Effect of phenotype on egg quality characteristics of F₁ locally-adapted Turkey of Nigeria

*¹Nosike, R. J., ²Ebuzor, C. A., ³Onunkwo, D. N., ¹Obasi, E. N., ¹Ezea, J. ¹Nwakpu, O.F.
¹Obike, O. M., ¹Ibe, S. N. and ¹Oke, U. K..

¹Department of Animal Breeding and Physiology, ²Department of Animal Production and Livestock Management, ³Department of Animal Nutrition and Forage Science, Michael Okpara University of Agriculture, Umudike, Abia State, Nigeria.

*Corresponding author's email: nosikereginald@gmail.com,

Tel: +2348037603823

Abstract

The local breeds of animals in Nigeria deserve improvement in their genetic profile and physiological status. A total of 78 day-old Random-bred Nigeria local turkey poults were used as parent stock to generate another 232 day-old poults (F₁) to evaluate the Nigerian local turkey phenotypes based on egg quality parameters. Three phenotypic classes (black, white and spotted) were obtained as base population and used to generate F₁ progeny for the study. Experimental design for the experiment was a Randomized Complete Block design (RCBD) with phenotypic class as major factor of interest and hatches as block. The egg quality characteristics, namely egg weight, egg length, egg width, egg shape index were the external egg quality characteristics while the internal egg quality characteristics include the albumen weight, yolk weight, yolk height, yolk width and Haugh Unit. These egg parameters were significantly ($p < 0.05$) highest in the black variety. Shell thickness, albumen height and yolk index were not significantly different ($p > 0.05$) in the three local turkey phenotypes. Generally, the black varieties had highest values internal egg quality traits. It is therefore, concluded that for rapid improvement of these traits, the black variety could be used to enhance egg quality and reproduction of Nigerian local turkeys in the study area. The present findings could assist in the design of long-term genetic improvement programmes for turkey production in Nigeria.

Key words: local turkey, phenotype, egg quality characteristics

Introduction

As the demand for animal protein in Nigeria increases, the need to improve animal protein production becomes necessary. Low egg production and hatchability which is usually observed on breeder turkey is of concern to the poultry industry. The local breeds of animals in Nigeria deserve improvement in their genetic profile and physiological status (Nosike *et al.*, 2013). The exploitation of indigenous poultry genetic resources for improving economic traits such as reproductive performance, production performance and egg quality amongst others is one of the

most important breeding goals. Egg quality can be external or internal. The external qualities of an egg are based on the size, shape, shell colour and texture of the egg (Singh, 1990). Egg weight, Egg length, Egg width, Albumen height, Shell thickness, Albumen height, Yolk weight, Haugh unit, Yolk height, Albumen weight and Yolk index are important internal egg quality parameters. Haugh unit is the accepted commercial and research standard for measuring albumen quality in poultry (Silversides, 1994). According to Ihekoronye and Ngoddy (1985), high quality egg generally have Haugh unit of 70

and above. Egg quality is a determinant of the reproductive fitness of the parent since the reproductivity and quality of breeding hens' egg have an overall significance on the continuity of the flock (Egahi *et al.*, 2011). The following egg weight (40.73 g), albumen weight (20.33g), yolk weight (13.03g), yolk index (0.58), Haugh unit (73.43%) and other egg quality traits were reported by Fayeye *et al.* (2005) as the egg quality characteristics of the Fulani-ecotype chickens, a type of Nigerian indigenous chickens.

Thus the success and profitability of a commercial breeder or layer enterprise is hinged greatly on the quality of eggs produced. Egg quality is influenced by both genetic and non genetic factors such as age, season, elevated environmental temperature, nutrition (Salahuddin and Howlader, 1999). However, age is more important than seasonal factors in determining egg quality. In Nigeria, no defined grade has been developed for shell eggs and little attention has been focused on internal egg quality factors such as yolk and albumen quality. The objective of the study was to determine how the three phenotypes of the local turkey affect egg quality traits.

Materials and methods

Experimental Site

The study was conducted at the Poultry Unit of the Teaching and Research Farm of the Michael Okpara University of Agriculture, Umudike, Abia State. Umudike is located on latitude 05°N 28' North and 07°E 32' East and lies at an altitude of 122m above sea level. This area is situated within the Tropical Rainforest zone of West Africa which is characterized by long duration of rainfall (April - October) and short period of dry season (November-March). Average rainfall is 2169.8mm in 148 – 155 rain days.

Average ambient temperature is 26°C with a range 22°C and 30°C. Its relative humidity ranges from 50 to 90%. These meteorological data were obtained from the meteorological station at the National Root Crops Research Institute, Umudike Abia State.

Management of the base population and production of F₁ birds

A total of 78 day-old local turkeys of three phenotypic classes based on plumage colour (black, white and spotted) were obtained from a reputable hatchery as base population. The poults comprised of 26 black, 23 white and 29 white phenotypes. At the time of breeding, 2 Toms and 12 hens of black, 2 Toms and 12 hens of white and 3 Toms and 18 hens of spotted were used for mating. Random mating was used for the mating scheme within each identified group by selecting sexually active males for the females in the ratio of 1:6 for egg production. Eggs produced by the base population turkeys were collected on a daily basis, identified appropriately with indelible ink-marker and set in the incubator on weekly basis. Total number of eggs laid was 356 comprising 128, 114 and 114 for Black, White and Spotted phenotypes respectively and stored for less than 7 days in crates with large end up. The laying period was between 25 and 30 weeks of age. The incubator was Cabinet incubator type with relative humidity of 80%, temperature of 55°C, proper ventilation and turning suitable for hatchable eggs. The eggs were hatched weekly in batches. The number of progeny (F₁) poults produced was 86, 72 and 74 for black, white and spotted respectively. The poults were properly identified on hatching. Distribution and number of poults hatched per phenotypic class is shown in Table 1.

Table 1: Distribution of local turkey poult hatchlings per phenotypic class

Mating	Phenotypic class	Hatch					Class total
		1	2	3	4	5	
Black x Black	Black	3	11	10	36	26	86
White x White	White	2	6	6	28	30	72
Spotted x Spotted	Spotted	2	7	8	26	31	74
Total hatch		7	24	24	90	87	232

Brooding, rearing and laying of eggs by the F₁ poult

A total of 210 day-old F₁ poult hatchlings in different batches were selected. The three phenotypic groups of local turkey contributed 70 straight-bred poult each for the study.

They were brooded in three small metal cages for each hatch for a period of 2 weeks after which they were transferred to small compartments according to their phenotypic group for a period of 4 weeks and finally to deep litter pens at 6 weeks of age. Dry wood shavings were used as litter material. Fresh clean water was given *ad libitum* to the poult during this period.

The birds were given routine vaccination. Prophylactic antibiotics and anticoccidial drugs were administered to the birds periodically. However, the birds were dewormed and acaricide sprayed to check worms and ectoparasites.

The respective hatches were brooded separately on floor pens. The brooding period was 6 weeks. From brooding through rearing, maximum comfort for the poult was ensured. Feed was provided in adequate quantity to the poult twice a day, namely at 8.30am and 2.30pm and drinking water was given *ad libitum*. Poult (0-6 weeks) were fed *ad libitum* with starter mash containing 28% crude protein and 2800kcal ME/kg. Growing turkeys (7-24 weeks) were fed growers mash (20% crude protein and 3000 kcal ME/kg). Laying hens (25-30 weeks) were on growers mash until 5% egg production was attained. During egg

production hens were fed layers' mash containing 18% crude protein and 3200kcal ME/kg. All nutrient composition is as labelled.

Data collection

The egg quality parameters measured in the three phenotypes were: Egg weight, Egg length, Egg width, Albumen height, Shell thickness, Yolk weight, Haugh unit, Yolk height, Albumen weight and Yolk index. Egg weight: weight of individual egg in grams using a beam balance initially adjusted to zero. Egg length: length from the broad to narrow end in mm using a pair of Vernier Calipers calibrated in mm. Egg width: width in mm using a pair of Vernier Calipers calibrated in mm. Egg index: ratio of egg length to egg width. Shell thickness: average of 3 measurements of the shell without membrane at the centre, middle and narrow end using a Micrometer Screw Gauge. Albumen height: height of the albumen in mm using Micrometer Screw Gauge. Yolk weight (g): weight of the yolk using Digital Electronic Scale. Albumen weight (g): weight of the albumen, using Digital Electronic Scale;

Yolk index: ratio of yolk height to yolk width; Yolk height: height of the yolk in mm, using Micrometer Screw Gauge; Haugh unit: estimated from the records of albumen height and egg weight using the formula by Haugh (1937):

$$HU = 100 \log (H + 7.57 - 1.7W^{0.37})$$

Where,

H= observed albumen height (mm)

W= observed weight of egg (g).

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Experimental design

The experiment was designed as a Randomized Complete Block (RCBD) with phenotypic class as factor of interest and hatch as block. The statistical model is given as;

$$Y_{ijk} = \mu + H_i + P_j + e_{ijk} \dots (1)$$

Where

Y_{ijk} = k^{th} observation in the i^{th} block and in the j^{th} phenotypic class

μ = Overall mean

H_i = effect of the i^{th} hatch (Block) ($i = 1, \dots, 5$)

P_j = effect of j^{th} phenotypic class ($j = 1, \dots, 3$)

e_{ijk} = Random error, assumed to be independently, identically and normally distributed with zero mean and constant variance [$i.i.d(0, \sigma^2)$].

Statistical analysis

Data obtained were statistically analyzed with Statistical Procedure for Social

Sciences (SPSS), 2011 version 16. All the parameters were determined in percentages which were subjected to arcsine transformation to satisfy the assumption of normal distribution. Duncan's Multiple Range Test (Duncan, 1955) was used to separate significant means.

Results and Discussion

Effect of phenotype on egg quality characteristics of F₁ Black, White and Spotted local turkeys

The means of internal and external egg quality characteristics of F₁ local turkeys are presented in Table 2 and 3 respectively.

The average Haugh units were $81.46 \pm 0.47\%$, $79.17 \pm 0.42\%$, $78.92 \pm 0.38\%$ for Black, White and Spotted turkeys respectively.

Table 2: Means of internal egg quality characteristics of F₁ local turkeys

Parameters	Phenotypic class		
	Black	White	Spotted
Albumen height (mm)	6.76 (0.05)	6.42 (0.06)	6.38 (0.08)
Albumen weight(g)	38.35 ^a (0.53)	35.11 ^b (0.41)	33.97 ^b (0.19)
Yolk weight (g)	20.11 ^a (0.15)	18.90 ^b (0.21)	18.26 ^b (0.22)
Yolk height (mm)	15.16 ^a (0.17)	14.54 ^b (0.11)	14.36 ^b (0.28)
Yolk width (mm)	41.34 ^a (0.39)	39.94 ^{ab} (0.33)	39.10 ^b (0.44)
Yolk index	0.37 (0.004)	0.36 (0.01)	0.36 (0.003)
Haugh unit (%)	81.46 ^a (0.61)	79.17 ^b (0.42)	78.92 ^b (0.38)

^{a-c}Means in the same row with different superscripts are significantly different ($p < 0.05$).

*S.E.M in parentheses

The values of egg quality traits obtained in this study were higher than those reported by Fayeye *et al.* (2005) for ecotype chicken. This may be attributed to specie difference. There were Significant differences

($P < 0.05$) in the egg quality parameters of the various phenotypes with black phenotype having highest values for egg weight, egg length, egg width, albumen weight, yolk weight, yolk height, yolk

width and Haugh unit compared with white and spotted turkeys. However, there was no significant difference ($P>0.05$) in Egg shape index, Shell thickness, Albumen height, Yolk height and yolk index. The external and internal egg quality traits are significant in poultry breeding for their influence on the yield of future generations, breeding performances, quality and growth

of the chicks (Altinel *et al.*, 1996). The Haugh unit obtained in this study is of high quality for all phenotypes and ranged between 78.92 and 81.46, which is indicative of high quality eggs, in agreement with the report by Ihekoronye and Ngoddy (1985) that high quality eggs generally have Haugh unit of 70 and above.

Table 3: Means of external egg quality characteristics of F₁ local turkeys

Parameters	Phenotypic class		
	Black	White	Spotted
Egg weight (g)	66.40 ^a (0.47)	61.35 ^b (1.51)	60.79 ^b (1.24)
Egg length (mm)	58.60 ^a (0.75)	54.60 ^b (0.93)	55.00 ^b (1.41)
Egg width (mm)	41.20 ^a (0.74)	39.20 ^b (0.37)	39.60 ^{ab} (0.68)
Egg shape index	0.70 (0.02)	0.72 (0.01)	0.72 (0.03)
Shell thickness (mm)	0.74 (0.03)	0.67 (0.03)	0.62 (0.02)

^{a-c}Means in the same row with different superscripts are significantly different ($p<0.05$) *S.E.M in parentheses

The average egg weights were 66.40 ± 0.47 g, 61.35 ± 1.51 g and 60.79 ± 1.24 g for Black, White and Spotted turkeys respectively. Egg length, egg weight and egg shape index determine egg resistance to cracking and are considered very important traits when eggs are packed in containers (Peters *et al.*, 2007). As the bird ages, total egg weight increases and the increase leads to a simultaneous increase in the weight of egg yolk.

Conclusion

This study has revealed the characterization of Nigerian local turkeys based on egg quality traits. The black phenotype had better egg quality parameter. The characteristic performance of the Nigerian local turkey studied reveals certain qualities that can be tapped in strategic improvement programme of the poultry industry. In view

of the results obtained in this study, it is recommended that: The black phenotype should be selected by breeders to achieve improved production based on the egg quality traits studied.

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