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Morphometric Parameters of whole egg and Egg Yolk of five Nigerian Domesticated Avian Species.

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Abstract: *Utilization of whole eggs and egg yolks of different avian requires evaluation of key parameters.Internal egg quality parameters such as albumen weight and yolk weight are very important considering the nutritional and cholesterol content for human consumption (Sparks, 2006).The present study evaluated morphometric parameters among the five eggs from the selected domesticated avian species in Nigeria namely the domestic chicken (Gallus domesticus), turkey (Meleagrisgallopavo), Muscovy (Moschatacairina), Japanase quail (Coturmix japonica) and Guinea fowl (Numidameleagris) .The aim of the study is to explore and document the morphometric potentials of the different avian species in providing scientific information for their efficient usage in industries and research purposes. The morphometric parameters of the eggs of different domesticated avian species are rarely documented hence the limitations in their usage and competition on the chicken egg alone for both consumption and industrial uses. The heaviest of all the eggs was that of turkey 69.22g but the weight was significantly different from that of Guinea fowl 38.52g and Quail 9.91g. The trend in the egg length was similar as the length of guinea fowl and quail were significantly different from each other and all other 3 eggs samples were statistically similar. Muscovy and chicken were similar in terms of diameter but significantly different from turkey 4.61 cm with the widest diameter and quail egg diameter of 2.22 cm (least).Albumen height of Muscovy, chicken and turkey were significantly different from that of guinea fowl 0.50 cm and that of quail 0.48 cm, both were not significantly different.White indexes of quail and Muscovy were similar however white index of quail 0.22 was significantly different from that of all other species. The Haugh units of eggs of chicken, turkey, guinea fowl and Muscovy 74.89, 77.13, 77.65 and 85.18 ($P \leq 0.05$)were statistically similar. There exist significant difference between all other eggs were compared with that of quail 92.28 in terms of haugh unit. Since all the eggs have values above 72, they all fall within the AA category of Haugh unit grading in terms of quality. The yolk index as reported in this study was subsequently estimated and reported.*

I. Introduction

Egg morphometric parameters such as egg weight, egg width, albumen and yolk weights are very important in poultry because these factors influence egg quality and grading (Farooqet al., 2001), reproductive fitness of the chickens and embryonic development (Onagbesanet al., 2007).The physical characteristics of the egg play an important role in the processes of embryo development and successful hatching. The most influential egg parameters are weight, shell thickness and porosity, shape index, described as maximum breadth to length ratio, and the consistency of the contents.

The average values of the physical characteristics mostly meet the requirements for the embryo's development. For those eggs, whose parameters do not fall in to the average range, the incubation process is more successful if the shell is thicker than average, the eggs are more pointed rather than round, and the contents firmNarushina and Romanova,2002.

The yolk makes up about 33% of the liquid weight of the egg; it contains approximately 60 calories, three times the caloric content of the egg white. The yolk of one large egg (50 g total, 17 g yolk) contains approximately: 2.7 g protein, 210 mg cholesterol, 0.61 g carbohydrates, and 4.51 g total fat. Egg yolk is a source of lecithin as well as egg oil for cosmetic and pharmaceutical applications. The yellow colour is due to lutein and zeaxanthin, which are yellow or orange carotenoids known as xanthophyll (USDA Nutrient Database, 2002).

The multipurpose usage nature of egg/ egg yolk and indeed the bio resources potentials of eggs require the evaluation of the major morphometric parameters of different avian species to reduce the pressure of competition on the widely known chicken eggs for breeding, industrial and commercial purposes.

II. Materials And Methods

The research work was carried out at the Reproductive Physiology and Biotechnology laboratories, ObafemiAwolowo University, Ile Ife, Osun State, Nigeria, Latitude 7° 31' and 7° 34' North and Longitude 4°

30′ and 4° 34′ East. The location is characterized by climatic conditions of mean annual rainfall of 1400 mm, mean temperature ranges between 28 °C to 34 °C, relative humidity of 75.8 % to 86 % for dry and wet seasons respectively. The altitude is 286m above sea level and populated with non- forested wetlands (Olajuyigbe, Alinaitwe, Adegboyega and Salubi, 2012).

A total of 150 eggs (30 eggs per species of the different avian species) were used in the determination of the parameters evaluated. The selected avian species for this research work are Chicken, Turkey, Quail, Guinea fowl and Muscovy. These eggs were available from the open markets in Osun state, south western Nigeria and only fresh eggs without broken shells and shell membrane were selected. Fresh eggs were sourced from the local market and transported to the Reproductive Physiology laboratory, Department of Animal Science, ObafemiAwolowo University, Ile Ife, Osun State for storage at 8 °C.

The Egg Yolk

The whole eggs were thoroughly washed with distilled water. The eggs were carefully broken by cracking the narrow anterior part of the oval shape to allow the easy flow out of the albumen. The shells were further broken to allow the egg yolk removed from the shell unbroken. The yolk and albumen were then placed on a flat stainless steel surface. The albumen and chalazae were carefully separated from the yolk. The separated yolk was then rolled on the filter paper to further remove remaining albumen parts attached to the yolk membrane. The yolks, with the membrane, were carefully transferred into a sterilized beaker where the membrane was punctured and raw egg yolk released.

Experimental Design

The experimental design used is completely randomized design (CRD).Whole eggs, egg yolks and egg yolk plasma samples were randomly allocated based on the five different avian species(5 treatments).The parameters evaluated in each of the 3 stages of these experiments were measured in 5 replicates and values recorded.

Statistical Analysis

Mean values recorded were subjected to Statistical analysis of variance using software (SAS, 2004) Means + S.E.M were compared using Duncan's multiple range test (Duncan, 1955). Differences were considered to be statistically different at $P \leq 0.05$

Data Collection

30 eggs were weighed per avian species (a total of 150 eggs). Sensitive top loading digital weighing scale was used to take the measurement in grams. The length and diameter of all the eggs were taken using the Vernier caliper. All readings were recorded in centimetres (cm). Albumen Height (cm) was measured using a tripod micrometer calibrated in 0.01 mm .The dimensions were taken between the yolk edge and the external edge of the thick albumen. All readings were converted to centimetres. White index was estimated by comparing egg albumen height (cm) and egg diameter (cm).

Haugh Unit. The values used in the estimation of the haugh unit were the albumen height and egg weight. (http://www.eggtester.com/haugh-unit, 2014)

Yolk Colour was determined using the yolk colour fan with a scale range of colour from 1-14 based on colour density. Yolk Height and Width (cm) was determined with the use of Vernier calipers and measurements were recorded in centimetres. The weight of the yolk was measured using sensitive digital top loading scale. Values were recorded in gram. Yolk Index was estimated by comparing the ratio of height and diameter of the yolk.

III. Results

The results of the morphometric parameters of whole egg and egg yolk of five (5) avian species of economic importance widely reared in different parts of Nigeria is detailed in Table and Table 2.The trend show some similarities between chicken, turkey and Muscovy egg/egg yolks which is pointer to their potentials as an alternative to the highly competitive chicken eggs/egg yolk.

Table 1 Morphometric Parameters of Whole Egg of Five (5) Different Domesticated Avian Species.

	WEIGHT (g)	LENGTH (cm)	DIAMETER (cm)	ALBUMEN HEIGHT(cm)	WHITE INDEX	HAUGH UNIT
QUAIL	$9.91^{c}\pm0.52$	$3.08^{c}\pm0.09$	$2.22^{d}\pm0.08$	$4.80^{d}\pm0.05$	$0.22^{a}\pm0.02$	$92.28^{a}\pm2.70$
CHICKEN	$65.55^{a}\pm1.79$	$6.13^{a}\pm0.09$	$4.16^{b}\pm0.16$	$6.00^{c}\pm0.05$	$0.15^{b}\pm0.01$	$74.89^{b}\pm3.08$
MUSCOVY	$67.86^{a}\pm3.03$	$6.31^{a}\pm0.05$	$4.11^{b}\pm0.11$	$7.40^{a}\pm0.08$	$0.18^{ab}\pm0.02$	$85.18^{ab}\pm6.12$
TURKEY	$69.22^{a}\pm1.95$	$6.24^{a}\pm0.10$	$4.61^{a}\pm0.03$	$6.60^{b}\pm0.07$	$0.14^{b}\pm0.01$	$77.13^{b}\pm4.62$
GUINEA FOWL	$38.52^{b}\pm1.64$	$4.78^{b}\pm0.12$	$3.64^{c}\pm0.07$	$5.00^{d}\pm0.05$	$0.13^{b}\pm0.01$	$77.65^{b}\pm3.16$

Means on the same column with different superscript are significantly different ($P \leq 0.05$)

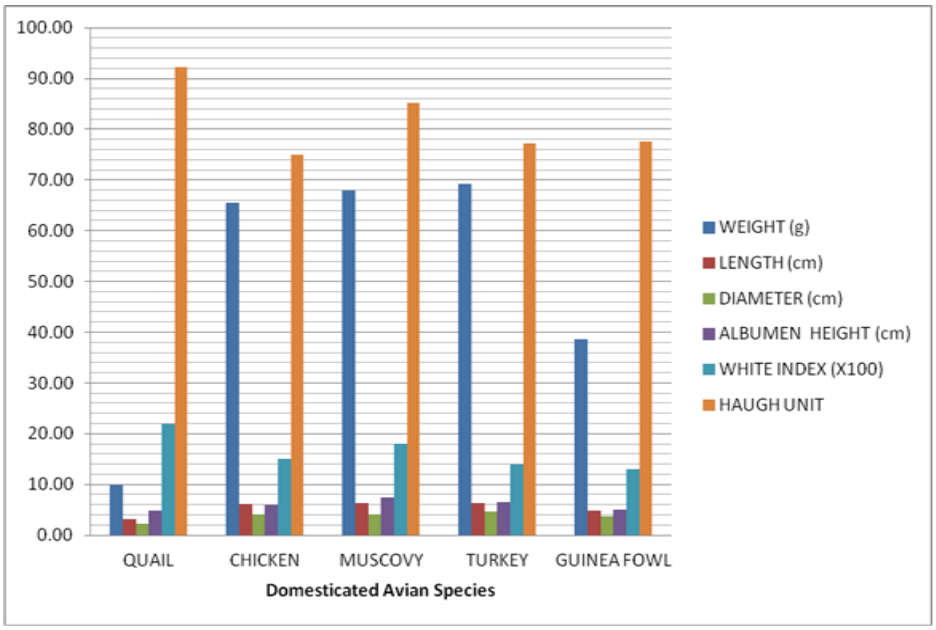

Figure 1:Morphometric Parameters of Whole Egg of Five (5) Different Domesticated Avian Species.

Table 2 Morphometric Parameters of Egg Yolk of five (5) Domesticated Avian Species.

SPECIE	YOLK COLOUR (Range1-14)	YOLK HEIGHT (cm)	YOLK WIDTH (cm)	YOLK WEIGHT(g)	YOLK INDEX
QUAIL	$5.80^{c}\pm0.37$	$0.70^{c}\pm0.08$	$3.00^{c}\pm0.11$	$4.15^{d}\pm0.48$	$0.42^{b}\pm0.03$
CHICKEN	$7.40^{b}\pm0.24$	$1.68^{a}\pm0.04$	$4.69^{b}\pm0.15$	$18.03^{b}\pm0.48$	$0.46^{b}\pm0.02$
MUSCOVY	$5.80^{c}\pm0.58$	$1.44^{a}\pm0.14$	$4.74^{b}\pm0.22$	$20.29^{b}\pm2.10$	$0.43^{b}\pm0.03$
TURKEY	$3.60^{d}\pm0.40$	$1.12^{b}\pm0.05$	$5.44^{a}\pm0.40$	$25.01^{a}\pm1.76$	$0.55^{a}\pm0.01$
GUINEA FOWL	$9.80^{a}\pm0.58$	$0.68^{c}\pm0.05$	$3.48^{c}\pm0.16$	$13.18^{c}\pm0.27$	$0.54^{a}\pm0.02$

Means on the same column with different superscript are significantly different ($P \leq 0.05$)

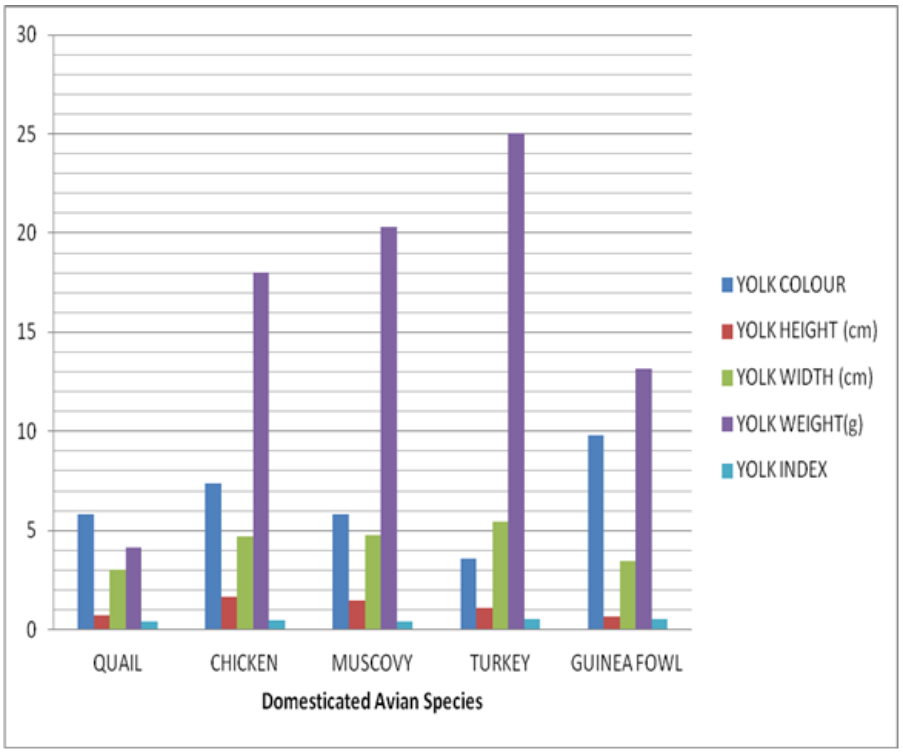

Figure 2: Morphometric Parameters of Egg Yolk of five (5) Domesticated Avian Species.

IV. Discussions

Turkey whole egg was the heaviest but the weight was statistically similar to that of chicken and Muscovy. The weight of eggs from quail being the least 9.91 g was significantly different from that of guinea fowl 38.52 g and Muscovy 57.86 g. Emilia, Monika and Magdalena (2014) evaluated the Morphology and chemical composition of turkey eggs and reported turkey eggs weighing 95 g and 110 g had lower yolk content (3.05 % and 4.86 %) and higher albumen content (3.16 % and 5.21 %) compared with eggs weighing 80 g. These values were higher than the 69.22 g reported in this presently study which could be due to the strains of the avian species used and husbandry practices. The trend in the egg length was the same as the length of guinea fowl and quail were significantly different from each other and all other 3 eggs samples were similar. Muscovy and chicken were similar in terms of diameter but significantly different from turkey 4.61 cm with the widest diameter and quail egg diameter of 2.22 cm (least).Albumen height of Muscovy, chicken and turkey were significantly different from that of guinea fowl 0.50 cm and that of quail 0.48 cm, both were statistically similar.

White index of quail and Muscovy were similar however white index of quail 0.22 was significantly different from that of all other species. The Haugh units of eggs of chicken, turkey, guinea fowl and Muscovy 74.89, 77.13, 77.65 and 85.18 were statistically similar. There exist significant difference between all other eggs and that of quail 92.28. Since all the eggs have values above 72, they all fall within the AA category of Haugh unit grading in terms of quality. Fajemilehin, Odubola, Fagbuaro and Akinyemi, (2008) reported some phenotypic parameters of Guinea fowl egg like egg weight, egg length, egg diameter and haugh unit with values of 38.66 g, 4.90 cm, 3.20 cm and 63.86. These values were similar to the recorded mean values in the present study of 38.52g, 4.78cm, 3.64cm however haugh unit of 77.65 was significantly different from their study. This is a measure the quality of the egg indicating that the qualities of whole eggs used in the present study were of higher quality.

Table 2 shows the values recorded for the assessment of the morphometric parameters of the egg yolks from the five domesticated avian species selected for this study. Muscovy and quail eggs were similar in colour. However the guinea fowl and chicken egg yolk colour 9.80 and 7.40 were higher and significant different from that of Muscovy and quail.

The Muscovy and chicken eggs yolk height were not significantly different but higher and significantly different from that of turkey 1.12 cm. Yolk heights of quail and guinea fowl eggs of 0.70 cm and 0.68cm were statistically similar but different from that of turkey.Yolk width of 4.69 cm and 4.74 cm for chicken and Muscovy eggs were similar statistically likewise that of quail and guinea fowl. Turkey yolk width was significantly different from that of all other species. Yolk weight in gram was another parameter assessed and compared among the five avian eggs. The highest weight of 25.01 g was recorded in turkey eggs while the lowest weight was recorded in quail 4.15 g. The weight of Muscovy egg yolk 20.29 g was not significantly different from that of chicken but significant differences exist among all other species evaluated. Yolk index is a measure of the egg yolk quality. Turkey yolk index was significantly different from that of all other species except guinea fowl. However, Muscovy was similar to quail and chicken in terms of yolk index.Ihsan, (2012) conducted a study on effects of Storage Temperature and Length on Egg Quality Parameters of Laying Hen eggs and reported 65.44 g (egg weight),0.65 cm(albumen height),1.48(albumen index) and 94 (haugh unit) in laying chicken. The values of egg weight and albumen height were similar to the values recorded in this study however the haugh unit and albumen indices which are measures of whole egg quality were higher. This could be due to the variation in the freshness of egg used. Etuk, Ojewola, Abasiekong, Amaefule andEtuk, (2012) reported egg quality parameters of ducks under different management in the tropics. The study results included the egg weight 70.08 g, egg length 6.11mm, egg diameter 4.62 cm, albumen height 0.65 mm, haugh unit 70.74, yolk height1.88, yolk diameter 4.85 and yolk index 40.60 %.All values reported were similar to the values recorded in this present study except the yolk index. This could be due to the specie specific factors of Muscovy duck while the similarities in results might be due to the closeness in the location of both experiments in the humid tropics. Dudusola, (2010) reported the quality characteristics and proximate composition of the eggs of quail and guinea fowl. The eggs of the two species had an oval conical shape with blunt and pointed ends. The shape indices of both the eggs had no statistical difference. As very well apparent, guinea fowl eggs (46.65 g) were much heavy than the Quail eggs (10.34 g). Proportion of yolk to total egg weight was higher in quail (31.4 %) than guinea fowl (30.6 %). Similarly, albumen content was higher in quail (61.2 %) than guinea fowl (55.9 %), however the ratio of yolk to albumen was higher in guinea fowl (0.55) than quail (0.52). The results of the present study were similar to the findings of this researcher in terms of weight of quail and guinea fowl eggs.

The parameters evaluated elucidated the constituents of eggs and egg yolk that are similar tothat of chicken egg thereby indicating the potential alternative uses of eggs/yolks from other domesticated avian species. The use of these bio resources might be more cost efficient because of the less competition on their usage in industrial and research work in this part of the world. This result also shows the economic importance of the different species hence this might enhance investment of farmers in their production.

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