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Effects of Genotype and Oviposition Time on Egg Quality Traits of Commercial Laying Birds

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Abstract

This study aimed at investigating the effects of strain of layers and oviposition time on external and internal egg quality traits. The strains of layers used for this study are Isa Brown (IB), Bovan Nera (BN) and Dominant Black (DB). The time of oviposition investigated are 8-10am, 10-12noon, 12-2pm and 2-4pm. Freshly laid eggs were collected from the different strains during the aforementioned periods, and were taken to the laboratory for both external and internal egg quality analysis. Analyzed results showed

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that egg weight was not significantly (P>0.05) affected by strain. The three strains recorded similar mean values. Similar results were reported for other traits except egg length and shell thickness where significant differences were reported among the strains. BN and IB were superior to DB in terms of shell thickness. With regard to internal egg quality traits, significant (P<0.01) differences among strains were reported only for yolk weight and albumen width. Pertaining to oviposition effect, almost all the traits were significantly influenced by oviposition time. Both external and internal egg quality traits had superior (P<0.01) and higher mean values during morning than afternoon or evening collection. This might be due to very low temperature prevailing in the former and which encouraged the birds to eat more resulting to bigger egg size and higher egg compositions. Haugh unit in this study was not significantly affected by strain and oviposition time. It is suggested than management practices in laying farm such as lighting and feeding pattern be focussed on having more eggs laid in the morning session than afternoon or evening session.

Keywords: Strain, oviposition time, egg weight, egg quality, Haugh unit.

1. INTRODUCTION

Worldwide, domestic birds are recognized as good sources of high quality animal proteins in form of tender nutritious meat and eggs. Commercial laying birds rank first in terms of egg production when compared to other avian species. However, several factors influence the quality and quantity of eggs obtained from these birds. Egg quality according to Mudhar (2011) composed of those characteristics of an egg that affects its acceptability to consumers. Egg quality may be divided into external and internal, and can be affected by strain of chickens (Orunmuyi et al., 2013), age of birds (Orhan et al., 2001; Lucas et al., 2013), storage time (Nowaczewski et al., 2010; Olawumi and Babatope, 2016), housing system (Mohan et al., 1991) and month of production (Elsayed, 2009).

In addition to aforementioned factors which influence the quality of an egg, time of oviposition equally plays a vital role in determining the quality of both external and internal characteristics. Oviposition time refers to the hours of the day when birds lay eggs, and may be affected by lighting period and feeding pattern. Time of oviposition, according to Hagan et al. (2013) plays a vital physiological role in determining eggshell quality because the amount of deposited shell is a linear function of time spent in the shell gland after plumbing, and therefore thickness. Previous studies have reported that eggs laid in the morning are heavier than those laid during the later periods of the day (Zakaria et al., 2009; Tůmová et al., 2009; Tůmová and Gous, 2012). Other investigators posited that eggs had better characteristics when laid in the afternoon than in the morning (Pavlovski et al., 2000a). On the other hand, Aksoy et al. (2001) observed that shell weight was not affected by the collection time.

With regard to the freshness and quality of an egg, which is measured by Haugh unit score, Tůmová et al. (2013) reported that time of oviposition has significant effect on this trait; between strains of chickens and housing systems. The results of the workers corroborated previous findings found in literature (Tůmová and Ebeid, 2005). Furthermore, significant interactions between genotype and housing (Leyendecker et al., 2001) and genotype and time of oviposition (Tůmová et al., 2009) on egg quality traits had been reported.

The aim of this study was to evaluate the effects of strain of laying birds and oviposition time on selected parameters of egg quality.

2. MATERIALS AND METHODS

2.1. Study location

The study was carried out at the Animal Breeding Unit, Teaching and Research Farm, Ekiti State University, Ado-Ekiti for a period of 52 weeks. Ado-Ekiti is situated along latitude $7^{0}31^{1}$ and $7^{0}49^{1}$ North of the Equator and longitude $5^{0}71^{1}$and $5^{0}27^{1}$East of the Greenwich meridian. The city falls under Derived Savannah zone. The city enjoys two separate seasonal periods namely, Rainy (May-October) and Dry (November-April) seasons.

2.2. Management of the experimental birds

The three strains raised were Isa Brown (IB), Dominant Black (DB) and Bovan Nera (BN). One hundred (100) day-old chicks of each strain were purchased from local hatcheries and reared under the same housing and management conditions. Each strain was housed in standard, well-constructed open-sided but separate pens (deep litter) from day-old till the commencement of laying. Cleanliness and other sanitary measures such as removal of caked or wet litters were carried out at regular intervals. The birds were vaccinated against Newcastle, Fowl pox and other viral diseases while antibiotics were administered to prevent bacterial infection. They were dewormed and given vitamins at regular intervals. At 5% production, layers mash was introduced and given *ad libitum* containing 2650Kcal/MEkg and 16.5% CP fortified with micronutrients. Fresh, clean water was given every day. Debeaking was carried out at the commencement of egg production in order to reduce the incidence of egg cannibalism and pecking. All the experimental birds were housed on the floor and were subjected to the same treatments.

2.3. Data collection

Freshly laid eggs were collected four times per day (8:00, 10:00, 12:00, 14:00 h) for each strain, and were taken to the laboratory for both external and internal analysis. The daily photoperiod consisted of 11h of light and 11h of darkness. Egg weight was individually determined to 0.01g accuracy using a sensitive scale. Egg length (along longitudinal axis) and egg width (along the equatorial axis) were measured with a micrometer.

After weighing, each egg was broken at the equatorial region and the contents poured in a crucible so as to measure the internal contents such as albumen and yolk indices. Yolk weight was measured on a scale, while albumen width, albumen height, yolk width and yolk height were measured using Vernier Calipher. Shell weight was also measured with sensitive scale, while shell thickness was measured using micrometer after allowing the shell to dry for some minutes.

Egg shape index= egg width/egg length x 100

Albumen weight= egg weight- (yolk weight + shell weight)

Haugh unit (HU- Haugh, 1937) = 100 log $(H-1.7w^{0.37} + 7.6)$

H- albumen height in mm

w- weight of egg in g

2.4. Data analysis

The data collected were subjected to analysis of variance (ANOVA) using Statistical Analysis System (SAS, 2001) and significant differences between means were determined by Duncan Multiple New Range Test.

Appropriate statistical model is:

$Y_{ijkl} = \mu + G_j + T_k + \varepsilon_{ijkl}$

Y_{ijkl} = observation of the l^{th} population, of the j^{th} genotype, and k^{th} time of oviposition

μ = Common mean

G_j = fixed effect of genotype (J=3)

T_k = fixed effect of oviposition time (k=4)

ε_{ijkl} = error term

3.1. RESULTS AND DISCUSSION

3.1. Effect of strain on external and internal egg quality traits

Table 1 shows the effect of strain of layers on both external and internal egg quality traits. There was no significant (P>0.05) effect of strain on egg weight regardless of time of oviposition. The three strains had similar mean values. Since they were raised under uniform management and feeding conditions, any of them could be suggested for rearing for egg production with acceptable size for domestic and industrial use. The result was not in line with the findings of Orunmuyi et al. (2013) who found significant effect of strain on egg weight of layers. In the same vein, there was no significant (P<0.05) effect of strain on egg width. The three strains recorded similar mean values in this trait. However, there was significant (P<0.05) difference among the strains with respect to egg length. Bovan Nera (BN) recorded higher mean value than either Isa Brown (IB) or Dominant Black (DB). The least mean value was recorded by Isa Brown. Shell weight in this study was not significantly (P>0.05) affected by strain. All the three strains had similar mean values. With respect to shell thickness, a major factor influencing storage and hatchery losses, BN and IB were superior to DB. This implies that the former produced thicker eggs than the latter. And during transportation of eggs to the market, it is assumed that eggs with thicker shells will record minimal breakage or spoilage than soft-shelled eggs.

With regard to internal egg quality traits, all the traits were not affected (P>0.05) by strain except yolk weight and albumen width. Pertaining to yolk weight, DB had higher mean value than IB and BN. However, IB and BN had similar mean values. For albumen width, IB and BN had higher (P<0.05) mean values, while DB was the lowest. In addition, Haugh unit (Hu), which is a determinant factor of egg quality was not affected (P>0.05) by strain of birds. All the three strains recorded similar mean values in this traits.

3.2. Effect of oviposition time on external and internal egg quality traits

Table 2 presents the effect of oviposition time on egg quality traits. There was significant (P<0.01) effect of oviposition time on egg weight. The 8-10am collection recorded higher (P<0.01) mean value than 10-12noon, 12-2pm and 2-4pm. The 10-12noon batch though superior to 12-2pm and 2-4pm was similar to 8-10am. The results indicate that morning collection are bigger than afternoon or evening collection. Previous authors reported similar findings (Tůmová et al., 2009; Tůmová and Gous, 2012). The researchers observed that eggs collected in the morning were bigger than other hours of the day. In the same vein, egg length and egg width were significantly (P<0.01) influenced by oviposition time. The 8-10am batch was superior in terms of mean values to other batches, that is, 10-12noon, 12-2pm and 2-4pm. In general, the afternoon batches recorded lower mean values than morning batches in all external egg quality traits. It is therefore, advisable that management practices such as feeding pattern and lighting programme be given proper attention to ensure that more eggs are laid in the morning than afternoon. With bigger eggs laid, the more the profit margin for the stockholders.

In addition, there was significant (P<0.01) effect of oviposition time on internal egg quality traits. Both albumen and yolk indices were influenced by the oviposition time. Albumen weight, height and width were better and superior in the morning than afternoon collection. This followed the trend reported for external egg quality traits. Also, yolk weight, height and width recorded higher (P<0.01) mean values in the morning batch than afternoon collection. The better and higher mean values reported in the morning collection may not be unconnected with the environmental conditions. There is usually very low temperature and cool breeze in the morning than afternoon. It is assumed that birds consume greater quantity of feeds in the morning because of favourable lower temperature regime which results to greater egg size. On the other hand, birds consume more water and eat less feed in the afternoon due to high environmental temperature thereby leading to production of small-sized eggs. The present result was in agreement with earlier studies (Tůmová et al., 2009; Tůmová and Gous, 2012). The workers reported that oviposition time had significant effect on internal egg quality traits.

In the present study (Table 2), Haugh unit (Hu) was not significantly (P>0.05) affected by oviposition time. The morning and afternoon batches recorded similar mean values. But all the values obtained were above the minimum score recommended for grade A egg (North, 1978). This implies that both morning and afternoon batches are fit for human consumption. The time of the day when an egg is laid or collected does not have any negative effect on the quality of an egg. The obtained result contradicts the findings of Tůmová et al. (2013) who reported that oviposition time significantly influenced Haugh unit.

4. CONCLUSION

It is evident from this study that strain and oviposition time significantly influenced the quality of eggs produced by birds. BN and IB produced eggs with thicker shells than DB, and their eggs are likely to stay fresh longer in the store than DB. Morning eggs (8-10am; 10-12noon) recorded higher mean values in both external and internal egg quality traits than afternoon collection. Hu for both sessions were higher but similar.

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Table 1: Least squares means showing the effect of genotype on egg quality traits

Traits	Isa Brown	Dominant Black	Bovan Nera
Egg weight (g)	63.15±0.998	62.96±0.998	63.20±0.998
Egg length (cm)	5.80^{b}±0.054	5.88^{ab} ±0.054	6.00^{a}±0.054
Egg width (cm)	4.37±0.031	4.35±0.031	4.31±0.031
Yolk weight (g)	15.96^{b}±0.326	16.93^{a}±0.326	15.81^{b}±0.326
Yolk width (cm)	3.87±0.042	3.92±0.042	3.88±0.042
Yolk height (cm)	1.80±0.030	1.86±0.030	1.83±0.030
Albumen weight (g)	40.02±0.83	40.54±0.83	40.68±0.83
Albumen width (cm)	7.17^{a}±0.126	6.58^{b}±0.126	7.20^{a}±0.126
Albumen height (cm)	0.79±0.035	0.88±0.035	0.82±0.035
Albumen height (mm)	7.85±0.347	8.81±0.347	8.19±0.347
Shell weight (g)	7.19±0.143	6.31±0.143	6.71±0.143
Shell thickness (cm)	0.59^{a}±0.006	0.53^{b}±0.006	0.57^{a}±0.006
Haugh unit	98.83±1.523	102.621±1.523	100.19±1.523
Yolk ratio (%)	25.30^{b}±0.473	26.95^{a}±0.473	25.05^{b}±0.473
Albumen ratio (%)	63.31±0.557	64.35±0.557	64.32±0.557
Shell ratio (%)	11.41±0.153	10.06±0.153	10.64±0.153

ab: Means with different superscripts along rows are significantly different ($P<0.01$)

Table 2: Least squares means showing the effect of Oviposition time on egg quality traits

Traits	Oviposition Time			
	8-10am	**10-12noon**	**12noon-2pm**	**2-4pm**
Egg weight (g)	$66.95^{a}\pm1.153$	$64.89^{a}\pm1.153$	$60.57^{b}\pm1.153$	$60.00^{b}\pm1.153$
Egg length (cm)	$6.01^{a}\pm0.062$	$6.07^{a}\pm0.062$	$5.70^{b}\pm0.062$	$5.80^{b}\pm0.062$
Egg width (cm)	$4.44^{a}\pm0.036$	$4.35^{ab}\pm0.036$	$4.32^{b}\pm0.036$	$4.26^{b}\pm0.036$
Yolk weight (g)	$17.10^{a}\pm0.377$	$16.53^{ab}\pm0.377$	$15.96^{bc}\pm0.377$	$15.34^{c}\pm0.377$
Yolk width (cm)	$3.99^{a}\pm0.048$	$3.89^{ab}\pm0.048$	$3.87^{ab}\pm0.048$	$3.81^{b}\pm0.048$
Yolk height (cm)	$1.90^{a}\pm0.035$	$1.80^{ab}\pm0.035$	$1.83^{ab}\pm0.035$	$1.78^{b}\pm0.035$
Albumen weight (g)	$43.06^{a}\pm0.956$	$41.62^{ab}\pm0.956$	$39.00^{bc}\pm0.956$	$37.95^{c}\pm0.956$
Albumen width (cm)	$7.00^{ab}\pm0.146$	$7.39^{a}\pm0.146$	$6.67^{b}\pm0.146$	$6.87^{b}\pm0.146$
Albumen height (cm)	$0.898^{a}\pm0.040$	$0.793^{ab}\pm0.040$	$0.853^{ab}\pm0.040$	$0.768^{b}\pm0.040$
Albumen height (mm)	$8.98^{a}\pm0.401$	$7.933^{ab}\pm0.401$	$8.53^{ab}\pm0.401$	$7.68^{b}\pm0.401$
Shell weight (g)	6.79 ± 0.165	6.74 ± 0.165	6.66 ± 0.165	6.77 ± 0.165
Shell thickness (cm)	$0.55^{b}\pm0.007$	$0.54^{b}\pm0.007$	$0.56^{b}\pm0.007$	$0.61^{a}\pm0.007$
Haugh unit	103.06 ± 1.759	98.66 ± 1.759	102.03 ± 1.759	98.45 ± 1.759
Yolk ratio (%)	25.56 ± 0.546	25.58 ± 0.546	26.35 ± 0.546	25.57 ± 0.546
Albumen ratio (%)	$64.29^{ab}\pm0.643$	$64.02^{ab}\pm0.643$	$62.67^{b}\pm0.643$	$64.98^{a}\pm0.643$
Shell ratio (%)	$10.14^{b}\pm0.176$	$10.40^{b}\pm0.176$	$10.98^{a}\pm0.176$	$11.29^{a}\pm0.176$

ab: Means with different superscripts along rows are significantly different ($P<0.01$)

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