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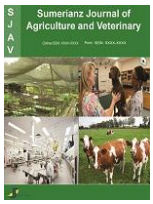

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Egg Quality Characteristics of Three Genotypes of Layers As Affected by Holding Period in the Derived Savannah Zone of Nigeria

Olawumi Simeon *
Department of Animal Science, Ekiti State University, Ado-Ekiti, Nigeria
Email: olawumisimeon@yahoo.com

Akinsola Kehinde
Department of Animal Breeding and Physiology, Michael Okpara University of Agriculture, Umudike, Nigeria

Olawumi Stephen
Department of Animal Science, Obafemi Awolowo University, Ile-Ife, Nigeria

Amana Charles
Department of Animal Production, Kogi State University, Anyigba, Nigeria

Ahutu Ismaila
Department of Animal Production, Kogi State University, Anyigba, Nigeria

Iyaode Ifelayo
Department of Animal Production, Kogi State University, Anyigba, Nigeria

Alexander Daniel
Department of Animal Science, Ekiti State University, Ado-Ekiti, Nigeria

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Abstract

Freshness of an egg is a desirable factor for both domestic and industrial usage. The present study was carried out to investigate the effects of genotype and holding period on external and internal egg qualities. The three genotypes whose eggs were collected for laboratory analysis are Isa Brown (IB), Dominant black (DB) and Bovan Nera (BN). Freshly laid eggs were collected from the strains and divided into four different groups as follows: day 1, 10, 20 and 30. The 1st group was measured on first day, 2nd group on 10th day, 3rd group on 20th day while, the 4th group was on 30th day after oviposition. External egg quality traits measured included egg weight, length and width, while the internal qualities are albumen and yolk indices. Haugh unit was calculated by mathematical formular. Analyzed results showed that the three genotypes differed significantly in egg weight, egg length and shell thickness. IB genotype was superior to other genotypes in egg weight. There was no significant differences among the genotypes in other traits including Haugh unit. In addition, almost all the measured traits were significantly affected by holding period. Egg weight, albumen height and yolk height declined in mean values as the storage time increased. Haugh Unit which is a determinant of egg quality also declined sharply from day 1 to 30. It is therefore, suggested that eggs stored under room temperature is not fit for consumption after 10th day.

Keywords: Albumen; Genotype; Holding period; Egg weight; Yolk; Haugh unit.

1. Introduction

Naturally, eggs from avian species are sources of good, nutritious, high quality animal proteins which can be consumed by all age groups. 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 [1] 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 [2] age of birds [3, 4], storage time [5, 6], housing system [7] and month of production [8].

Other factors which influence the interior egg quality are egg size, egg shell thickness and hen age. Eggs from older hens are usually larger and have thinner egg shells [9-13] Albumen quality mainly depends on genetic factors and can only be marginally influenced by nutrition. Low pH in the drinking water may improve albumen height. Organic acids in the feed however, do not affect this criterion [14].

Eggs are the only food of animal origin which can be stored for several weeks in their natural condition without losing specific characteristics. The ability of eggs to be stored for several weeks evolved through their function as source of nutrients for the developing embryo. Most nutrients for the embryos are located in the egg yolk. The albumen main functions are to supply water and to prevent microbes from entering the egg and multiplying. The yolk and albumen are enclosed by the eggshell, which allows the exchange of carbon dioxide, oxygen and water through its pores.

*Corresponding Author

With regard to the freshness and quality of an egg, which is measured by Haugh unit score, Tůmová, *et al.* [15] 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 [16]. Furthermore, significant interactions between genotype and housing [17] and genotype and time of oviposition [18] on egg quality traits had been reported.

Eggs meant for domestic consumption, processing and industrial use must be fresh, and the internal contents intact, hence the need to consider how long eggs could be stored before being put to use. There have been reports of egg deterioration with prolonged storage time [19, 20]. The present study on egg quality traits of commercial layers is focused on the effects of strain and holding period on both external and internal egg qualities.

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. 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 are 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 for each strain, stored and analyzed at 1, 10, 20 and 30 days. The eggs were stored at room temperature, and were taken to the laboratory for both external and internal analysis. The daily photoperiod consisted of 13 h of light and 11 h 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 screw gauge.

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. Albumen width, albumen height, yolk width and yolk height were measured using Vernier Calipher. Shell thickness was measured using micrometer after allowing the shell to dry for some minutes.

Haugh unit (HU- [21] = 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 and significant differences between means were determined by Duncan Multiple New Range Test [22].

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} holding period

μ = Common mean

$G_{j=}$ fixed effect of genotype (J=3)

$T_{k=}$ fixed effect of holding period (k=4)

ε_{ijkl} = error term

3. Results and Discussion

3.1. Effect of Genotype on External and Internal Egg Quality Traits

The results in table 1 showed that the three genotypes differed significantly (P<0.01) in egg weight. Bovan Nera (61.35±0.97) recorded the highest mean value when compared with Dominant Black (58.51±0.97) and Isa Brown (57.82±0.97). However, Dominant Black (DB) and Isa Brown (IB) had similar mean values. The same trend was observed with respect to egg length. Bovan Nera (BN) was superior (P<0.01) to DB and IB, while both DB and IB recorded similar mean values. There was no significant (P<0.05) differences among the genotypes with respect to egg width. The three genotypes recorded similar mean values. With regards to internal contents, that is, albumen and yolk indices, the three genotypes recorded similar mean values (P>0.05). This insignificant (P>0.05) difference was also observed among the genotypes for Haugh unit. That is, the genotypes had similar mean values. With respect to

shell thickness, IB ($0.46^{a}\pm0.74$) was better and superior ($P<0.01$) to DB and BN. BN (0.44 ± 0.74) genotype was intermediate, while DB (0.42 ± 0.74) had lowest mean value.

The present data revealed that significant differences exist between strains of layers in some external egg quality traits. The size and shell's strength of an egg affects the consumer's preference, breakages, fertility, hatchability and farmer's profit margins. Therefore, the poorer the shell of an egg, the higher the loss in terms of low sales, poor fertility and hatchability. According to Altinel, *et al.* [23], the quality of the egg shell was of vital importance for the laying flock, embryo growth and chick quality. The obtained result was in agreement with the findings of Orunmuyi, *et al.* [2] who reported significant effect of strain of layers on external egg quality traits. Haugh units in this study, though insignificant among the three genotypes indicate that the eggs are fresh and good for consumption. Albumen height and Haugh unit measure the viscosity of thick albumen. The values obtained for the three genotypes were higher than the standard (HU= 70, North [24]. The values obtained in this study were low for fresh eggs, but is still acceptable. The obtained results corroborate the work of Tůmová, *et al.* [18] who observed significant effect of strain on Haugh Unit.

Table-1. Least square means showing the effect of Strain on External and Internal Egg Quality traits

Traits			
	Bovan Nera	**Dominant Black**	**Isa Brown**
Egg weight (g)	$61.35^{a}\pm0.97$	$58.51^{b}\pm0.97$	$57.82^{b}\pm0.97$
Egg length (cm)	$5.96^{a}\pm0.64$	$5.75^{b}\pm0.64$	$5.68^{b}\pm0.64$
Egg width (cm)	4.30 ± 0.03	4.27 ± 0.03	4.27 ± 0.03
Albumen height (cm)	0.60 ± 0.01	0.61 ± 0.01	0.60 ± 0.01
Albumen height (mm)	6.02 ± 0.16	6.09 ± 0.16	6.00 ± 0.16
Albumen width (cm)	4.63 ± 0.26	4.65 ± 0.26	5.40 ± 0.26
Yolk height (cm)	1.17 ± 0.06	1.24 ± 0.06	1.20 ± 0.06
Yolk width (cm)	2.36 ± 0.15	2.26 ± 0.15	2.61 ± 0.15
Shell thickness (cm)	$0.44^{b}\pm0.74$	$0.42^{c}\pm0.74$	$0.46^{a}\pm0.74$
Haugh unit	72.77 ± 1.25	74.12 ± 1.25	73.51 ± 1.25

abc Means along rows with similar superscripts are significantly different ($P<0.01$)

3.2. Effect of Holding Period on External and Internal Egg quality Traits

There was significant ($P<0.01$) effect of holding period on egg weight in this study (Table 2). Day 1 (61.52 ± 1.12) recorded the highest mean value, followed by day 10 (59.06 ± 1.12), 20 (58.95 ± 1.12) and 30 (57.37 ± 1.12), being the lowest. With respect to egg length and egg width, the three genotypes recorded similar mean values. That is, there was no significant ($P>0.05$) differences among the genotypes. Albumen height (Table 2) in this study was significantly ($P<0.01$) affected by holding period. Day 1 (1.07 ± 0.02) has the highest mean value, followed by day 10 (0.51 ± 0.02), 20 (0.43 ± 0.02) and 30 (0.40 ± 0.02), being the lowest. Albumen width and yolk width followed the same trend with albumen height. The mean values shot up at day 10 showing that the quality has deteriorated due to microbial activity. At day 20 and 30, the traits could not be measured as the whole egg white and yolk became watery and flat. Yolk height also deteriorated with holding period. The highest mean value was recorded on day 1, followed by day 10, 20 and the lowest on day 30. This indicates deterioration of the quality of the yolk as the storage time advanced. In the case of Haugh unit, day 1 (101.99 ± 1.45) has the highest unit score, while other holding periods had scores that were below the standard score (Hu= 70).

In this study, the negative effect of holding periods was pronounced on almost all the measured traits. It was observed that the mean values were higher on 1st day than 10th, 20th, and 30th day. There was weight loss due to increase of the air cell caused by the diffusion of water through the eggshell. The permeability of the eggshell depends on the thickness of the shell, number of the pores and the quality of the cuticle. This means that as the eggs stay longer in the store under room temperature, the internal contents decline in freshness and taste. This shows that a lot of microbial activity has taken place during the time through shell pores. Both the yolk and albumen indices showed progressive decrease in quality as the storage time advanced. That is, the longer the storage time, the more the deterioration, and this renders the egg unfit for consumption. Haugh Units declined rapidly with storage duration at room temperature. Haugh unit is an important determinant of egg quality and egg freshness, and deteriorates with storage time [6]. Earlier study reported that increasing storage time decreased Haugh unit significantly in different breeds and strains [9].

Table-2. Least square means showing the effect of Holding Period on External and Internal Egg Quality traits

Traits	Holding Period			
	Day 1	**Day 10**	**Day 20**	**Day 30**
Egg weight (g)	$61.52^{a}\pm1.12$	$59.06^{ab}\pm1.12$	$58.95^{ab}\pm1.12$	$57.37^{b}\pm1.12$
Egg length (cm)	5.81 ± 0.07	5.70 ± 0.07	5.90 ± 0.07	5.78 ± 0.07
Egg width (cm)	4.22 ± 0.03	4.30 ± 0.03	4.29 ± 0.03	4.30 ± 0.03
Albumen height (cm)	$1.07^{a}\pm0.02$	$0.51^{b}\pm0.02$	$0.43^{c}\pm0.02$	$0.40^{c}\pm0.02$
Albumen height (mm)	$10.71^{a}\pm0.18$	$5.13^{b}\pm0.18$	$4.26^{c}\pm0.18$	$4.01^{c}\pm0.18$
Albumen width (cm)	$7.96^{b}\pm0.30$	$11.61^{a}\pm0.30$	$0.00^{c}\pm0.30$	$0.00^{c}\pm0.30$
Yolk height (cm)	$2.08^{a}\pm0.07$	$1.17^{b}\pm0.07$	$0.84^{c}\pm0.07$	$0.72^{c}\pm0.07$
Yolk width (cm)	$4.36^{b}\pm0.18$	$5.27^{a}\pm0.18$	$0.00^{c}\pm0.18$	$0.00^{c}\pm0.18$
Shell thickness (cm)	$0.36^{c}\pm0.86$	$0.45^{b}\pm0.86$	$0.46^{ab}\pm0.86$	$0.48^{a}\pm0.86$
Haugh unit	$101.99^{a}\pm1.45$	$69.74^{b}\pm1.45$	$61.94^{c}\pm1.45$	$60.20^{c}\pm1.45$

abc Means along rows with similar superscripts are significantly different ($P<0.01$)

4. Conclusions and Recommendation

From the results of this study, it was observed that genotype has significant effect on some external and internal egg quality traits. Bovan Nera eggs were heavier than those of Dominant Black and Isa Brown. The strain could be considered a farmers' choice for profitable rearing and for production of bigger and quality eggs for domestic consumption and processing industries. In addition, holding period significantly affected both external and internal egg qualities. Only day 1 eggs appeared good for consumption due to very high Haugh Unit, while the rest, that is, from day 10 to 30 declined in Haugh Unit, and therefore not good for consumption except when stored under refrigeration. Therefore, it is suggested that eggs laid by hens and stored under room temperature should be consumed before 10^{th} day after oviposition in order to maintain its freshness and quality.

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