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Comparison of the Morphometric Characteristics of Exotic Commercial and Local Chicken Eggs in the Tropical Environment

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Abstract: Twenty-five freshly laid eggs were collected weekly from each of exotic commercial and local chicken flocks designated (E) and (L), respectively. These made a total of 125 eggs each over a period of 5 weeks for the experiment and were analyzed for morphometric characteristics. The mean egg weight values, shell weight and shell thickness of the exotic layer eggs significantly differed from those of the local chicken eggs ($p<0.05$). The haugh unit value was also significantly higher in the exotic layer eggs but the albumen index of eggs of the chicken genotypes did not differ ($p>0.05$). However, mean yolk weight was higher ($p<0.05$) in the local chicken eggs. There was high correlation ($p<0.05$) between shell thickness and specific gravity in the exotic chicken eggs. This was negative in the local chicken eggs. There was no correlation between shell thickness and yolk weight of the local eggs. Eggs of both chicken genotypes exhibited positive correlation in respect of yolk weight and egg weight values. Eggs of the exotic commercial layers were superior in all the parameters measures except in yolk weight, which may be partly genetic and partly environmental. However, as eggs, the composition of both egg types and their biological value were not considered to differ as to give one or other any nutritional superiority, although differences existed in the morphometric characteristics.

Key words: Exotic commercial layers, local chickens, egg morphometric characteristics

INTRODUCTION

As an article of food, the chicken egg is very high in protein. Its amino acid make up is so balanced to qualify the egg as a reference protein source for measuring other protein foodstuff and it is therefore one of the few foods produced in pre-packaged form by nature for man[1]. However, certain non-nutritional attributes sometimes influence the acceptability of eggs by some sophisticated consumers. For instance the colour of the shell is of no known nutritional value to man but it affects consumers preference[2]. Others include albumen height, yolk height, albumen viscosity, egg shell thickness, haugh unit. However, while these attributes, bear no relationship to the nutritional qualities of the egg, the shell and its membrane fulfilled a mainly protective function and act as a source of calcium for the developing chicks[3], the albumen acts as a moisture and protein for the developing embryo and because of its large water content has specific heat thus protecting the embryo from large flunctuations of temperature[3]. The haugh unit as an expression relating egg weight and height of thick albumen is most wicely used research measure of albumen quality[4].

In Nigeria, Table eggs are produced primarily by exotic commercial layers and to a small extent by local chickens. However, previous research efforts have shown that although the local chicken perform very poorly in meat and egg production, it possesses useful genetic attributes that can be harnessed in crossbreeding programme[5]. It is generally assumed that eggs of the exotic chickens have a better quality than those of the local chickens, a belief associated with the proper feeding of the exotic layers while the local chickens are usually allowed to feed on kitchen waste or exposed to free range conditions. However, information is lacking on the differences in the morphometric egg quality characteristics between the exotic commercial layers and the local chickens.

The purpose of the study was to compare the physical attributes of the eggs of the two chicken genotypes under their usual management conditions in the tropical environment.

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MATERIALS AND METHODS

Twenty-five freshly laid eggs collected randomly from each of the exotic commercial and local chicken flocks designated (E) and (L), respectively were analyzed weekly to make a total of One hundred and Twenty-Five eggs of each group for the experiment. The exotic commercial layers were maintained on deep litter and fed ad libitum on a proprietary mash the composition of which is shown in Table 1. The local chicken population was kept on a modified free-range condition where the area was fenced, water was provided ad libitum and the birds fed with kitchen wastes to mimic the conditions under which these birds are normally maintained. Eggs from the two populations were analyzed independently over 5 weeks for the following morphometric characteristics: Whole Egg Weight (W_EG), Yolk Weight (W_Y), Shell Thickness (SH_{TH}), Specific Gravity (S_G) Albumen Height (A_H), Albumen Diameter (A_D), Yolk Height (Y_H) and Yolk Diameter (Y_D). After weighing, each egg was broken into a flat dish. The Albumen Height (AH), Yolk Height (YH) and Albumen Diameter (AD) were measured before separation[6]. All weights were determined using a high precision balance while the linear measurements, Shell Thickness (SHTH), Albumen Diameter (AD) and Yolk Diameter (YD) were determined with a micrometer screw gauge and venier caliper. Specific gravity was determined using the volume of water displaced by the eggs in a measuring cylinder and applying the Eq:

Specific Gravity (S_G) = Weight of Egg (g)/Volume of Water displaced (mL)

Applying the conventional formular[7] egg quality indices were computed from the morphometric data as follows:

Albumen Index (A_1) = Albumen Height (A_H)/Albumen Diameter (A_D)

Yolk Index (Y_1)= Yolk Height (Y_H)/Yolk Diameter (Y_D)

Haugh Unit (H_U) = $100 \log (A_H - 1.7 W_{EG}^{0.37} + 7.6)$

Where A_H is albumen height (mm)
W_{EG} is weight of egg (g)

The data collected were analyzed using the one-way analysis of variance by General Linear Models (Least squares) procedures of[8]. Duncan's new multiple range test was used to determine significant differences between means[9]. Data were also fitted into simple Linear Regression Model of type $Y = a + b_1x_1 + \Sigma ij$[10].

Table 1: Proximate composition of the commercial diet used in the experiment as provided by the manufacturer

Nutrients	% Composition
Crude protein	16.0
Metabolizable energy	11.0MJ
Calcium	3.5
Available phosphorus	1.0
Fibre	4.5
Fat	3.0

RESULTS AND DISCUSSION

A summary of the difference between the morphometric characteristics of the eggs of the exotic chickens and those of the local chickens is presented in Table 2. Table 3 shows the regression and correlation between various parameters of eggs of the two chicken genotypes. Eggs of the exotic commercial layers showed superior traits in most of the morphometric characteristics when compared with those of the local chickens. The mean egg weight values, shell weight and shell thickness of the exotic layers differed from those of the local chickens ($p<0.05$). Egg weight of the exotic layers was on the average heavier, with 9.5g as the difference between the mean weight of the two egg categories. Shell weight of the exotic chicken eggs was also superior ($p<0.05$). These higher values may partly be attributed to the effect of nutrients in the diet of the exotic chicken, such as calcium, phosphorus, etc which may be lacking for the local chickens that were not fed on a balanced diet. Lack of such nutrients could have a reactive effect on the morphometric quality traits of the local chicken eggs. The thicker and heavier shell of the exotic chicken eggs could be an advantage during transportation.

Haugh unit, which is a measure of the albumen quality[4,11], was significantly higher in the exotic layers eggs ($p<0.05$). This attribute is the widely used quality measurement of eggs[12]. There was however no significant difference ($p<0.05$) in the albumen index between the eggs of the two chicken genotypes.

Mean yolk weight, which is a function of yolk mass, was higher ($p<0.05$) in the local chicken eggs, being 22.8% of the whole egg weight as against 16.4% in the eggs of the exotic layers. Asuquo[13] had earlier reported such a higher percentage yolk weight value when they compared the exotic and the local chicken eggs, although they found no statistical significance in the difference. The values of yolk and albumen indices were 0.48 and 0.099 for the exotic and 0.39 and 0.095 for the local chicken eggs, respectively Table 2, indicating higher values for the exotic commercial layers which is a plus for this group.

Table 2: Comparison of the internal morphological characteristics of eggs from exotic chickens fed normal layers diet and those of local chickens in an enclosed range condition

	Mean value (x) of quality parameters		Differences between sample means
Quality parameters	X_E	X_E	X_E X_L
Whole egg weight (g)	50.0±2.96	40.5±4.27	9.5
Shell weight (g)	6.2±0.15	4.9±0.56	1.3
Yolk thickness (g)	11.9±0.98	15.1±1.89	3.1*
Shell thickness (mm)	0.36±0.048	0.34±0.046	0.023
Albumen index	0.099±0.022	0.095±0.02	0.004
Yolk index	0.48±0.046	0.39±0.042	0.09
Haugh Unit (HU)	79.8±8.72	77.3±7.29	2.5
Specific gravity	1.060±0.03	1.063±0.05	0.003

Indicating the parameter with the higher value difference in the local chicken eggs

Table 3: Properties of regression and correlation between various egg quality parameters of the exotic and local chickens egg reared on commercial feed and modified range condition, respectively

Exotic commercial layers (E-series)				Local chicken (L-series)			
Relationship	R	Probability	Degree of freedom	Relationship Eq.	R	Probability	Degree of freedom
$YW = 3.67+0.1649\ W_{EG}$	0.4976	p<0.01	30	6.521+0.2283 WEG	0.575	p<0.001	33
$SH_W = 1.248+0.0985\ W_{EG}$	0.5506	p<0.001	30	4.36+0.0127WEG	0.4696	p<0.001	30
$SG = 0.007+0.0563\ SH_W$	0.5949	p<0.001	31	$1.15+0.0014\ W_S$	0.0103	No correlation	-
$SH_{TH} = -1.624+4.843\ SG$	0.4471	p<0.01	30	7.89+4.109SG	-0.4660	p<0.001	54
$YI = 0.4992 - 0.0014\ Y_W$	0.0334	No correlation	48	$0.366+0.001\ Y_W$	0.0373	No correlation	48
HU = -38.90+108.90 SG	0.3988	p<0.05	31	78.67+0.152SG	0.3380	p<0.05	35
$H\ Log\ HU = -3.61+3.25log - W_{EG}$	0.8707	p<0.01	30	Log HU = 1.083+0.5log WEG	0.6459	p<0.001	30

Where: Y_W is Yolk weight, SH_{TH} is Shell thickness, SH_W is Shell weight, YI is Yolk Index, SG is Specific Gravity, HU is Haugh Unit, W_{EG} is Whole egg weight

There was a highly significant correlation (p<0.01) between shell thickness and specific gravity (r = 0.4471) in the exotic breed. The relationship between shell thickness and specific gravity in the local chicken eggs was, however negative (Table 3). This may be due to the fact that the yolk forms such a high proportion of the whole egg of the local chicken. There was also lack of correlation between shell thickness and yolk weight in the local chicken egg. However, eggs of both genotypes exhibited positive correlation in respect of yolk weight and egg weight (r =.4976, p<0.01) for exotic layers and (r = 0.5575, p<0.01) for the local. Linear relationship existed between Haugh Unit and specific gravity of eggs of the two chicken genotypes although there was no significant difference in the specific gravity of the eggs between the two. Also within each group the specific gravity did not show any appreciable change with the eggs size, which agrees with the earlier findings of Rindel[14].

CONCLUSION

The study showed the eggs of the exotic commercial layers to be superior in all morphometric parameters measured except in yolk weight. These significant differences between the genotypes seem partly genetic and partly environment, which is in agreement with the report of[15]. However, there was no attempt to expose the local chickens to the same management condition as the exotic commercial layers since the focus of the comparison was based on the eggs of the chicken genotypes in their usual condition of management. Avian eggs have identical chemical composition, so neither the proximate composition nor the amino acid profile of the eggs was examined for any value difference.

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REFERENCES

1. Ensminger, M.E., 1977. Animal Science. Animal Agriculture series. 7th Ed. The interstate printers and Publishers, Inc. Danville, Illinois.
2. Olori, V.E. and E.B. Sonaiya, 1992. Composition and shell quality of white and brown eggs of the Nigeria Indigenous chicken. Nig. J. Anim. Prod., 19: 12-14.
3. Ekwenzor, I.K.E., A.W. Granville, E.E. Nkanga and O.K. Ogbalu, 2002. The effects of crude oil contaminated feeds on the yield and quality of eggs of poultry birds (*Gallus domesticus*).Journal of Agriculture in the Tropics and Subtropics, 103: 89-97.

4. Haugh, R.R., 1937. The Haugh unit for measuring egg quality. U.S. Egg Poultry Manag., 43: 552-555.
5. Nwosu, C.C., S.I. Omeje and A.I. Ikeme, 1987. Effects of genotype, age and egg size on measures of shell quality of local and crossbred hens. J. Anim. Prod. Res., 7: 19-27.
6. Olumu, J.M., 1975. Effects of traditional methods of Storage on egg quality, Nig. J. Anim. Prod., 2: 182-187.
7. Carew, S.N., J.M. Olumu, A. Sekoni, S.A. Offiong and S.A. Olurunju, 1983. The characteristics and quality of guinea fowl eggs, In the Helmet Guinea Fowl (Numida Meleagridis Pallas) in Nigeria.
8. Statistical Analysis System Institute Inc. (SAS), (1986). Guide for Personal Computers Version 6th Edn., SAS Institute Inc. North Carolina, USA.
9. Steel, R.R.G. and J.H. Torrie, 1980. Principles and Procedures of Statistics. Mac Graw-Hill Book Company Inc. NY, London.
10. Daniel, W.W., 1978. Biostatics: A Foundation for Analysis in the Health Science 2nd ed John Wiley and Sons New York.
11. Card, L.E. and M.C. Nesheim, 1973. Poultry Production, 11th ed. Lea and Febiger, Philadelphia, pp: 291-293.
12. Hawthrone, J.R., 1950. The action of Egg White Ecosystem and Ovomuncoid and Ovomucin. Biochem. Biophys. Acta, 6: 28-35.
13. Asuquo, B.O., B. Okon and A.O. Ekong, 1992. Quality Parameters of Isa- Brown and Nigeria Local Chicken Eggs. Nig. J. Anim. Prod., 1 and 2: 1-5.
14. Rendel, J.A., G.R. Mr. Daniel and J.A. Mc. Guire, 1984. Egg Characteristics and Production Efficiency of Dwarf (dw) White Leghorn Hens Divergently selected for body weight. Poultry Sci., 63: 214-221.
15. Adegbola, T.A. and V. Olatoke, 1988. Effect of Hen's age on the Physical characteristics and composition of their eggs. Nig. J. Anim. Prod., 18: 39-41.