Journal of Animal Husbandry and Dairy Science
Volume 1, Issue 1, 2017, PP 20-27

The use of Egg Weight and Linear Characteristics as Selection Criteria for Genetic Improvement of Albumin and Yolk Height of Nigeria Local Chicken Eggs

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ABSTRACT

The study was carried out at the Federal University of Agriculture Makurdi to determine the relationship between internal and external egg characteristics of the Nigeria local chickens. A total of 300 eggs collected over a period of four weeks from the Nigerian local chickens were used for the study. Fifty five (fifty hens and five cocks) were reared in cages at the University of Agriculture Animal Teaching and Research Farm, Makurdi. Nigeria. Egg external characteristics measured were egg weight, egg width, egg length, shell thickness and shell weight. Egg weight was 49.53g, while egg width, egg length, shell thickness and shell weight were 2.46mm, 3.67mm, o.33mm and 6.08g respectively. The internal egg parameters were albumin height (8.33mm) and yolk height (17.51mm) respectively. All the external egg characteristics have significant and positive correlations with the internal egg characteristics.

The correlation between egg weight (EGGWT), egg length (EGGLGHT) and egg width (EGGWDT) were high, positive and significant (P<0.05). This implied that an increase in egg weight will lead to a corresponding increase in egg length and egg width. The relationship between egg weight and shell weight observed in this study were highly significant, thus selection targeting egg weight will also improve egg shell weight. Significant (P<0.05) correlation value was found between egg weight and albumen height. There is therefore an indication that as egg weight increases, the height of the albumen also increases, the Haugh unit which is based on the albumen height also increases. A highly significant (P<0. 01) correlation was found between egg weight and yolk height. This indicated that as egg weight increases, yolk height also increases. This study indicated that egg weight has high association with egg linear measurement and internal egg characteristics. Egg weight can be selected to exploit the correlated response to selection of egg linear parameter and internal egg traits qualities that influence hatch weight of local chickens.

Keywords: *correlation, egg-characteristics, linear-measurement, improvement, selection;*

INTRODUCTION

Local chickens are widely distributed in the rural areas of the tropical and subtropical countries. Local chickens in Africa are generally hardy in nature, adaptive to rural environments, survive on little or no inputs and adjust easily to fluctuations in feed availability. They are known for their adaptation and resistance to endemic diseases and other harsh environmental conditions (Nwakpu *et al., 1999*). Chickens largely dominate flock composition and make up about 98% (Gueye, 2003) of the total poultry members (chickens, ducks, turkeys etc) kept in Africa. Local chickens contribute 80% of the 120 million poultry type raised in rural areas in Nigeria (RIM, 1992). They also contribute substantially not to only rural economies but also to the gross national product (GNP) (Momoh *et al.*, 2007). They also generally play a key role within the context of many social events (special banquets for family and also for distinguished guests, cocks as alarm clocks). There are no cultural or religious taboos concerning the consumption of eggs and poultry meat. Their products are often preferred by majority of Nigerians for special dishes (Horst, 1989). Their outputs (eggs and meat) are readily available to villagers and people in the urban or semi-urban areas this serves as a good source of protein in diet and income.

The local 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 products and functions. Thus, great genetic resources embedded in the indigenous poultry await full exploitation that will provide basis for the benefit of farmers in developing countries (Horst, 1988; Sonaiya *et al.,* 1999). Though poultry breeding in Nigeria started in 1985 at the National Animal Production Research Institute, Zaria (Adebambo, 1992), reports have that research on the local chicken started earlier with comprehensive information about the local fowl. The local chicken of Nigeria is small in size and grows slowly. Poultry eggs are biological structures intended by nature for procreation and are highly versatile foods containing many essential nutrients, as they support life during embryonic growth (Abanikannda *et al.*, 2007).

Chicken eggs are nutritional, economic and easy to prepare for food as they provide basic balanced sources of nutrients for humans of all ages (Matt *et al.*, 2009).

Moreover, high quality protein, low caloric value and ease of digestibility make egg valuable in many therapeutic diets for adults (Bufano, 2000). The egg, a major product of poultry is one of the cheapest sources of animal protein; eggs are readily available to the populace than the other sources of animal protein. The shapes and sizes of avian eggs differ from other species of birds. The egg size and internal qualities are important for both table and fertility. (Sekeroglu and Altuntas, 2008). The nutrient content of eggs and the weight of day-old chicks depend on weight of egg (Khan *et al.*, 2004; Saatic *et al.*, 2005).

Justification for the study

Egg varies in size, weight and colour between and within chicken breeds. There is therefore a need to exploit the correlation between the internal and external characteristics of eggs in order to deduce a model for predicting the internal characteristics of eggs using the external characteristics. This will help poultry farmers to identify eggs that will be useful in reproduction for quality chicks and eggs that should be sold off or eaten as food. The study was aimed at determining the correlation between the internal and the external characteristics of eggs of local chicken.

Materials and Methods

The research was carried out at the Animal Teaching and Research Farm in the Federal University of Agriculture Makurdi, Benue State. Makurdi lies within the lower river Benue trough in the middle belt region of Nigeria. The area is characterized by a period of dry season between the months of October and March and a period of rainy season between the months of April to September. Annual rainfall ranges from 973mm to 1324mm (www.ourbenue.com.ng). The climate is characterized by tropical weather conditions comprising of low altitude, low rainfall and moderate humidity at varying times of the year (Gwaza *et al.*, 2011).

Experimental Animals

This study was carried out on 300 eggs of local chickens obtained from fifty females and five males which were randomly obtained from Wadata market Makurdi at mature reproductive state.

Management of Experimental Animals

The birds were housed separately in five groups of 11birds each of 10 females and 1 male. The birds were vaccinated against coccidiosis and worms using leviworm 200, gendox and PPR powder. Vitamins were also given to birds through drinking water. The birds were fed a commercial layer ration.

Collection of Eggs

A total number of 300 eggs were collected from the birds for laboratory analysis of both external and internal egg characteristics.

Parameters Measured

Egg weight: the egg weight was measured using the electronic balance PL203 Mettler Toledo with the accuracy of 0.001g. Egg length: egg length was measured in centimeter using the manual venier calipers sensitive to 0.1mm. Egg width: the egg width was measured in centimeter using the manual venier calipers sensitive to 0.1mm. Egg shell thickness: A micrometer screw gauge sensitive to 0.01mm was used for measuring the shell thickness. Egg shell weight: this was measured in grams using the electronic weighing balance PL203 Mettler Toledo with the accuracy of 0.001g. Yolk height: this was measured in millimeters using the manual venier calipers sensitive to 0.1mm. Albumen height: this was measured millimeters using the manual venier calipers sensitive to 0.1mm.

Statistical Analysis

All data collected from the study was subjected to simple linear and multiple regression and correlation analysis.

Result and Discussion

Descriptive Statistics of Linear, External and Internal Egg Parameters

Egg Weight

The descriptive statistics results are presented in table 1. Egg weight ranged from 37.02 to 57.11g with a mean of 49.53g and coefficient of variation (10.76%). The low coefficient of variation observed showed that egg weight did not vary extensively among the sampled local birds.

Egg Linear Measurement

Egg length ranged from 3.31cm to 3.96cm with a mean of 3.67cm and a low coefficient of variation (3.88%) which indicated that egg length did not vary widely between the birds. The observed egg width ranged from 2.00cm to 2.91cm with a mean of 2.46cm. The coefficient of variation (9.67%) indicated that eggs did not vary widely between the birds.

Egg External Parameters

The observed values of shell thickness ranged from 0.19mm to 0.51mm with a mean of 0.33mm and a high coefficient of variation (18.91%) showed that eggs varied considerably in shell thickness. Shell weight ranged from 3.47g to 8.00g with a mean of 6.08g. The recorded coefficient of variation was 15.30% showed that egg shell weight varied considerably between the birds.

Egg Internal Parameters

Albumen height ranged from 6.50mm to 12.50mm with a mean of 8.30mm. The coefficient of variation (15.68%) indicated that egg albumin height varied considerably between the birds. Yolk height ranged from 15.00mm to 20.40mm with the mean of 17.52mm. The low coefficient of variation recorded (6.13%) showed that egg york height did not vary widely as albumin height between the birds.

Table1. *Descriptive statistics of egg weight, linear measurement and internal parameters*

Variable	Lower range	Upper range	Mean	SD	CV (%)
Egg weight (g)	37.02	57.11	49.53	5.33	10.76
Egg length (cm)	3.31	3.96	3.67	0.14	3.88
Egg width (cm)	2.00	2.91	2.46	0.24	9.67
Shell thickness (mm)	0.19	0.51	0.33	0.06	18.91
Shell weight (g)	3.47	8.00	6.08	0.93	15.30
Albumen height (mm)	6.50	12.50	8.30	1.30	15.68
Yolk height (mm)	15.0	20.40	17.52	1.07	6.13

SD= standard deviation, CV= coefficient of variation, Min= minimum value, Max= maximum value

Correlation between Internal and External Egg Parameters

Correlation between Albumen Height, Shell Thickness and Shell Weight

The regression equation for the determination of the relationship was

EGGWT = 11.0+9.79STH+2.56SWT+0.191AH … (1)

Where EGGWT = egg weight

STH = shell thickness

SWT = shell weight

AH = albumin height

The coefficient of determination (R value) was R^2=0.806.

As shown in table 2, there was no significant ($p>0.05$) correlation between shell thickness and albumen height. This implied that the shell thickness of local chicken eggs was not dependent on any of the internal quality traits. A significant ($p<0.05$) positive correlation was obtained between shell weight and albumen height in this study. This result agrees with the findings of Olawumi and Ogunlade, (2008.)

Correlation between Yolk Height, Shell Thickness and Shell Weight

The regression equation for the determination of the relationship was

EGGWT= 11.0+9.79STH+

2.56SWT+2.78YHT… (2)

Where EGGWT= egg weight

STH = shell thickness

SWT = shell weight

YHT = York height

The coefficient of determination (R value) was R^2=0.315.

There was no significant correlation between shell thickness and the yolk height. There was a significant, positive (p<0.05) correlation between shell weight and yolk height. These results agree with the findings of Olawumi and Ogunlade, (2008).

Correlation between Egg Weight, Width and Length

The regression equation for the determination of the relationship was

EGGWT = 0.9+0.87 EGGLGHT + 18.5 EGGWDT…… (3)

Where EGGWT = egg weight

EGGLGHT = egg length

EGGWDT = egg width

The coefficient of determination (R value) was R^2=0.680.

The correlation between egg weight and egg linear characteristics is shown in table 2. The correlation between egg weight (EGGWT), egg length (EGGLGHT) and egg width (EGGWDT) were high, positive and significant (P<0.05). This implied that an increase in egg weight will lead to a corresponding increase in egg length and egg width. The positive correlations obtained in this study were in agreement with the findings of Farooq *et al.* (2001), who reported significant and positive correlations between egg weight, egg length and egg width. The overall mean egg weight obtained in this research was 49.53g with a standard deviation of 5.33 and this described how egg weight varied between the birds. The overall mean egg weight differed slightly from those recorded by other researchers such as Wolanski *et al*. (2007), who reported values ranging between 63.4 to 66.0g when they determined relationships among egg characteristic and early growth in ten broiler breeder strains at ages between 46 weeks and 57 weeks. The differences observed in this study could be due to breed difference and age as these are local birds.

Correlation between Egg Weight and Shell Thickness

The regression equation for the determination of the relationship was

EGGWT=29.8+59.0STH… (4)

The coefficient of determination (R^2) was = 0.488

There was a positive, significant (p<0.05) correlation (0.699) between egg weight and shell thickness compared to 0.32 reported by Zhang *et al*. (2005), 0.26 by Standelman (1986); 0.05 by Olawumi and Ogunlade (2008) and 0.21 by Kul and Seker (2004).

Correlation between Egg Weight and Shell Weight

The regression equation for the determination of the relationship was

EGGWT=20.8+4.73SWT… (5)

The coefficient of determination (R^2) was = 0.675

There was a statistically significant positive phenotypic correlation (p<0.05) between egg weight and shell weight (0.826). This may be due to the fact that egg weight according to Stadelman (1986) is directly proportional to the unit shell weight. The egg weight had a significant correlation with shell weight in this study. Heavier eggs are therefore expected to have higher shell weight than lighter eggs. This assertion was revealed in this study by positive correlation between egg weight and shell weight. The relationship between egg weight and shell weight observed in this research were highly significant, thus the weight of the egg can be used to predict shell weight.

Correlation between Egg Weight and Albumen Height

The regression equation for the determination of the relationship was

EGGWT=35.1+1.74AHT… (6)

The coefficient of determination (R^2) was = 0.181.

A moderately significant (P<0.05) correlation value was found between egg weight and albumen height. There is therefore an indication that as egg weight increases, the height of the albumen also increases, the Haugh unit which is based on the albumen height also increases. Benton *et al*. (1997) also reported this trend.

Correlation between Egg Weight and Yolk Height

The regression equation for the determination of the relationship was

EGGWT=0.8+2.78YHT… (7)

The coefficient of determination (R^2) was = 0.301.

A highly significant (P<0. 01) correlation was found between egg weight and yolk height. This indicated that as egg weight increases, yolk height also increases.

Correlation between Egg Length and Width

The regression equation for the determination of the relationship was

EGGWT=-5.86-1.24EGGLT +9.52EGGWDT…… (8)

The coefficient of determination (R^2) was =0.666.

There was also a statistically significant but negative phenotypic correlation (p<0.001) obtained between egg width and egg length (-0.018). Similar results were reported by Ozcelic (2002); Kul and Seker (2004) and Olawumi and Ogunlade (2008). Thus increase in egg length will eventually reduce egg width. These observations also agree with the reports of Choprakarn *et al*. (1998).

Correlation between Egg Linear Parameters, Shell Thickness and Shell Weight

The regression equation for the determination of the relationship was

EGGWT = 5.0 + 0.33EGGLT + 14.4EGGWDT +23.8STHIC + 4.73SWT… (9)

Where

EGGWT = egg weight, EGGLT = egg length, EGGWDT = egg width, STHICK = shell thickness, SWT = shell weight,

AHT = Albumin height, YHT = York height

The coefficient of determination (R^2) was = 0.708.

The correlation between egg length and egg shell thickness was low and positive and significant (p<0.01) implying that an increase in the egg length results in increase in shell thickness.

The correlation between egg width and egg shell weight was moderately positive and significant (p<0.01) implying that an increase in the egg width results in increase in shell weight.

Table2. *Correlation between egg linear Parameters, shell weight, shell thickness Measured*

Egg traits	EWT	ELT	EWDT	STH	SWT	AHT	YHT
EWT	1.000						
ELT	0.008	1.000					
EWDT	0.824**	-0.018	1.000				
STH	0.699**	0.039	0.649**	1.000			
SWT	0.826**	0.112	0.665**	0.660**	1.000		
AHT	0.425**	0.071	0.402**	0.118	0.415**	1.000	
YHT	0.561**	0.023	0.360**	0.248	0.425**	0.562**	1.000

***= correlation is significant at the 0.001 level*

EWT= Egg weight, ELT= Egg length, EWDT = Egg width, STH= Shell thickness, SWT=Shell weight, AHT = Albumen height and YHT = Yolk height

Conclusion and Recommendations

Conclusion

The results of this study indicated that external linear characteristics of egg positively and significantly correlated with the internal characteristics. Selecting superior eggs using egg linear measurement for improvement of egg weight will also improve the internal egg characteristics and chick output at large. Selection to improve hatch weight of chicks can be achieve with a high degree of accuracy using egg linear measurements.

Recommendation

Since egg weight had a positive association with all the external and internal egg characteristics, it is recommended that egg weight be selected for the improvement of egg internal quality in a selection programme for genetic improvement.

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