

Physical Egg Characteristics of Hisex and Lohman Strains in Khartoum State Farms

Mojahid Abdallah Abdalhag^{1, *}, Saadia Abbas², Rashid Habiballa Osman³

¹Department of Animal Production, Al-Neelain University, Kartoum, Sudan

²Department of Poultry Production, University of Khartoum, Khartoum (Shambat), Sudan

³Department of Poultry Production, West Kordofan University, El-Nuhud, Sudan

Abstract

Study was carried out to determine the effect of strain and age on egg quality characteristics and to compare these qualities in two poultry commercial layer strains (Hisex and Lohmann) and two ages (20-40wks, 50-70wks) under Sudan conditions. A total of 60 eggs were collected from three companies around Khartoum State (A, B and C). Data were collected on egg weight, shell weight, shell weight percentage, shell thickness, yolk weight, yolk weight percentage, yolk height, yolk diameter, yolk index, yolk color, albumen weight, albumen weight percentage, albumen height and Haugh unit. The results revealed that the (Strain) significantly affected some egg quality characteristics with Hisex being better in egg weight, egg shell weight percentage, yolk weight, yolk diameter, albumen weight, albumen height and Haugh unit, while the Lohmann was better only in yolk index. The results also showed that Hen's age significantly affected some egg quality characteristics with age two (50-70wks) being superior in egg weight, egg shell weight, yolk weight, yolk diameter, albumen weight and albumen height, while age one (20-40wks) was better only in yolk index. Strain by age interaction significantly affected some egg quality characteristics. These were egg weight, egg shell weight, egg shell weight percentage, yolk weight, yolk diameter, yolk index, albumen weight, albumen height and Haugh unit, with better improvement in these characteristics except the Haugh unit which was significantly reduced. Therefore, Hisex eggs were superior to Lohmann eggs in all physical egg quality characteristics measured except for yolk index under Sudan conditions, and that older layers laid better quality eggs than younger ones.

Keywords

Shell Thickness, Yolk Weight, Yolk Index, Albumen Weight, Albumen Height and Haugh Unit

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1. Introduction

Poultry eggs are very important for feeding people and consider as an excellent source of protein as well as it acceptable to people all over the world. A large number of layer breeds have been developed to obtain maximum egg production, known as commercial hybrids. The hybrid layers usually start laying at about 20 weeks of age and the peak of egg production is attained during the first production cycle at 30-32wks [1]. The average production rate of commercial

layers usually remains very close to 0.9 eggs per day [2]. The egg size and the internal quality are very important for both table eggs and hatching eggs. However, the nutrient content of an egg is dependent on its size [3]. The egg size of a chicken is affected by many factors such as heredity, dietary factors, body size, feed and water consumption, ambient temperature and diseases [4]. The climatic conditions have also been known to affect the production behavior of the laying hens [5, 6]. In areas where climate is hot and humid, commercial hybrids produce an average of 180-200 eggs per year, while in more temperate climate, birds can produce

* Corresponding author

E-mail address: mojahidhag@yahoo.com (M. A. Abdalhag), Rashid roshdi.20023@yahoo.com (R. H. Osman)

between 250 and 300 eggs per year. The monitoring of egg quality characteristics is important mainly in terms of production economy. The attention is devoted especially to eggshell quality, because cracked eggshell presents higher losses for market egg producers. Therefore, it is very important to evaluate the egg quality characteristics and factors affecting them [7]. The genotype is one of the most important factors, influencing not only egg weight but also other egg characteristics [8]. There is a considerable number of Commercial Hybrid layers such as Hisex, Lohmann, Bovar and Rhode Island Red (RIR) which have been imported in Sudan since the early fifties of last century by government and private sector.

However, no research work has been conducted under local climatic conditions in Sudan to study their eggs characteristics or production performance. Therefore, this study was planned to study the egg quality characteristics of two common layer Breeds in Sudan (Hisex, Lohmann) at commercial farms.

2. Material and Methods

2.1. Experimental Side

The layers from three farms (A, B and C) were kept at cage in floor space 1m² which is used for seven to ten mature layers in closed system house. The temperature, humidity, ventilation, and light were controlled at optimum range and all layers were healthy. Layers are fed their required dietary allowances which are based on local ingredients (Sorghum, Groundnut cake, Sesame cake and Wheat bran) and the super concentrate was imported as described by company manual. Fresh water was available to them throughout the day.

The chemical analysis of the diets ingredient was shown for individual farms in table 1. A total of 60 eggs were collected from three commercial farms around Khartoum state (A, B and C). Five replicates samples per each farm were represented two strains (Hisex, Lohmann) and two ages (in range of (20 to 40) and (50 to 70) weeks old) in each farm.

2.2. Egg Parameter

egg quality parameters like egg weight, shell weight, shell weight%, shell thickness, yolk weight, yolk weight%, yolk height, yolk diameter, yolk index, yolk color, albumen weight, albumen weight%, albumen height and haugh unit were measured.

The fresh eggs which were collected randomly from cages are immediately sent to the laboratory in the department of poultry production. All samples are weighed individually using a digital balance with accuracy (0.001g) and then broken to record their internal quality characteristics. The

yolk weight and egg shell weights were determined with an electronic balance. Albumen was carefully separated from yolks and egg shells before weighing. Albumen weight was measured by subtraction of yolk weight + shell weight from the overall egg weight according to:

$$\text{Albumen weight} = \text{Total weight} - (\text{Yolk weight} + \text{Eggshell weight})$$

The albumen height measured after eggs were broken and their contents were laid on flat clean dish by using Vernier (precision 0.1mm) as close to the periphery of the yolk as possible.

The yolk height and yolk diameter were determined by measuring the separated yolk from egg content by using Vernier with accuracy (0.1mm).

The yolk color was recorded by using Roche yolk color Fan which was used to comprise the range of yolk color from one to fifteen degrees. The egg shell thickness was measured at three different random points in the equatorial shell zone using Micrometer with accuracy (0.20mm).

The Yolk index was calculated by dividing the yolk height with the yolk diameter, by using the individual weight of each egg and its components, the percentage of each component were calculated.

The Haugh unit was calculated as the ratio between egg weight and albumin height using the following formula [9].

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

2.3. Statistical Analysis

The data collected were subjected to analysis of variance technique using completely randomized design (3 × 2 × 2 Factorial arrangement with three farms, two strains and two ages). The data were analyzed using the general linear model procedure of SAS software version 9 [10]. The differences between means were compared using Duncan's Multiple Range test.

Table 1. The chemical composition of the commercial rations in the experimental farms.

Component	Farm (A)	Farm (B)	Farm (C)
Crude protein (%)	17.04	16.04	16.99
Metabolizable Energy (Kcal/kg)	2897.11	2832.24	2885.75
Crude fiber (%)	4.37	4.00	3.97
Calcium (%)	2.91	3.40	3.22
Phosphorus (%)	0.37	0.33	0.41
Lysine (%)	0.85	0.76	0.63
Methionine (%)	0.41	0.37	0.42

3. Results and Discussion

Highly significant differences ($p < 0.01$) were observed between Hisex and Lohmann strains with respect to egg

weight, yolk diameter, albumen weight, albumen height and Haugh unit in table 2 with Hisex eggs being superior to Lohmann eggs in all these parameters.

Significant differences ($p < 0.05$) were observed between these two strains with respect to egg shell weight percentage, yolk weight and yolk index, with Lohmann eggs having higher values than Hisex only in Egg shell weight percentage and yolk index (10.87 vs 10.21, 0.42 vs 0.40). So the Hisex strain is better in egg weight, egg shell weight percentage, yolk weight, yolk diameter, albumen weight, albumen height and haugh unit, while the Lohmann strain was better in yolk index and egg shell weight percentage. Strain significantly affected egg weight as in this study higher egg weight recorded by Hisex versus Lohmann. This result is in agreement with the results of [8, 11] who studied the effects of genotype on egg quality in Brown-egg laying hens. Strain significantly affected Haugh Units as in the current study, a higher value of Haugh Units was recorded by Hisex compared to Lohmann. This result is in agreement with

the results of [12] who found significant higher values for Haugh Units in white egg layers than in brown egg hens. No significant differences were observed between these two strains with respect to egg shell weight, shell thickness, yolk weight percentage, yolk height, yolk color and albumen weight percentage. No significant effect of strain on Shell thickness is reported in this study which disagree with result reported by [13]. They reported highly significant difference on Shell thickness when compared Lohmann with Ardennaise and Famennoise strain. This could be attributed to differences in their diets composition especially calcium level or source needed for optimum shell formation. Calcium absorption affected by ambient temperature, availability of vitamin D, P ratio, protein and energy level.

The source of Ca might affect hen productivity and egg quality. [14] reported that shell quality was improved when part of the fine limestone (LIM) in the diet was substituted by particulate LIM or oyster shell.

Table 2. The means and standard errors of egg quality characteristics for Hisex and Lohmann strains.

Trait	Strain		SEM	Significance
	Hisex	Lohmann		
	Mean	Mean		
Egg weight (g)	63.42	58.55	± 0.817	**
Egg Shell weight (g)	06.43	06.35	± 0.124	NS
Egg Shell weight %	10.21	10.87	± 0.181	*
Shell thickness (mm)	39.33	40.53	± 0.750	NS
Yolk weight (g)	17.26	16.11	± 0.265	*
Yolk weight %	27.27	27.58	± 0.481	NS
Yolk height (mm)	16.70	16.53	± 0.196	NS
Yolk diameter (mm)	41.33	39.40	± 0.375	**
Yolk index	00.40	00.42	± 0.005	*
Yolk color	09.80	09.40	± 0.221	NS
Albumen weight (mm)	39.73	36.09	± 0.710	**
Albumen weight %	62.52	61.55	± 0.528	NS
Albumen height (mm)	07.87	06.87	± 0.172	**
Haugh unit	87.38	82.52	± 0.943	**

*Significant ($p < 0.05$); ** Highly significant ($p < 0.01$); NS = Not Significant; SEM: standard error of means.

Highly significant differences ($p < 0.01$) were observed between age one (20-40wks) and age two (50-70wks) in egg characteristics with respect to egg weight, egg shell weight, yolk weight, yolk diameter and albumen weight in table 3 with eggs of age two being superior to eggs of age one in all these parameters in both strains.

Significant differences ($p < 0.05$) were observed between these two ages in yolk index and albumen height, with age one (younger layers) eggs having higher values than the older hens only in Yolk index.

So the age of Hens significantly affected some egg quality characteristics, where age two (50-70wks) is superior in egg weight, egg shell weight, yolk weight, yolk diameter, albumen weight and albumen height, while age one (20-40wks) is better only in yolk index. The effect of layer age on

egg weight is significantly highly increased in egg weight with increased layer's age. Similar results have been reported by [15] in two commercial egg type strains of chicken (ISA Brown and Korean Native Chicken) where egg weight increased with increase in age (45 to 80 weeks of age). Age significantly affected Yolk weight. Higher yolk weight was recorded in age two layers. This result is in agreement with the results recorded by [15, 16, 8]. No significant differences were observed between these two ages with respect to egg shell weight percentage, shell thickness, yolk weight percentage, yolk height, yolk color, albumen weight percentage and Haugh unit. No significant age effect on Haugh units was found in this study which is in contrast with the results of [8] who found that the Haugh units increased with hen's age.

Table 3. The means and standard errors of egg quality characteristics of Two Ages.

Trait	Ages (week)		SEM	Significance
	(20 - 40)	(50 - 70)		
	Mean	Mean		
Egg weight (g)	57.17	64.80	±0.817	**
Egg Shell weight (g)	06.11	06.68	±0.124	**
Egg Shell weight %	10.72	10.36	±0.181	NS
Shell thickness (mm)	40.27	39.60	±0.750	NS
Yolk weight (gm)	15.58	17.80	±0.265	**
Yolk weight %	27.32	27.53	±0.481	NS
Yolk height (mm)	16.40	16.83	±0.196	NS
Yolk diameter (mm)	39.03	41.70	±0.375	**
Yolk index	00.42	00.40	±0.005	*
Yolk color	09.27	09.93	±0.221	NS
Albumen weight (g)	35.48	40.33	±0.710	**
Albumen weight %	61.96	62.11	±0.528	NS
Albumen height (mm)	07.03	07.70	±0.172	*
Haugh unit	84.02	85.88	±0.043	NS

*Significant ($p<0.05$); ** Highly significant ($p<0.01$); NS = Not Significant; SEM: standard error of means.

Highly significant ($p<0.01$) were observed for strain by age interaction with respect to egg weight, egg shell weight, yolk weight, yolk diameter, albumen weight and albumen height showed improvements in all strains table 4 with (Hisex*Age Two) eggs being superior to all these parameters except egg shell weight which were higher in (Lohmann*Age Two), while (Lohmann*Age one) having lower values in all these parameters.

Also significant differences ($p<0.05$) were observed for strain by age interaction with respect to egg shell weight percentage, yolk index and Haugh unit, with (Hisex*Age Two) eggs being superior only in haugh (88.51 ± 1.345), and having lowers values in egg shell weight percentage and yolk index ($09.92 = 0.256$, $00.40 = 0.008$) respectively compared with others strain by age interaction.

So Strain by age interaction significantly affected some egg quality characteristics with respect to egg weight, egg shell weight, egg shell weight percentage, yolk weight, yolk diameter, yolk index, albumen weight, albumen height and haugh unit. According to the result of this study the strain by age interaction improved all these characteristics except for Huagh unit which is significantly reduced [17].

The measurement of egg quality between these two commercial strains revealed that, Hisex eggs are superior to Lohmann's under Sudan conditions where heat stress is a major management problem. The bird's ability to dissipate heat during heat stress is compromised, making excessive heat production. Thus, live weight, egg production, egg quality and eggshell quality are affected [18].

Table 4. The means and standard errors of strain*age subclasses of egg quality characteristics.

Trait	Age (week)				SEM	SIGN
	Hisex (20 - 40)	Hisex (50 - 70)	Lohmann (20 - 40)	Lohmann (50 - 70)		
	Mean	Mean	Mean	Mean		
Egg weight (g)	60.36 ^b	66.49 ^c	53.99 ^a	63.12 ^{bc}	±1.148	**
Egg Shell weight (g)	06.32 ^{ab}	06.55 ^b	05.90 ^a	06.81 ^b	±0.170	**
Egg Shell weight %	10.50 ^{ab}	09.92 ^a	10.94 ^b	10.80 ^b	±0.256	*
Shell thickness (mm)	40.33	38.33	40.20	40.87	±1.055	NS
Yolk weight (g)	16.33 ^b	18.19 ^c	14.83 ^a	17.40 ^{bc}	±0.375	**
Yolk weight %	27.05	27.49	27.59	27.27	±0.686	NS
Yolk height (mm)	16.47	16.93	16.33	16.73	±0.280	NS
Yolk diameter (mm)	40.40 ^b	42.27 ^c	37.67 ^a	41.13 ^{bc}	±0.525	**
Yolk index	00.41 ^a	00.40 ^a	00.43 ^b	00.41 ^a	±0.008	*
Yolk color	09.67	09.93	08.87	09.93	±0.311	NS
Albumen weight (g)	37.71 ^b	41.75 ^c	33.26 ^a	38.91 ^{bc}	±1.008	**
Albumen weight %	62.44	62.59	61.47	61.62	±0.754	NS
Albumen height (mm)	07.53 ^{bc}	08.20 ^c	06.53 ^a	07.20 ^{ab}	±0.246	**
Haugh unit	86.24 ^{ab}	88.51 ^b	81.79 ^a	83.25 ^{ab}	±1.345	*

^{a-b}Means in the same row with different superscripts differ significantly ($p<0.05$); SEM: standard error of means.

4. Conclusion

The purpose of our study was to determine the effect of strain and age on egg quality characteristics between two poultry commercial layer strains (Hisex and Lohmann) and two ages (20-40wks, 50-70wks) under Sudan conditions. The results revealed that the strain significantly affected some egg quality characteristics with Hisex being better than Lohmann in most of egg quality characteristics. In addition, the Hen's age significantly affected some egg quality characteristics as well when the age (50-70wks) being superior. Strain by age interaction also significantly affected some egg quality characteristics with better improvement. These findings provide evidence that Hisex eggs were superior to Lohmann eggs in most of physical egg quality characteristics which were measured under Sudan conditions, and that elder layers laid better quality eggs than younger ones.

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