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RESEARCH ARTICLE

The Effects of Genotype on Internal and External Egg Quality Traits, Egg Proximate Composition and Lipid Profile Characteristics of Three Strains of Layer Turkeys

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ABSTRACT

This study was conducted to determine the influence of egg genotype on internal and external egg quality, proximate composition and lipid profile. Ninety (90) fresh eggs of the three genotype in exotic, crossbred and local strains of layers turkey were used. The genotype has significant effect (P<0.05) on egg proximate composition and other egg traits. Egg quality trait in term of crude protein highly favored exotic compared to other. There's significant effect (P<0.05) on internal and external egg quality trait. The result also showed significant effect (P<0.05) on egg weight and egg production traits when compared between genotypes. The mean weights of exotic turkey eggs (76.10 g) was significantly (P<0.05) much heavier than the crossbred and local turkey eggs (65.85 g). The egg length and egg width followed the same pattern. The proportion of shell weight to the egg weight was higher in exotic turkey (7.40 g) than the local turkey (6.15 g). Similarly, the exotic turkey eggs had the highest values of internal and external egg traits. The effect of genotype on egg biochemical indices were significantly (P<0.05) different from each other. The highest value of the total cholesterol (TC) and Try glycerol (TG) were found among the local turkey eggs. The egg lipids for High density lipoproteins (45.80±4.28%) and low density lipoproteins (51.60±6.58%) were also significantly (P<0.05) different and higher in the local turkey eggs. The mean values of potassium, glucose, total protein, albumin, globulin, calcium and phosphorus of the genotype were also significantly (P<0.05) influenced. The egg minerals in relation to genotypes were also significantly (P<0.05) influenced, the values are suggestive of the existence of genetic variation. The present study therefore indicates that genotype, significantly affect egg weight and egg quality traits. The implication is that the egg quality traits are influenced by both genetic and non genetic factors.

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INTRODUCTION

In Nigeria, there are many varieties of poultry including Turkey. They are emerging as an important source of animal protein and provide essential substances as other meat but has comparatively low percentages of fat and high percentages of proteins (Nixey and Grey, 1985). The productivity and quality of the breeding egg has an overall effect for poultry flock and for economic breeding (Isidahomen *et al.*, 2011).Moreover, the external and internal quality traits are important in poultry breeding because of their influence on the yield on the progeny generation. The egg production of local turkeys can rose up to 99 eggs per hen per year with improved feeding, housing and health care (Tadelle *et al.*, 2000). The relationship between weight, length and width of eggs has been reported by Danilov (2000) who also noted the proportion of yolk, albumin and shell that contribute to the egg weight increase with hen's age. Thus egg weight is one of the important phenotypic traits which influences egg quality and reproductive fitness of the chickens parent (Islam *et al.*, 2001; Farooq *et al.*, 2001).Egg quality is composed of those characteristics of an egg that affects its acceptability to consumers such as cleanliness, freshness,

egg weight, shell quality, yolk index etc (Song *et al*., 2000).

Environment has been shown to influence productivity of farm animals particularly in the tropical environment where the weather affects deleteriously on the productive performance and well-being of all domestic animals (Ilori *et al*., 2009).Productive adaptability itself is a phenomenon whereby an animal gives acceptable level of production in a stressed environment (Ibe,1990). Efforts to characterize the breeds of turkey which are local crossbred and exotic entails the assessment of the productive traits of the birds including the egg traits. These qualities of the turkey eggs can be influenced by many factors which may be genotype and environment (Isidahomen, *et al.*, 2011). Economically, important egg quality traits such as weight, size, yolk and albumin contents are quantitative traits with continuous variability.

The assessment of proximate composition of different strains of turkey has been given less attention. Hence, this study examines the quality characteristic of egg of three strains. This study, therefore, was conducted to evaluate the proximate composition, egg quality of different strains of local, crossbred and exotic turkey eggs.

MATERIALS AND METHODS

This study was conducted at the poultry unit in the teaching and research farm Ambrose Alli University, Ekpoma, Edo State. Ninety fresh eggs each from three strains namely: local, crossbred and exotic turkeys were used to obtain the eggs quality traits of these turkeys. These comprised 30 eggs from each genotype. The eggs collected were sorted and pedigreed along each sire line. All hens were wing tagged for proper identification and subjected to the same management practices throughout the experimental period. The birds were fed *ad libitum* with layer mash containing 16% Crude Protein, 2800kcal/kg Metabolisable Energy.

Data Collection

Data was collected on:

Body Weight: This was taken on individual bird from each female turkey with the aid of a scale balance in kg.

Egg Weight: This was taken on individual eggs from each layer with the aid of an electronic balance having sensitively of 0.01g.

Egg Length: A Venire caliper with an accuracy of 0.1mm was used to determine the egg length. It was taken as the longitudinal distance between the narrow and the broad ends.

Egg Width: It was measured to the nearest 0.1mm with venire caliper. The egg width was taken as the diameter of the widest cross-sectioned region.

Egg shell weight: This was taken on individual eggs from each layer with the aid of an electronic balance having sensitively of 0.01g.

Egg shell Thickness: It was measured to the nearest 0.1mm with micrometer screw gauge

Yolk weight: This was taken on individual eggs from each layer with the aid of an electronic balance having sensitively of 0.01g.

Yolk length: A Venire caliper with an accuracy of 0.1mm was used to determine the egg yolk length. It was taken as the longitudinal distance between ends.

Yolk height: It was measured to the nearest 0.1mm with venire caliper. The egg height was taken as the distance between the base and the height.

Proximate composition: The Proximate composition of eggs was determined according to the method of AOAC (1990).

Data Analysis

All data collected were subjected to Analysis of Variance in a generalize linear model (GLM) of the Statistical Analysis System Institute (SAS, 1999), Significant differences were computed using New Duncan multiple range test (Gomez and Gomez, 1984) to determine the significance of specific classes.

The data were analyzed using the model specified below:

The model is stated thus:

$Y_{ijk} = \mu + G_i + \Sigma_{ij}$ where,

Y_{ijk} = Dependent Variable

μ = Overall mean

G_i = Effect of the i^{th} genotype on egg traits

Σ_{ij} = Random Residual error

RESULTS

Least square means and standard error of proximate composition as affected by genotype are presented in Table 1. Genotype significantly affected ($P<0.05$) proximate composition. The crude protein value was highest in Exotic egg strain (22.03) while the least value was recorded in Local egg strain (19.45), the ash content was highest in the Local egg strain (9.52%) and lowest in the Exotic (3.79%). The Moisture content was highest in the Local egg strain (30.68%) and lowest in the Exotic egg strain (27.14%).

Least square means and standard error of egg weight as affected by genotype are as presented in Table 2. Egg weight were found to have significant ($P<0.05$) effect in this study. Exotic egg strain had the highest mean value (76.10) while the Local egg strain had the least (65.85). Egg length followed the same trend with egg weight (6.27), while Local egg strain had the least mean value of egg width (5.85). For albumin weight, yolk weight and yolk length and other parameters measured favor the exotic chicken when compared with their local and crossbred.

The least square means and standard error of means for egg lipids parameters for the three genetic group are the total cholesterol (TC) and Try glycerol (TG), High density lipoprotein (HDL), Low density lipoprotein(LDL), potassium (K), sodium (Na), glucose (G), total protein (TP), globulin (Glu), calcium (ca) and phosphorus (P) were found were significantly ($P<0.05$) affected by genotype, except albumin (Alb) of turkey eggs.

DISCUSSION

Crude protein in this study were found to have significant ($P<0.05$) effect in this study. Exotic genotype had the highest value while the local had the least value.

Table 1: Least-squares means and standard error of means on turkey eggs proximate composition as affected by genotype

Parameters	Local	Exotic	Crossbred
Either Extract (%)	33.77±0.09[b]	36.79±0.82[a]	34.54±0.01[b]
Crude Protein (%)	19.45± 0.00[c]	22.03± 0.00[a]	20.70±0.01[b]
Ash (%)	9.52±0.88[a]	3.79±0.40[c]	6.66±0.13[b]
Nitrogen Free Extract (%)	6.98±0.19[c]	12.06±0.09[a]	9.11±0.01[b]
Moisture (%)	30.68±0.09[a]	27.14±0.00[c]	28.99±0.01[b]

a,b,c means in the same row with different superscripts are significantly different (P<0.05)

Table 2: Least square means and standard error of means of weight, external and internal egg quality of turkey as affected by genotype

Parameters	Local	Exotic	Crossbred
Egg weight(g)	65.85±0,87[c]	76.10±1.71[a]	70.98±0.92[b]
Egg length(cm)	5.85±0.09[b]	6.27±0.16[a]	6.09±0.09[ab]
Egg length (cm)	4.04±0.05[b]	4.32±0.07[a]	4.14±0.06[b]
Shell weight(g)	6.20±0.09[c]	7.35±0.10[a]	6.55±0.15[b]
Shell thickness (%)	0.34±0.00[b]	0.36±0.00[a]	0.36±0.00[a]
Albumin weight (g)	43.70±0.47[c]	54.00±0.32[a]	47.45±0.39[b]
Yolk weight (g)	25.10±0.16[a]	24.45±0.34[a]	23.15±1.13[a]
Yolk length (cm)	3.90±0.02[c]	4.32±0.06[a]	4.13±0.04[b]
Yolk Height(MM)	0.82±0.02[b]	1.03±0.02[a]	1.01±0.01[a]

Means and in the same row with different superscript are significantly different (P<0.05)

Table 3: Least-squares means and standard error of means on turkey eggs biochemical indices as affected by genotype

Parameters	Local	Exotic	Crossbred
Total Cholesterol (mg/dl)	417. 60± 16.48[a]	226.60±0.96[c]	321.80±8.40[b]
Try glycerol (mg/dl)	325.00±6.06[a]	262.60 ±1.51[c]	299.80±239[b]
High Density Lipoprotein (%)	45.80±4.28[a]	36.80±0.85[b]	41.00±1.79[ab]
Low Density Lipoprotein (%)	51.60±6.58[a]	19.00±0.46[c]	35.36±3.13[b]
Potassium (mmol/l)	77.22±1.75[a]	59.36±1.48[c]	69.72±1.68[b]
Sodium (mmol/l)	104.60±0.34[a]	85.60±3.54[c]	95.00±1.97[b]
Glucose (mg/dl)	350.80±1.92[a]	326.2±2.78[c]	340.00±2.28[b]
Total Protein (mg/dl)	3.76±0.10[a]	3.00±0.00[c]	3.20±0.05[b]
Albumin (mg/100ml)	1.00±0.00	1.00±0.00	1.00±0.00[b]
Globulin (mg/100ml)	2.40±0.11[a]	2.00±0.00[b]	2.00±0.00[b]
Calcium (mg/dl)	11.48±0.20[c]	13.40±0.05[a]	12.58±0.14[b]
Phosphorus (mg/dl)	25.46±0.86[a]	27.16±0.24[a]	26.24±0.56[b]

a,b,c means in the same row with different superscripts are significantly different (P<0.05)

This is in agreement with finding of (Faga *et al*., 1989; Isidahomen *et al.,* 2009) who observed that the genotype significantly affected the chicken genotype irrespective of the size. Also the values fall within the range according Babangida *et al.* (2006).Moisture content favor the local turkey eggs showing the highest mean value and the least value was observed among the exotic. The reason could be their genetic makeup. However the value recorded were lower compared to the report of Olomu, (2003). Also the values fall within range according to Babangida *et al*. (2006) and Olomu, (2003). The values for ether extract was also highest in exotic genotype and the lowest was observed in local which may also due to their genetic makeup and which is in agreement with the report of Isidahomen *et al*. (2013). Exotic also recorded the lowest ash value while the highest value was recorded in local egg genotype. However, the value did not agree with the work of Babangida *el al*. (2006), but agree with the report of Isidahomen *et al.* (2013) who reported that the exotic chicken eggs had the highest value and the least value was recorded in the Normal local chicken. This could be attributed to environmental and the analytical procedure involved. Exotic also recorded the lowest moisture value while the local had the highest value. However, the value did not agree with the work of Babangida *el al*. (2006).

The exotic turkey weight was much higher than the crossbred and local. This is basically due to the vast difference in size of this genotype (Isidahomen *et al*, 2011). The absolute weight of external and internal egg characteristic were significantly (P<0.05) higher in exotic and crossbred compared to local turkey. The differences were obviously due to much higher egg weight in the turkeys. The effect of genetic group on egg weight were significantly (P<0.05) different. Exotic turkey had higher egg weight than local turkey, since egg weight is highly heritable traits. The difference between the three might be expected. In general the egg weight of local turkey is low compared to exotic turkey. The reason for the higher weight might be due to the fact that it is an improved genotype (Sharma *et al.,* 2006). Egg weight variations in different genetic groups were reported by many authors (Washburnn 1990; Padhi *et al.,* 1998 and Chatterjee *et al.,* 2007a). The effects of genetic group on egg length and egg width were also significantly (P<0.05) different from each other. The exotic turkey showed higher values in egg length and egg width than the local turkey. Shell weight was significantly (P<0.05) affected by genetic group. The egg shell weights were significantly higher in exotic turkey than the local turkey eggs shell (Padhi *et al.,* 1998). Shell thickness varied significantly (P<0.05) between genetic group. The shells of exotic turkey eggs are thicker than the local counterpart. The mean shell thickness was better for their suitability (Parmer *et al.,* 2006; Padhi *et al.,* 1998; Wani *et al.,* 2007 and Chatterjee *et al.,* 2007b). The albumin weight differed significantly (P<0.05) between the genetic group. Exotic turkey eggs had better albumin weight than the local and this is in agreement with the report of (Parmer *et al.,* 2006 and Chatterjee *et al.,* 2007b). The reason for the higher weight might be due to the fact that it is an improved genotype. Yolk weight value were significantly (P<0.05) influenced by genotype. The yolk weights were significantly higher in local than exotic (Isidahomen *et al.,* 2011). Parmer *et al.* (2006) also observed lower yolk weight index for kadknult birds. However, higher yolk length and yolk height and were also observed in this experiment. The values support the reports by Singh *et al.* (1993) and Sachdera *et al.* (2006).

The effect of genotype on egg biochemical were significantly (P<0.05) different from each other. The highest value of the total cholesterol (TC) and Try glycerol (TG) were found among the local turkey eggs. These can be attributed to the greater adaptation of the local turkey to the hot humid environment especially in terms of body temperature since total cholesterol play a major role in many biochemical processes, such as the composition of cell membrane and the synthesis of steroids hormones (Isidahomen, *et al.,* 2009).The lower of the cholesterol by fasting of broilers/poultry were previously reported (Faisal *et al* .,2008; El-sheikh *et al.,* 2004) which is mainly due to the enhancement of the catabolic reaction of lipids in the blood and a reduction in the cholesterol synthesis (Calabotta *et al.,*1985).

The egg lipids for High density lipoproteins and low density lipoproteins were also significantly ($P<0.05$) different and higher in the local turkey eggs and lower in the exotic turkey eggs table 1.in birds, lipids, which are mainly represented by triglycerols, are synthesized primarily in hepatocytes and stored in adipocytes and growing oocytes, and are associated, in yolk deposition and embryo development (deAlvarenga *et al.,* 2010). Lipoproteins are set of complex spherical particles formed from lipids and proteins. These particles circulate in the blood streams, transporting endogenous and exogenous lipids in the plasma (deAlvarenga *et al.,* 2010) and Isidahomen, *et al.,* 2009). Low density lipoproteins are even smaller, denser and more concentrated in cholesterol due to the removal of a large portion of the triacylglycerol. High density lipoproteins are the smallest lipoproteins (approximately 10 nm), comprised of about 57% proteins and with density of 1.210 g/ml (versus 1.0 mg/ml of water and less than 0.95g/ml chylomicrons). These lipoproteins remove free cholesterol from the circulation and conduct this compound towards excretion (deAlvarenga *et al.,* 2010).

The mean values of potassium, glucose, total protein, albumin, globulin, calcium and phosphorus of the genetic group were also significantly ($P<0.05$) influenced. However ,the present results are inconsistent with the values of total protein, albumin, urea, cholesterol, given by Isidahome *et al.,* 2009 who observed significant ($P<0.05$) genetic effect in their chicken study. Moreover, the local genotype had a significantly higher ($P<0.05$) mineral content and a lower 11.48±0.20 calcium values. The present findings are inconsistent i with the report of earlier workers (Isidahomen *et al.,* 2009). Mineral parameters are important in the proper maintenance of the osmotic pressure between the circulating fluid and the fluid in the tissue space so that the exchange of materials between the blood and cells could be facilitated. They also contributed to the viscosity and maintenance of the normal blood pressure and PH. All the values obtained from the minerals were all within range as reported by (Isidahomen *et al.,* 2009). The implication is that breeds/ strain may affect the electrolyte values. The significant genotypes biochemical values are suggestive of the existence of genetic variation. The higher values of calcium, phosphorus, urea and albumin in local than exotic might be attributed to various environmental factors associated with genes.

Conclusion

The present study therefore indicates that genotype, significantly affect egg weight and egg quality traits. The implication is that the egg quality traits are influenced by both genetic and non genetic factors. The crossbred eggs were very close to the exotic, suggesting that eggs quality traits of turkey could be improved by crossbreeding.

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