, **WOE**= Weight of the eyeball, **APC**=Anterior –Posterior Circumference of the eyeball, **MLC**= Medio-lateral circumference of the eyeball, **RD**=Retina diameter, **CD**= Cornea diameter and **SD**= Sclera diameter.

The APC in this result is shorter than MLC in all the groups. This justified the shape of the eyeball in chicken to be oval as also reported by Venkatesan and Ramesh (2006) in domestic fowl. The significant difference observed in the APC between the male and the female chickens in this study is contrary to the previous report of the polar diameter by Mayakkannan *et al*. (2017) in Japanese quails at eight- and fourteen-week-old groups. Hall and Ross (2007) stated that in birds, the axial length (polar diameter) of the eye may be associated with visual acuity, the ability to resolve two discrete objects. Further they stated that a longer axial length is associated with longer posterior nodal point of the lens at which the image is focused. Lack of significant difference obtained in the cornea diameter of right and left eye balls of both male and female chickens across the genotypes in this study is similar to the earlier report of Mayakkannan *et al*. (2017) in Japanese quails at eight- and fourteen-week-old groups. An enlarged cornea is said to allow more amount of light to enter the eye through an enlarged pupil. The corneal diameter can be associated with visual sensitivity, the light-gathering ability of the eye (Hall and Ross, 2007). What was observed in the present study of the males to have wider circumferences of eyeball than the females in all genotypes is contrary to the reports of Olopade *et al*. (2005) in the eye ball of three breeds of goat in Nigeria, who reported no significant difference.

## CONCLUSION

There was significant difference in parameters among the genotypes with NN eyeball parameters significantly different from those of FF and NC. There was significant difference in parameters between the male and the female, with the WOE, APC, MLC and SD significantly different between the male and the female chicken of the three genotypes. It was observed that males had wider circumferences of eyeball than the females in all genotypes. The results have provided eyeball morphometrics of chicken genotypes in Nigeria and the results is valuable in clinical comparative avian ocular anatomy and in the assessment of avian ocular pathologies.

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