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Egg Quality Characteristics, Phenotypic Correlations and Prediction of Egg Weight in Three (Naked Neck, Frizzled Feather and Normal Feathered) Nigerian Local Chickens

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Abstract: A study was conducted to determine egg quality characteristics, phenotypic correlations and prediction of egg weight from egg quality parameters in three varieties (naked neck, frizzled feather and normal feathered) of local chickens in Akwa Ibom State, Southeastern Nigeria. A total of 600 eggs (200 each of naked neck, frizzled feather and normal feathered varieties) were collected. External and internal defects were computed and expressed as percentage of total egg production and summed up to obtain the total defects score for each variety. Egg quality parameters were compared between varieties using Multivariate General Linear Model of SPSS version 17.0 for ANOVA. Means were tested using Duncan's Multiple Range Test. Phenotypic correlations of egg quality parameters and prediction of egg weight using yolk weight, yolk width and albumen weight was done. Lowest total defects score (11.00%) was recorded for frizzled feather, 11.63% for naked neck and the highest (12.65%) for normal feathered. Egg weight differed significantly ($p<0.05$) among the 3 varieties with the values of 45.72 g, 44.72 g and 41.91 g for naked neck, normal feathered and frizzled feather varieties respectively. Yolk weight, yolk width, yolk height, yolk index, albumen weight, albumen width, albumen index and shell thickness were not significantly different ($p>0.05$). Mean highest value of 82.49% for haugh unit by naked neck was significantly different ($p<0.05$) from 77.57% by normal feathered and 77.01% by frizzled feather. Naked neck had best egg quality characteristics, followed by normal feathered and lastly the frizzled feather. In the normal feathered variety, strong, positive and significant ($p<0.01$) correlations were observed between egg weight and yolk weight (0.773) and albumen weight (0.797); yolk weight and albumen weight (0.567); yolk index and yolk height (0.715); haugh unit and albumen height (0.954) and albumen index (0.863). In the naked neck, strong, positive and significant ($p<0.01$) correlations were observed between egg weight and yolk weight (0.611) and albumen weight (0.768); haugh unit and albumen height (0.934). In the frizzled feather, strong, positive and significant ($p<0.01$) correlations were observed between egg weight and yolk weight (0.567) and albumen weight (0.680); haugh unit and albumen height (0.883) and albumen index (0.856). These parameters would give rapid improvements if selected together in the respective varieties. Egg weight was predictable from albumen weight with sufficient Reliability (R) of 0.77. 0.77 and 0.68 for normal feathered, naked neck and frizzled feather varieties respectively. Although many egg quality characteristics have strong genetic basis, it is necessary to implement a total quality management programme to maintain consistently good quality throughout the egg production cycle.

Key words: Local chickens, egg quality, phenotypic correlations, predictions

INTRODUCTION

The Nigerian local chickens (naked neck, frizzled and normal feathered) constitute about 80% of the 120 million poultry birds. These varieties, particularly the naked neck possess good egg laying characteristics (Udoh *et al*., 2012). Production of eggs from these local chickens is of great economic importance in the poultry industry. The success of the enterprise however depends on the total number of quality eggs produced (Ojedapo *et al*., 2009). Egg quality is a general term which refers to several standards which define both internal and external qualities. Evaluation of the internal and external qualities of chicken egg is an important index in commercial egg production (Parmer *et al*., 2006) and consumer preferences for better quality eggs (Kul and Seker, 2004). To maintain consistently good egg quality throughout the life of the hen, it is necessary to implement a total quality management programme throughout the production cycle. Stadelman (1977) observed that many characteristics of egg quality have a strong genetic basis. This implies that egg quality traits can be improved genetically through knowledge of their genetic variability (Obike *et al*., 2011). Therefore varieties comparison of local chickens for egg quality will provide useful information that will facilitate breeding decisions.

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With current researches geared towards genetic conservation, it is imperative to integrate the local chicken into the layer-breeding programmes. Adeolu *et al*. (2008) stated that adequate information on genetic parameter estimations of existing chicken populations with regard to egg production traits are essential in the development of suitable breeding programmes. This necessitates studies on the phenotypic correlations between egg weight and other egg quality traits of the local chicken varieties.

The use of predictions in poultry breeding activities had been emphasized by Abanikannda *et al*. (2007); Galal (2007) and Raji *et al*. (2008). Forecasting of egg weight without recourse to sensitive electronic scale has been a serious problem in egg production enterprise. To overcome these problem suitable models need to be developed which will assist local poultry farmers and breeders in determining the correct weight of eggs laid by the difference local chicken varieties.

MATERIALS AND METHODS

One hundred and eighty (180) pullets commonly raised in Akwa Ibom State were randomly purchased from local markets in 3 senatorial districts (Eket, Uyo and Ikot Ekpene) of the State. These were quarantined for two weeks after which 126 pullets weighing between 988 g-1011 g each were selected based on their health status. They consisted of 42 each of normal feathered, frizzled feather and naked neck with 14 of each variety from Eket, Uyo and Ikot Ekpene senatorial districts. The pullets were dewormed and vaccinated against prevalent local infections before lay.

The study, lasting for four (4) months (June-September, 2011), was sited in Uyo (5°1'N; 7°53'E). The tropical climate of Uyo has a mean annual temperature of between 26°C and 28°C while the mean annual rainfall ranges from 2000 mm-3000 mm.

The pullets were kept individually in the cells of a 2-tier battery cage in an open sided poultry house. They were fed *ad libitum* with a commercially prepared (Vital feeds) grower mash containing 16% crude protein and 2500 kcal ME/kg. The feed was changed to layer mash when 10% egg production as attained. Free - choice drinking water was made available using troughs.

Six hundred (600) freshly laid eggs (200 each of naked neck, frizzled feather and normal feathered) were collected. Eggs were collected twice daily, identified with a marker pen according to variety and transferred daily to the laboratory using egg crates. Here, each egg was weighed with a sensitive electronic weighing balance, external and internal defects assessed through candling and egg quality characteristics determined within 24 hrs. Egg defects examined included gross cracks, hairline cracks, cage marks, spot stains and stained eggs. Egg quality characteristics investigated were egg weight, yolk weight, yolk height, yolk width, yolk index, albumen weight, albumen height, albumen width, albumen index, haugh unit and shell thickness.

Egg defects were computed and expressed as percentages of total egg production and summed up to obtain the total score for each variety. Egg quality parameters were compared between varieties using Multivariate General Linear Model of SPSS (2001) version 17.0 for ANOVA. Means were tested using Duncan's Multiple Range Test (Duncan, 1955). Phenotypic correlations of egg quality parameters and the prediction of egg weight (dependent variable) using yolk weight, albumen weight and yolk width as independent variables were done.

Table 1: Proportions of defects and total defects score for naked neck, normal feathered and frizzled feather local chickens

Defects (%)	Normal feathered	Naked neck	Frizzled feather
Gross cracks	1.00	0.67	1.00
Hairline cracks	1.00	1.30	1.67
Star crack	1.33	1.00	1.00
Thin shelled	0.00	0.33	0.00
Pimples	1.33	1.00	0.67
Pin holes	1.67	1.33	2.00
Cage mark	2.33	2.00	2.33
Sport stain	2.66	3.00	2.33
Stained egg	1.33	1.00	1.00
Total score	12.65^{a}	11.63^{b}	11.00^{b}

^{a,b}Means along rows with different letters are significant different ($p<0.05$)

Table 2: Egg quality characteristics for naked neck, normal feathered and frizzled feather local chickens

Egg quality traits	Normal feathered	Naked neck	Frizzled feather
Egg weight (g)	44.72^{b}	45.82^{a}	41.91^{c}
Yolk weight (g)	14.26^{a}	14.72^{a}	13.91^{a}
Albumen weight (g)	23.27^{a}	23.89^{a}	21.68^{a}
Yolk ht (cm)	1.95^{a}	2.00^{a}	1.97^{a}
Yolk width (cm)	4.27^{a}	4.36^{a}	4.16^{a}
Yolk index	0.46^{a}	0.45^{a}	0.47^{a}
Albumen Ht (cm)	0.94^{b}	1.10^{a}	0.92^{b}
Albumen width (cm)	9.43^{a}	9.41^{a}	9.27^{a}
Albumen index	0.09^{a}	0.11^{a}	0.09^{a}
Shell thickness (mm)	0.37^{a}	0.37^{a}	0.35^{a}
Haugh unit	77.57^{b}	82.49^{a}	77.01^{b}

^{a,b,c}Means along rows with different letters are significantly different ($p<0.05$)

RESULTS AND DISCUSSION

The proportions of egg defects and total defects score of the 3 local chicken varieties are presented is Table 1. Egg defects varied among varieties, suggesting a genetic basis for egg defects (Stadelman, 1977; Beyer, 2005). Cage marks and spot stains were the most prominent defects across varieties. This could be attributed to the battery cage used, necessitating the implementation of a total quality management programme. Total defects score was highest for normal feathered (12.65%), followed by naked neck (11.63%) the lowest (11.00%) by frizzled feather variety.

The mean egg quality characteristics of the 3 local chicken varieties are presented in Table 2. Values for

Table 3: Phenotypic correlations of egg quality characteristics in normal feathered local chicken

	Egg weight	Yolk weight	Yolk height	Yolk width	Yolk index	Albumen weight	Albumen height	Albumen width	Albumen index	Shell thickness	Haugh unit
Egg weight	1.00	0.773**	0.261**	0.202*		0.797**					
Yolk weight		1.00	0.295**	0.236*		0.567**					
Yolk height			1.00								
Yolk width				1.00							
Yolk index			0.715**		1.00	0.216*					
Albumen weight			0.213*	-0.384**		1.00	0.226*			-0.266**	
Albumen height							1.00				
Albumen width								1.00			
Albumen index							0.394**	-0.680**	1.00		
Shell thickness										1.00	
Haugh unit							0.954**	-0.344**	0.863**		1.00

Table 4: Phenotypic correlations of egg quality characteristics in naked neck local chicken

	Egg weight	Yolk weight	Yolk height	Yolk width	Yolk index	Albumen weight	Albumen height	Albumen width	Albumen index	Shell thickness	Haugh unit
Egg weight	1.00	0.611**		0.373*		0.768**				-.0236*	
Yolk weight		1.00		0.358*		0.276**				-.0243*	
Yolk Height			1.00								
Yolk width				1.00							
Yolk index				0.240*	1.00	-0.324**					
Albumen weight						1.00				-0.266**	
Albumen height				0.240*		-0.324**	1.00				
Albumen width								1.00			
Albumen index							0.206**		1.00		
Shell thickness										1.00	
Haugh unit							0.934**	-0.269*	0.208**		1.00

Table 5: Phenotypic correlations of egg quality characteristics in frizzled feather local chicken

	Egg weight	Yolk weight	Yolk height	Yolk width	Yolk index	Albumen weight	Albumen height	Albumen width	Albumen index	Shell thickness	Haugh unit
Egg weight	1.00	0.567**				0.680**					
Yolk weight		1.00									
Yolk height			1.00								
Yolk width				1.00							
Yolk index					1.00			0.246*			
Albumen weight						1.00					
Albumen height							1.00	0.288**			
Albumen width								1.00			
Albumen index								-0.579**	1.00		
Shell thickness										1.00	
Haugh unit							0.883**	-0.280**	0.856**		1.00

egg weight were significantly different ($p<0.05$), with naked neck eggs being heaviest (45.82 g), followed by the normal feathered (44.72 g) and the least (41.91 g) by frizzled feather. These differences could be attributed to differences in their genotypes. The values for naked neck and normal feathered were similar to 43.13 g and 43.44 g obtained for naked neck and normal feathered chickens respectively in Abeokuta (Nigeria) by Ikeobi *et al.* (2004). Yolk weight, yolk width, yolk height, yolk index, albumen height, albumen width, albumen index and shell thickness were not significantly different ($p>0.05$) among the 3 local chicken varieties. Values for yolk index were within the acceptable range of 0.33 and 0.50 and albumen index within 0.05 and 0.17 required for good quality eggs (Ihekoronye and Ngoddy, 1985). Eggs of the 3 varieties therefore had good internal qualities, protected by egg shell thickness of between 0.35-0.37 mm. Chineke (2001) observed that egg shell thickness below 0.33 mm are considered too thin with the risks of breakage and ease of entry by micro-organisms. Naked neck had best egg quality characteristics, followed by normal feathered and lastly the frizzled feather. The superiority of the naked neck genotype over frizzled and normal feathered could be attributed to greater efficiency of thermoregulation associated with this gene.

Phenotypic correlations of egg quality characteristics in the 3 local chicken varieties are presented in Table 3, 4 and 5. In the normal feathered, strong, positive and significant ($p<0.01$) correlations were observed between egg weight and yolk weight (0.773) and albumen weight (0.797); yolk weight and albumen weight (0.567); yolk index and yolk height (0.715); haugh unit and albumen

height (0.954) and albumen index (0.863). In the naked neck, strong, positive and significant ($p<0.01$) correlations were observed between egg weight and yolk weight (0.611) and albumen weight (0.768); haugh unit and albumen height (0.934). In the frizzled feather, strong, positive and significant ($p<0.01$) correlations were observed between egg weight and yolk weight (0.567) and albumen weight (0.680); haugh unit and albumen height (0.883) and albumen index (0.856). The positive associations between egg weight and other egg quality indices in this study agree with earlier observations of Abanikannda *et al*. (2007); Yakubu *et al*. (2008). These parameters would give rapid improvements in the respective varieties if selected together.

Egg weight was predictable from albumen weight with sufficient Reliability (R) of 0.77, 0.77 and 0.68 for normal feathered, naked neck and frizzled feather varieties respectively.

Conclusion and recommendation: The results of this study revealed that Nigerian local chicken varieties produce egg with varying proportions of defects. Frizzled feather variety had least total defects score, followed by naked neck and the highest by normal feathered. Eggs of the 3 varieties had good quality characteristics. Naked neck had best egg quality characteristics, followed by normal feathered and lastly the frizzled feather. Simultaneous selection and improvement of egg quality traits are possible in the 3 varieties because of the strong affinity between them. Egg weight is predictable from albumen weight in the 3 varieties.

Naked neck variety should be further characterized, conserved and crossed with normal feathered to improve egg quality characteristics of local chickens in Southeastern Nigeria. A total quality management programme should be implemented throughout the egg production cycle to reduce egg defects.

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