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EGG QUALITY ASSESSMENT OF INDIGENOUS CHICKENS IN THE NORTH CENTRAL AGRO ECOLOGICAL ZONE OF NIGERIA

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Abstract

Adult female indigenous chickens were assessed for egg characteristics in the North central agro ecological zone of Nigeria. Data were generated as Out/on station on all female chickens. Chickens were maintained as a single unimproved population and allowed to mate, lay and hatch naturally. External and internal qualities were assessed on the first generation eggs. Egg weight showed mean value of 39.59 ±0.06 g which did not vary significantly. There was however significant variation by state. Overall mean egg length was 3.80±0.01 cm, while on-station had 3.81± 0.01 cm. Mean egg width was 3.89 ± 0.01cm and on-station 3.88± 0.01 cm, but values varied significantly (P<0.01) by states. Mean shell thickness was 0.90±0.32mm while on-station value was 0.52±0.05 mm. There was significant difference in shell thickness (P<0.001) by states. Thickness varied from 0.35±0.03 to 0.790±0.08 mm in Nasarawa and Niger states. Shell weight was observed to be 4.18± 0.01 and showed non-significant difference by site and state. Internal quality showed that mean albumen width 18.78 ± 0.02 cm. Albumen height was observed to be 4.57± 0.03 cm and showed no significant difference by site but differed significantly (P<0.001) by state. The overall quality rating of the egg (Haugh unit) was 76.31± 0.16. Highest egg quality (Hu=78.61±0.22) was observed in Nasarawa and least (Hu = 73.44±0.16) in Niger state. Most correlation values were significant at 1%. Only egg weight is correlated with shell weight at 5 % (0.036; P<0.05). Most egg characteristic measured was lowly correlated. There was similarity of egg in the study area since most traits were non-significant. The high egg qualities are an indication of good reproductive performance in the chickens and the positive correlations showed that the traits could be used to predict each other and thus aid selection and hasten selection processes to develop the indigenous layer chickens.

Key words*: indigenous chickens, egg characteristics, egg quality, egg weight, Haugh unit.*

INTRODUCTION

Physical egg qualities are external and internal. The external quality refers mainly to outer observations on the intact egg by means of non-destructive examination but including shell quality while the internal quality refers to observations on the interior components which play important roles on integrity, processes of embryo development and successful hatching (Narushin and Romanov, 2007).

Nigerian indigenous chickens showed great variation in egg weight (Adedokun and Sonaiya, 2001; Peter et al. (2002). Msoffe et al. (2001) and Katule (1990). Research had shown that egg weights from indigenous chicken of various genetic group vary significantly. Egg weight measurement is important because of its direct relationship with the size of the day-old chick (Moran, 1990)

Egg length is the longest portion observed on the external surface or its long borders and the width which is the shorter portion of the egg (Gunlu et al., 2003) are a measure of surface area and can also be used to predict shell quality characteristics, hatchability and chick weight (Mebratu, 1997), and interior parameters (Narushin, 2005). Egg shape attracts consumers' attention, with preference being given to normal shapes (Narushin and Romanov, 2007). The soundness of egg shell is its fitness or strength or ability to allow the egg to go through handling processes without damage.

The assessment of the internal characteristics of the egg can be carried out through the destructive technique which involves breaking it (Narushin and Romanov, 2007) or the nuclear-magnetic resonance, computer vision and acoustics. These methods are non-destructive assessment; the internal characteristics of the

egg have to do with the consistency of contents (Kuchida et al., 1999; Coucke et al., 1999). Albumen is formed from the layers of secretion of the anterior section of the hen's oviduct (Scott and Silversides, 2000). The primary natural purpose of the albumen is to protect the yolk and provide additional nutrition for the growth of the embryo (when fertilized) (Stevens, 1996). The albumen has a major influence on the overall interior egg quality (Jacob et al., 2000). Albumen quality is influenced by genetic and environmental factors such as temperature, humidity, presence of carbon dioxide, pH and storage time (Fayeye et al., 2005). Others include nutrition and the hen's age (Roberts and Ball, 2004). Loss of water from the egg through evaporation during storage is influenced by temperature and humidity and is detrimental to internal egg quality (Scott and Silversides, 2000). There are several measures of egg yolk quality, as the yolk ages it absorbs water from the albumen and increases in size; this weakens the perivitelline membrane (Kirunda and Mckee, 2000). The yolk is also flattened and often displaced to one side as opposed to the fresh egg whose round yolk stays in a central position surrounded by the thick albumen (Jacob et al., 2000).

The research is aimed at assessing the physical egg qualities of the Nigerian Indigenous chicken within the North Central Agro- ecological Zone to provide further data which may be useful for future genetic / reproductive studies.

MATERIALS AND METHODS

The study was carried out in the North Central Zone of Nigeria between January 2014 to March 2018. The area has an average elevation of 1,300 m above sea level. The longitudes and latitudes of the areas are; Benue (7º,12'N; 7º,29'N and 8º,45'E; 9º,24'E), Kogi (7º,12'N; 7º,56'N and 7º,11'E; 6º,58'E), Nasarawa (8º,35'N; 8º,37'N and 8º,09'E; 9º,02'E), Niger (9º,27'N; 9º,46'N and 6º,31'E; 7º,01'E) and the Federal Capital Territory (FCT) (9º,09'N; 9º,20'N and 7º,14'E; 6º,49'E) (Microsoft Encarta, 2008)

The North Central Agro – ecological Zone of Nigeria experiences a sub humid tropical climate with two distinct seasons, rainy and dry. The rainy season lasts from April to September and received from 1000- 2500 mm of rain, while the dry begins in October and ends in March. The two seasons are due to the moisture laden south westerly-wind from the Atlantic Ocean and the dry dusty north-easterly from the Sahara Desert (BSN, 1982). Temperatures are high throughout the year averaging 30º C. Mean annual temperatures per state are Benue 30ºC, Nasarawa 31ºC, Kogi 29º C, Niger 30º C and the Federal Capital Territory 29ºC. The relative humidity ranged from 47 to 85 %. The study area experienced mean daily sunshine duration of 8 hours (TAC, 2002). The vegetation varies considerably. It is best described as savannah, a region of tall grasses and trees.

Farming is the main occupation in the area. Crops cultivated includes: Yam, Soya beans, Rice, Cowpea, Cassava, Sweet potatoes, Sorghum, Maize, Millet, Cocoyam etc. Livestock and poultry are mainly kept as part time farming activities; Cattle, sheep, goats, chickens, ducks, geese, turkeys, pigeons and guinea fowls are kept.

Birds used for the study were scavenging indigenous chickens found within the study area and data were collected as Out - and - On stations

Traditional management was practiced in the study area. Marked areas were provided for birds at night but are allowed to scavenge freely in the day. Supplementary feeds in the form of house- hold refuse and grains were usually given in the morning before scavenging and later in the evening before rest. Water was supplied at various locations around the home. No vaccination was given and, diseases were controlled by using ethno veterinary knowledge or slaughter of affected chickens.

Data were generated for external and internal egg qualities on outdoor (Out station) from birds kept by local farmers. Sixty-two indigenous chicken of both sexes were randomly selected from four states and the Federal Capital Territory (Abuja) and kept indoors (On station). These birds were kept as un-improved and maintained as a single mating population in an open sided poultry house screened with wire mesh for protection. They were allowed to mate, lay and hatch naturally. Data were collected from their first generation progenies for egg quality assessment. Both indoor and outdoor (On station /Out station) egg qualities were determined as follows:

Egg weight was measured using a sensitive platform scale in grams to two decimal places.
Egg length was determined as the distance between the two ends using a Vernier calliper.
Egg width was measured as the diameter at the broadest part of the egg using a Vernier Calliper.
Egg shell weight was determined by breaking the egg and the shell, excluding membrane, immediately weighed in grams using a sensitive scale.
Shell thickness was measured, excluding the shell membrane, using a digital micrometre screw gauge (calibrated in mm).
Internal egg characteristics were taken as follows:
Albumen width was measured by carefully separating the albumen and the width measured in millimetres on a tripod using a micrometre screw gauge.
Albumen height was measured by pouring content of the egg into a plate and measured on a tripod micrometre screw gauge (calibrated in mm)
Yolk width - The yolk was carefully separated and measured in millimetre on a tripod using micrometre.
The Haugh Unit (HU) value was estimated from the relationship: HU= log (H + 7.73- $1.7W^{0.36}$) 100, Where H = albumen height W= egg weight (Haugh, 1937).
Egg characteristics were subjected to analysis of variance using the SPSS version 17 (2008).
Significantly different means in a subset were separated using the Ryan Einot Gabriel Welsch F- Tests in Statistical package for Social Sciences SPSS Version 17 (2008). Pearson's Correlation co- efficient was computed to test the relationship in egg parameters measured.

RESULTS AND DISCUSSIONS

Egg weights of indigenous chickens for out-station and on station are presented in Tables 1 and 2. There was significant variation by state with highest (39.86 ± 0.15 g) and lowest ($39.32 \pm 0.16\ g$) values reported in Nasarawa and Kogi State respectively. The mean egg weight obtained in this study is higher than the 28 g and 29.37 g mentioned by Williamson and Payne (1978) and Mbap and Zakar (2000) but similar to 36–41 g (Sonaiya, 2003) for indigenous chickens in Nigeria.

Table 1. Overall mean egg characteristics by site

Parameter	Out-Station	On-Station	LS	Combined Mean
Egg weight (g)	39.59± 0.06	39.69± 0.05	NS	39.64± 0.04
Egg length (cm)	3.80± 0.01	3.81± 0.01	NS	3.80± 0.01
Egg width (cm)	3.89±0.01	3.88 ±0.01	NS	3.89±0.01
Shell thickness(mm)	0.90±0.32	0.77± 0.26	NS	0.84±0.20
Shell weight (g)	4.18±0.01	4.17±0.01	NS	4.18±0.01
Albumen width (cm)	18.78±0.02	18.78± 0.01	NS	18.78±0.01
Albumen height (cm)	4.57±0.03	4.61±0.02	NS	4.59±0.02
Yolk width (cm)	12.76±0.02	12.75±0.02	NS	12.75±0.01
Haugh Unit	76.31 ± 0.16^{b}	67.45 ± 0.11^{a}	***	71.88±0.13

Note:- LS = Level of significant. NS = Not Significant.
Significant at *** = (P<0.001)

For improved breeds Obioha (1992) and Narushin and Romanov (2007) gave 50- 60g as standard weights. This is an indication that the local chicken egg weights are inferior to their exotic counterpart. Overall mean egg length for out- station was 3.80±0.01, while on-station had 3.81 ± 0.01cm. The egg length values were not significantly different by site and state. Mean egg length in the present study is lower than 5.77 – 6.12 cm reported by Mbap and Zakar (2000). Overall mean egg width for out-station of 3.89 ± 0.01 cm and on-station 3.88±0.01cm, were similar but values varied significantly (P<0.01) by states. The highest width ($3.95 \pm 0.02\ cm$) was observed in Benue State and the least ($3.84 \pm 0.02\ cm$) in Nasarawa State.

Table 2. Egg characteristics by state

Parameter	Benue	Kogi	Nasarawa	Niger	Abuja	Overal Mean Out- Station	On- Station	LS
Egg weight(g)	39.41± 0.15^{b}	39.32±0.16^{b}	39.86± 0.15^{b}	39.73± 0.15^{b}	39.50±0.15^{b}	39.56±0.18	39.86± 0.05^{a}	***
Egg length(cm)	3.78± 0.01	3.78±0.01	3.79± 0.01	3.81± 0.01	3.82±0.01	3.80±0.01	3.81± 0.01	NS
Egg width(cm)	3.95± 0.02a	3.89±0.02^{ab}	3.84± 0.02^{a}	3.90± 0.02^{ab}	3.89±0.02^{ab}	3.89±0.02	3.88± 0.01^{a}	**
Shell thickness	0.52± 0.02^{b}	0.52±0.01^{b}	0.35± 0.03^{a}	0.79± 0.08^{b}	0.52±0.01^{b}	3.80±0.01	0.52± 0.05^{b}	***
Shell weight(g)	4.23± 0.03	4.18±0.03	4.18± 0.03	4.23± 0.03	4.18±0.03	4.20±0.03	4.16± 0.01	NS
Albumen wi(cm)	18.78± 0.04	18.69±0.04	18.75± 0.04	18.85± 0.04	18.82±0.04	18.78±0.04	18.77± 0.01	NS
Albumen ht(cm)	4.57± 0.07^{a}	3.66±0.07^{b}	4.53± 0.07^{a}	4.59± 0.07^{a}	4.62±0.07^{a}	4.39±0.07	4.71± 0.02^{a}	***
Yolk width(cm)	12.75± 0.05	12.71±0.06	12.79± 0.06	12.78± 0.06^{a}	12.76±0.05	12.76±0.05	12.75± 0.02	NS
Haugh Unit	76.22±0.02^{a}	74.34±0.52^{a}	78.61±0.22^{a}	73.44±0.162^{a}	78.14±0.52^{a}	76.31±0.162	67.45±0.11^{b}	***

Note:- Ns, not Significant, (***P<0.001, (**P<0.01) Means in a row with different superscripts are significantly different.
Where: wi = width, ht = height

Overall mean shell thickness was 0.90±0.32 mm for out-station while on-station value was 0.52±0.05 mm. There was no significant difference in shell thickness by site but it was significant (P<0.001) by state. Thickness varied from 0.35±0.03 to 0.790±0.08 mm in Nasarawa and Niger State respectively. Shell weight was observed to be 4.18± 0.01 and 4.16± 0.01 g for out/ on stations respectively; and showed no significant difference by site and state.

Mean albumen width for out-station was 18.78 ± 0.02 cm while that of on-station was 18.79± 0.01 cm. There was no significant difference in albumen width by site and state. Overrall mean albumen height was observed to be 4.57±0.03 cm at out- station while that of on-station was 4.71±0.02 cm and showed no significant difference by site but differed significantly (P<0.001) by state. It varied from 3.66± 0.07 to 4.62± 0.07 cm in Kogi State and Abuja respectively. The mean yolk width recorded for out-station was 12.76 ± 0.02 cm and 12.75 ± 0.02 cm for on- station, which showed a non- significant difference by site and by state. The non-significant difference in egg length, shell weight, albumen weight and yolk width between states is a reflection of the similarity of the indigenous chickens in the study area. The egg weight, length and width values of indigenous chickens also showed that they were smaller compared with exotic breed. The overall quality rating of the egg (Haugh unit) at out-station was 76.31± 0.16 while on-station value was 67.45± 0.11. There was significant difference (P<0.001) by site and by state. Highest egg quality (Hu=78.61±0.22) was observed in Nasarawa and least (Hu = 73.44±0.16) in Niger state. The egg quality rating (Haugh unit) of 84.36 – 91.16 reported by Awosanya et al. (1998) is lower than the value obtained in this study. The egg shell thickness obtained in this study is higher than 0.34 – 0.35mm and 0.36±0.01 reported by Awosanya et al. (1998) and Mancha (2004) respectively. Mebratu (1997) and Chineke (2001) also gave lower values of 0.31–0.38 mm and 0.31±2.37 mm respectively for egg thickness. The importance of good shell thickness is that it enables the best use of nutrients contained in the egg by the embryo (Sergeyeva, 1976). There are lesser chances of bacteria penetration (Fisinin et al., 1990), dehydration (Roque and Soares, 1994) and also offers the best protection from mechanical damage (Sergeyeva, 1976).

Correlation coefficients between egg measurements are presented in Table 3. Most correlation values were significant at 1%. Only egg weight is correlated with shell weight at 5 % (0.036; P<0.05).

Most egg characteristic measured was lowly correlated. Albumen height is correlated with yolk width (0.389; P<0.01). There was no significant correlation between egg weight and shell thickness (-0.024) and albumen weight (-0.014). Egg length was not significantly affected by shell thickness (0.004) and shell weight (0.006).

Table 3. Correlation among egg parameters

Egg weight	Egg Length	Egg Width	Shell Thickness	Shell Weight	Albumen Wt	Albumen ht	Yolk Width
EW	0.036**	0.073**	-0.024ns	0.036*	-0.014ns	0.048**	0.041**
EL		0.180**	0.004ns	0.006ns	0.018**	0.018**	0.018**
EWi			-0.014ns	0.070**	-0.053**	0.108**	0.096**
STH				0.054**	0.008ns	0.013ns -	0.012ns
SW					0.017**	0.047**	0.009ns
A.W						0.036**	0.122**
A.H							0.389**
Ywi							

* = Significant at *P<0.05
** = Significant at **P<0.01

CONCLUSIONS

The positive correlations between egg quality characteristics showed that the traits could be used to predict each other and could hasten selection processes to develop the indigenous chicken for egg.

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