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Laying Performance and Egg Quality Traits in White and Brown Commercial Hens

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ABSTRACT

The current study aimed to assess egg production traits and egg quality measurements of brown eggs as compared to white ones for two commercial layer strains under Egyptian environmental conditions. Hy-line brown and Hy-line W-36 layer strains were used in this study. During the first 90 days from the onset of egg production. 663 laying hens were used in this experiment to determine egg production characteristics (447 brown Hy-line layers and 216 W-36 Hy-line layers). Results indicated that Brown Hy-line layers had significantly heavier body weight than the white ones. Concerning some body measurements brown Hy-line layers had highly significant shank length compared to the white ones. However, W-36 Hy-line layers had highly significant comb length and wattle length compared to brown hens. Regarding egg production traits, the brown layers reached to sexual maturity earlier than the white ones. The brown layers produced significantly heavier egg weight than W-36 Hy-line layers. Furthermore, the brown layers produced significantly higher egg mass than the white counterpart. However, strain had no significant effect on egg number and egg production mean. Concerning external egg quality, brown eggs recorded higher egg shape index, shell thickness compared to white eggs. Regarding internal egg quality, it could be noticed that the brown eggs had higher albumen percentage and yolk index compared to those estimated by white eggs. However, the white eggs had higher Haugh units and yolk percentage than the brown eggs. It can be concluded that brown Hy-line layers had higher body weight, egg weight, egg mass, yolk index, albumen percentage and shell thickness compared to white ones. However, white eggs recorded higher Haugh units and yolk percentage than brown eggs.
Keywords: Brown Hy-line, W-36 Hy-line, strain, productive performance, egg quality

INTRODUCTION

Poultry industry is considered to be from important economic industries, which contribute significantly to national income in Egypt. Poultry breeding also provides a source of high protein nutritional value of low cost compared to other meat. Chickens are good converters of feed into useable protein in meat and egg. Commercial layers usually start egg production at about 20 weeks of age; also produce 0.9 eggs per day (Kekeocha, 1985).

Stadelman (1977) defined egg quality as important characteristics for consumer.

Egg quality is important for consumer and producer, where the economic success for poultry production is measured by the total number of qualitative produced eggs (Monira *et al*., 2003). Quality of eggshell depends on strain or line of chicken (Buss and Guyer, 1982).

Egg shell quality is an important factor to poultry industry; it has direct and significant effects on prices in poultry industry of commercial flocks. Where the percentage of broken eggs during transport from producers to consumers is about 7-8 %, this cause serious economic problem for both breeders and dealers (Hamilton, 1982), therefore it is very important to evaluate the egg quality traits. The internal egg quality is very important for consumers but for producers the external egg quality is very important. The current study was conducted to measure and compare productive performance, some body measurements and egg quality traits of two commercial layer (Brown and W-36 Hy-Line) strains under Egyptian environmental conditions.

MATERIALS AND METHODS

Location and experimental breeds

This study was carried out at poultry breeding farm, Poultry production department, Faculty of Agriculture, Ain Shams University.

Two commercial layer strains namely Brown Hy-line and W-36 Hy-line were used in this study. 663 layers were used in the current research (447 Brown Hy-line and 216 W-36 Hy-line).

Flock management

The hens from both strains were exposed to the same managerial and environmental conditions. The layers were placed in the laying house and housed in three-tier cages with three layers in each cage. The layers of both strains were fed a mash diet up to 20 weeks of age contained 2850 Kcal ME/kg feed and 18% crude protein.

The lighting program was maintained for 14 hours /day at 20 weeks of age and then . subsequently the lighting period was gradually increased by 20 minute/week until it had reached a length of 17 hour/day.

Measurements and observations:

Body weight and body measurements:

Body weight in grams was individually recorded at 30 weeks of age for each strain. Body measurements including shank length, comb length and wattle length were separately measured in (cm) using measuring tape.

Egg production parameters:

Egg production parameters including (egg number and egg weight) were individually recorded throughout the laying period through the first three months of egg production. Means of egg mass and egg production rate were calculated for each strain.

External egg quality measurements:

Egg quality traits were determined using 60 eggs (30 Brown and 30 White). Eggs were individually weighed in grams and recorded for each hen within strain to the nearest 0.01 g using an electronic digital balance. Shape index was calculated by [width /length]*100 according to (Carter, 1968). Specific gravity was conducted using Gradational densities salt solutions method, specific gravity was estimated by preparing nine saline solutions of densities ranged from 1.060 to 1.100 with 0.005 separation value. Each egg was placed in the first solution. Egg that sink was transferred to the next solution of higher density until egg float in the solution which it's specific gravity equal egg specific gravity value which floated in it.

Egg shell breaking strength was determined according to Fathi and El-Sahar (1996) using egg shell strength apparatus. Percentage of egg shell was calculated using the following equation:

Shell percentage = [Wet shell weight / Fresh egg weight] * 100.

Shell thickness with membranes was measured with a 0.001-millimeter accuracy using a digital micrometer. Average of three measurements (two at both pointed and broad polar and one at equator) was recorded.

Internal egg quality measurements:

Indirect calculating method of determining albumen weight as the following equation:

Albumen weight = Egg weight – [Yolk weight + Shell weight]. Albumen percentage was calculated as the following equation:

Albumen percentage = [Albumen weight / Egg weight] *100.

Haugh units were calculated according to Stadelman *et al*. (1988) as follows:

$$\textbf{H.U.} = 100 \log [H + 7.57 - 1.7\, W^{0.37}]$$

Where:

H.U. = Haugh units

H = height of the albumen (mm).

W = egg weight (g).

Yolk percentage was estimated as follow:

Yolk percentage = [Yolk weight / egg weight] *100.

Yolk height was converted to yolk index.

Yolk index was estimated as follow:

Yolk index = [Yolk height / yolk diameter] * 100. (Well, 1968).

Statistical analysis:

Data were subjected to one-way analysis of variance with strain effect using the General Linear Model (GLM) Procedure of SAS (2002) as following model:

$$Y_{ij} = \mu + S_i + e_{ij}$$

Where:

Y_{ij} = Trait measured.

μ = Overall mean.

S_i = A fixed effect of strain (i = 1, 2).

e_{ij} = An experimental error.

Differences among means were compared by the multiple range test according to Duncan (1955).

RESULTS AND DISCUSSION

Data of body weight and body measurements for both Hy-line brown and Hy-line white are presented in table (1). Results showed highly significant differences between strains for body weight and body measurements. The Hy-line brown females were heavier body weight (1701.0 g) than white Hy-line females (1326.9 g). Our results are in agreement with the findings of Singh *et al.* (2009) they found that the Lohmann brown egg layers were heavier than the Lohmann white egg layers. The results for some body measurements are shown in table (1). There were significant differences between brown and white Hy-line for shank length, comb length and wattle length. The brown Hy-line hens had longer shank length than white Hy-line hens; this indicated that the brown Hy-line hens have more adaptation with heat stress than the white counterparts. This result was in accordance with Rayan *et al.* (2013) they found that brown strain had significantly higher shank length when compared to white ones. In this study, the white Hy-line had significantly higher comb and wattle length when compared with brown Hy-line hens. These results were confirmed by Rayan *et al.* (2013) they indicated that the white strain had significantly higher comb and wattle length compared with brown strain.

Table (1): Means ± SE of body weight (g) and some body measurements (cm) for Hy-line strains.

Trait	Strain		Significance
	Brown Hy-line	W-36 Hy-line	
Body weight (g)	$1701.00^{a}\pm27.03$	$1326.95^{b}\pm35.69$	0.0001
Shank length (cm)	$9.11^{a}\pm0.15$	$8.71^{b}\pm0.13$	0.0001
Comb length (cm)	$3.29^{b}\pm0.09$	$6.41^{a}\pm0.08$	0.0001
Wattle length (cm)	$2.58^{b}\pm0.14$	$3.49^{a}\pm0.11$	0.0001

[a and b] **Means within the same raw with different superscripts are significantly different.**

Table (2) gives the effect of strain on age at sexual maturity and egg production traits. The mean of age at sexual maturity was high significantly between strains. The brown Hy-line females commenced to lay at an earlier age and produced higher percentage of eggs than white Hy-line females. This result was agreement with Roushdy *et al*. (2008) they indicated that Hy-line brown strain commenced to lay eggs at an earlier age than that of both of two local breeds (Fayoumi and Dandarawi). Data of egg weight for both (brown and white Hy-line strains) are shown in table (2). The brown Hy-line eggs were significantly heavier (60.63 g) than white Hy-line eggs (56.74 g). Our results agree with the findings of Scott and Silversides (2000) they found that eggs from brown hens were heavier than those from white hens. The same results were found by Singh *et al.* (2009) and Riczu *et al.* (2004) also found that eggs from brown hens were heavier than white eggs. However, no significant differences between the two strains for egg number throughout the first 90 days from the onset of egg production. These results were agreement with those obtained by Badawe (2006) who found that no significant differences between brown and white hens for egg number. Regarding egg mass, results illustrated that there was significant effect of strain on egg mass between two strains. Where, Hy-line brown layers recorded highly significant egg mass than W-36 layers. This result was supported by Grobas *et al.* (2001) they compared the production performance of brown hens (lay brown eggs) with White Leghorn (lay white eggs). They found that the brown hens (ISA-Brown) had higher egg mass than white hens. Also, Bonekamp *et al.* (2010); and Ragheb *et al.* (2013) they indicated that egg mass of brown eggs were significantly heavier than white eggs. With respect to egg production percentage, it could be observed that there were no significant differences of egg production mean for two strains during the first 90 days from the onset of egg production. The same results supported by Badawe (2006).

Table (2): Means ± SE of egg production characteristics for Hy-line strains.

Trait	Strain		significance
	Brown Hy-line	W-36 Hy-line	
Age at sexual maturity (d)	$138.98^{a} \pm 1.74$	$141.11^{b} \pm 1.95$	0.0001
Egg weight (g)	$60.63^{a} \pm 0.19$	$56.74^{b} \pm 0.43$	0.0001
Egg number	$80..98^{a} \pm 2.12$	$76.81^{a} \pm 1.79$	NS
Egg mass (g)	$4909.63^{a} \pm 131.46$	$4358.84^{b} \pm 108.99$	0.005
Egg production (%)	$89.97^{a} \pm 2.35$	$85.35^{a} \pm 1.99$	NS

[a and b] Means within the same raw with different superscripts are statistically different.
NS = Non significant.

The results of external egg quality are given in table (3). The egg shape index, specific gravity, shell thickness, shell strength and shell percentage are shown in table (3). Egg shell has an important role for consumer, producers and economic implications because cracked egg shell percentage increases losses for market egg producers. The current study indicated that the brown eggs had higher shape index than W-36 eggs, this result was agreement with Monira *et al* (2003). With respect to specific gravity, our results showed that there were no significant differences between strains for specific gravity. Leyendecker *et al.* (2001b) indicated that the white Hy-line eggs had better specific gravity than brown Hy-line eggs. However, the results reported by Riczu *et al.* (2004) observed that brown eggs had a higher specific gravity than the white ones. Results showed that the overall average of the Hy-line brown eggs had significantly more shell thickness than Hy-line white eggs. Similar trend was observed by Vits *et al.* (2005) they found that shell thickness of Lohmann brown were better than that of Lohmann Selected Leghorn (LSL). The same results were found by Ledvinka *et al.* (2000). Egg shell breaking strength considered to be one of the most important egg quality traits. It is important to note that the brown eggs had shell breaking strength better than the white ones, but differences were not significant. The mean values were 4.09 and 3.96 (kg/cm^2) for Brown and W-36 Hy-line eggs, respectively. Vits *et al.* (2005) found that shell breaking strength of Lohmann brown is better than that of LSL. Furthermore, Fathi and El-Sahar (1996) observed that the brown eggs had significantly higher egg shell breaking strength compared to the White ones. Regarding shell percentage, our results showed that there was no significant effect of strain on shell percentage for brown and white eggs. Conversely, Silversides and Scott (2001) indicated that eggs from brown layers had higher egg shell percentage compared to eggs from white layers.

Table (3): Means ± SE of external egg quality measurements for Hy-line strains.

Trait	Strain		Significance
	Brown Hy-line	W-36 Hy-line	
Egg shape index	$76.42^{a} \pm 0.24$	$75.72^{b} \pm 0.20$	0.02
Specific gravity	$1.079^{a} \pm 0.0009$	$1.079^{a} \pm 0.0008$	NS
Shell thickness (mm)	$0.38^{a} \pm 0.01$	$0.36^{b} \pm 0.003$	0.04
Shell strength (kg/cm^2)	$4.09^{a} \pm 0.07$	$3.96^{a} \pm 0.06$	NS
Shell percentage	$9.07^{a} \pm 0.19$	$8.84^{a} \pm 0.17$	NS

[a and b] Means within the same raw with different superscripts are statistically different.
NS = Non significant.

Table (4) illustrated the results of internal egg quality. The albumen quality play important role for egg quality. There were significant differences between the two strains for Haugh units. White Hy-line eggs had better Haugh units than brown Hy-line eggs. Similar result was found by Leyendecker *et al.* (2001b) Furthermore, results showed significant differences between two strains for albumen percentage. Where, the brown eggs had higher albumen percentage compared to the white eggs. The same trend was detected by Wall *et al*. (2010) they found that albumen percentage of brown eggs was higher than that of white eggs. However, Ragheb *et al.* (2013) observed that the overall albumen percentage of the Hy-line brown eggs were similar to that of the white eggs. The current results showed that the brown eggs had significantly higher yolk index than white eggs. Concerning yolk percentage, W-36 Hy-line eggs recorded higher yolk percentage when compared with the brown eggs. This result is in accordance with the findings by Wall *et al.* (2010) they indicated that yolk percentage of Hy-line brown eggs was less than that of White ones.

Table (4): Means ± SE of egg weight and internal egg quality measurements for Hy-line strains.

Trait	Strain		Significance
	Brown Hy-line	W-36 Hy-line	
Haugh units	$86.94^{b} \pm 0.88$	$89.72^{a} \pm 0.63$	0.001
Albumen %	$68.94^{a} \pm 0.79$	$66.74^{b} \pm 0.50$	0.04
Yolk %	$21.77^{b} \pm 0.41$	$24.26^{a} \pm 0.38$	0.0001
Yolk index	$45.82^{a} \pm 0.53$	$42.79^{b} \pm 0.32$	0.0001

[a and b] Means within the same raw with different superscripts are statistically different.

CONCLUSION

More important conclusions can be abbreviation as follow:

- Average values for body weight, age at sexual maturity, egg weight, egg mass, yolk index, albumen percentage and Shell thickness of Hy-line brown layers were better than values for W-36 Hy-line layers.
- Differences in Haugh units yolk percentage between two strains were significantly higher for white eggs than those of brown ones.

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الأداء الانتاجي و صفات جودة البيض في الدجاج التجاري البياض الأبيض والبني

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إستهدفت الدراسة الحالية إلى تقدير صفات إنتاج البيض ومقاييس جودة البيض البني مقارنة بالبيض الأبيض في سلالتين من الدجاج البياض التجاري تحت ظروف البيئة المصرية. تم استخدام خطين الهاي لاين البني والهاي لاين W-36 في هذه الدراسة خلال فترة وضع البيض (أول ٩٠ يوم من بداية انتاج البيض). تم استخدام عدد ٦٦٣ دجاجة بياضة في هذه التجربة (٤٤٧ دجاجة هاي لاين بني، و٢١٦ دجاجة هاي لاين أبيض). أشارت النتائج إلى أن السلالة البنية كانت ذات أوزان جسم أثقل بدرجة معنوية عن السلالة البيضاء. وفيما يتعلق ببعض مقاييس الجسم، سجلت السلالة البنية طول ساق أعلى بدرجة معنوية مقارنة بالسلالة البيضاء، بينما سجلت السلالة البيضاء طول عرف وداليتان أطول بدرجة معنوية عن السلالة البنية. بخصوص صفات إنتاج البيض، وصلت السلالة البنية إلى عمر النضج الجنسي مبكرا عن السلالة البيضاء. أنتجت الدجاجات البنية بيض أثقل بدرجة معنوية عن مثيلتها البيضاء. بالإضافة إلى ان الدجاجات البنية انتجت كتلة بيض أعلى بدرجة معنوية عن مثيلتها البيضاء. بينما لم يكن هناك تأثير معنوي للسلالة على عدد البيض وكذلك على متوسط إنتاج البيض. وفيما يتعلق بجودة البيض الخارجية، سجل البيض البني دليل شكل البيضة و سمك قشرة بيضة أعلى معنويا مقارنة بالبيض الأبيض. و فيما يختص بجودة البيض الداخلية، يمكن ملاحظة أن البيض البني سجل نسبة مئوية للبياض و دليل صفار أعلي بدرجة معنوية مقارنة بالبيض الأبيض. بينما حصل البيض الأبيض على وحدات هو ونسبة مئوية للصفار أعلى من البيض البني. ويمكن تلخيص ذلك بأن: الدجاجات البنية البياضةحصلت على وزن جسم، وزن بيضة، كتلة بيض، دليل صفار، و نسبة مئوية للبياض و سمك قشرة أعلى بمقارنتها بمثيلتها البيضاء. بينما سجل البيض الأبيض وحدات هو و نسبة مئوية للصفار أعلى مقارنة بالبيض البني.