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Comparative Study on Production Efficiency of Two Strains of Brown and White Egg Laying Hens in Kuwait

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Abstract: The high nutritional value of eggs makes them an important part of the normal diet of people in general and specifically in Kuwait. The majority of egg consumption in Kuwait and the Gulf area is of the white egg type. However, it is known that the majority consumption in European countries and in the Middle East is of the brown egg type. This could be due to high quality of brown eggs including shell thickness. Therefore, the current research was conducted to assess the quality of brown eggs as compared to white eggs for two laying hen strains under local conditions. Furthermore, comparison between production efficiency of brown and white laying hens was conducted. Hy-line brown and white laying hen strains were used in the current study. During the laying period (22-69 weeks of age), percent egg production, egg weight, egg mass, feed consumption and feed efficiency were determined every four weeks. Shell weight, thickness, yolk and albumen weight and percentage and Haugh unit were determined at different laying periods for both brown and white eggs. It was found that egg production, egg weight and egg mass of the brown hens were significantly ($P<0.05$) higher than that of the white hens. Furthermore, there were no significant differences ($P>0.05$) in the feed consumption between brown and white hens. However, feed efficiency was significantly ($P<0.05$) better for brown hens than that of the white hens. In addition, weight and percentage of egg yolk were somewhat lower in the brown eggs than that in the white eggs. It was also found that shell weight and percentage of shell were better in brown eggs than that in white eggs. Our results indicate that brown hen strains could have better production efficiency and higher egg quality than white hen strains. Therefore, it can be concluded that using brown laying hens could benefit both the poultry industry and consumers in Kuwait.

Key words: Laying hens, poultry industry, egg production, egg quality

INTRODUCTION

The eggs are known to be healthy food because of their high nutritional value and that makes eggs an important part of the normal diet of people in general and specifically in Kuwait, where the local consumption is one of the highest in the world (255/eggs/person/year) (Muasa, 2008). Using strains of laying hens that have better production efficiency and higher egg quality is important for producers to reduce their costs and be able to improve profitability and compete with the imported products in both quality and price.

It is known that egg production, egg quality and production efficiency are under the effect of the genetic makeup of the laying hen (Singh *et al*., 2009). Therefore, major poultry primary breeding companies have used genetic tools to develop different strains of laying hens, first for production of white eggs and then for production of both white and brown eggs. It is important to mention that the majority of egg consumption in Kuwait and Golf area is of the white egg type while the majority consumption in European countries and Middle East is of brown egg type. This indicates that the preference of consuming brown or white eggs depends on the region of the world.

In comparing strains used for production of white and brown eggs, Silversides *et al*. (2006) found that egg production for ISA brown was more than that for ISA white hens. Scott and Silversides (2000) found that eggs from ISA-Brown hens were heavier than those from ISA-White hens and had more shell and albumen but less yolk weight. In addition, Silversides and Scott (2001) reported that eggs from ISA-Brown hens had greater percentage of shell than those from ISA-White hens. In addition, Grobas *et al*. (2001) compared production performance of ISA-Brown hens with Dekalb Delta, a White Leghorn egg layer. They found that egg weight and egg mass from ISA-Brown were more than that from Dekalb Delta and feed efficiency was also better for the ISA-Brown hens. Using brown laying hens (Shaver 579) and white laying hens Shaver (2000), Riczu *et al*. (2004) found that eggs from the brown hens were heavier, had more egg-shell and had a higher specific gravity than the

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white eggs. They also found that the bone breaking strengths of the brown hens were greater than did the white hens.

Furthermore, Vits *et al*. (2005) found that % egg production, egg weight, shell thickness and shell breaking strength of Lohmann brown are better than that of Lohmann Selected Leghorn (LSL). In addition, Benyi *et al*. (2006) found that Hy-line brown hens laid more but lighter eggs, utilized feed more efficiently and had a lower mortality than Hy-line W-98 white hens.

Therefore, it can be concluded that differences in egg production and quality do exist between different strains of laying hens and that brown egg hens could perform better than white egg hens. However, further studies are needed to confirm that these differences occur under the local Kuwaiti environmental conditions.

Therefore, the current research was conducted to further assess the egg production and egg quality of two laying hen strains one of white type and the other of brown type under local Kuwaiti conditions.

MATERIALS AND METHODS

A total of 300 one-day old pullets Hy-Line variety W-98 white and also 300 one-day old pullets from Hy-Line variety brown were used for the pullet study. The pullets were housed in batteries till sixteen weeks of age and then were moved to laying cages where they were kept till the end of the experiment. The pullets of each strains were divided into 6 replicates (n = 6). Sixty of the total 300 pullets were used for the laying hen study. The hens were divided into 3 replicates (n = 3). All pullets and hens were provided with food and water *ad libitum*. The pullets were fed grower ration from day one till 8 weeks of age (18.5% protein, 2750 kcal/kg), developer ration from 8 weeks-16 weeks of age (14.5% protein, 2750 kcal/kg) and pre-lay from 16 weeks till 22 weeks of age (17.5% protein, 2750 kcal/kg) and laying ration from 22 wks of age to the end of the laying period (18.0% protein, 2900 kcal/kg). Photoperiod regimens that was used for pullets and laying hens followed the recommendations by the strain producing company. The laying hens were provided with 14 hours of light and 10 hours of darkness. The pullets and hens were vaccinated as per the recommendations by the strain producing company.

Data collected: Brown and white pullets were weighed at hatch and then every four weeks until sixteen weeks of age. In addition, feed consumptions for both brown and white pullets were measured and feed efficiencies for both brown and white pullets were calculated.

For the data during the laying period, hen-housed percent egg production, egg weight, egg mass and feed consumption were measured weekly and feed efficiency was calculated. Egg quality was measured every four weeks, starting at 22 wks of age and ended at 69 wks of age when the experiment ended. Egg quality measured included haugh unit, shell weight, shell %, yolk weight, yolk %, albumen weight and albumen %. Shell thickness including shell membranes was also measured.

Daily temperature and relative humidity were recorded and were adjusted accordingly.

Data analysis: It is important to note that the data used for the statistical analysis of the production parameters of the brown and white laying hens in our experiments was for the period from 22-69 weeks of age. The data were grouped in 12 weeks periods resulting in a total of four groups. The data were analyzed using a one-way ANOVA utilizing the S-Plus statistical program (Crawley, 2002) and comparison between brown strain vs white strain at each age period was the main effect. Means were separated using Tukey's test and the significance was set at $P<0.05$.

RESULTS AND DISCUSSION

Pullet production: Data for total body weight gain until 16 weeks of age (g/bird), total feed consumption (g/bird) from 0-16 weeks of age and feed efficiency (g feed/g gain) for both brown and white Hy-Line pullets are shown in Table (1). Overall body weight gain for the brown pullets was more than the white pullets, however, the difference was not significant ($P>0.05$). However, cumulative feed consumption until 16 wk of age for the brown pullets (4634.8 g/b) was significantly ($P<0.05$) less than that for the white pullets (5322.7 g/b) and feed efficiency for brown pullets was significantly ($P<0.05$) better (4.18) than that for the white pullets (4.85). These results are important because they imply that the cost of raising Hy-Line brown pullets is less than that of Hy-Line white pullets and that will be reflected in the total cost of production of Hy-Line brown hens vs. Hy-Line white hens. This information is of great significance to the local egg industry when they decide to utilize Hy-Line strain of brown or white birds as their egg laying stocks.

Egg laying period. Laying performance: Egg Production. Hen housed egg production for both Hy-Line brown and white laying hens for 4 periods, 12 wks per period, are shown in Fig. 1. The percent hen housed egg production for the brown hens was significantly ($P<0.05$) higher than that of the white hens at all the four periods that were studied. Furthermore, overall average percent egg production for brown and white hens were significantly different 86.77 and 84.24%, respectively for the period from 22 until 69 wks of age (Fig. 2). In addition, overall percent egg production reported by the company guide was higher for brown hens than the white hens for the periods from 22 to 69 weeks of age. Lewis *et al*. (2004) reported that ISA brown hens had higher egg production than Shaver white hens and Silversides *et al*. (2006) also reported that ISA brown hens had higher egg production than ISA white hens. Furthermore, Benyi *et al*.

Table 1: Body weight gain, total feed consumption and feed efficiency for the hy-line brown and white pullets (0-16 weeks of age)

	Strains	
Parameters	Brown pullets	White pullets
Body weight gain (g/bird) (0-16 weeks)	*1105.2±8.4[a]	1097.1±19.2[a]
Feed consumption (g/bird) (0-16 weeks)	4634.8±200.2[b]	5322.7±184.7[a]
Feed efficiency(g feed/g gain) (0-16 weeks)	4.18±0.21[b]	4.85±0.18[a]

*Values are expressed as Means±SD.

[ab]Means within the same row with different superscripts are significantly different (P<0.05).

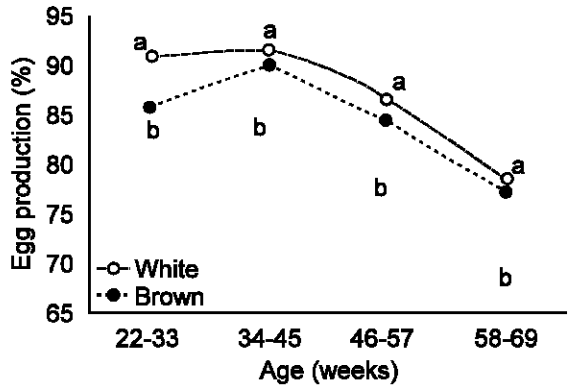

Fig. 1: Percentage egg production for hy-line brown and white hens at different age periods.
Values are expressed as Means±SD
[ab]Means within the same period with different superscripts are significantly different at (P<0.05)

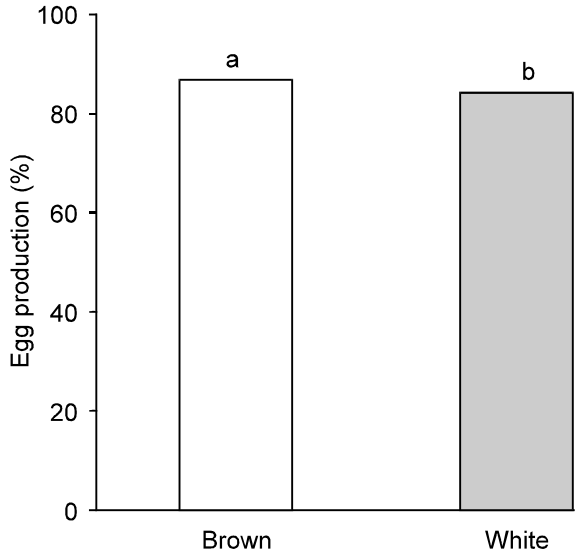

Fig. 2: Overall percent egg production for brown and white hy-line hens from 22-69 weeks of age.
Values are expressed as Means±SD
[ab]Means with different superscripts are significantly different (P<0.05)

(2006) found that Hyline brown layers laid more eggs than Hyline (W-98) white laying hens and Bonekamp *et al*. (2010) found that Lohmann Brown Classic layers laid more eggs than Lohmann LSL Classic layers. In addition Anderson (2002) provided detailed information on the differences in egg production and quality between different white and brown egg strains. He also found that the overall average of hen-day egg production for the brown hens was higher than that of white hens. However, Mutaf *et al*. (2009), using local breeds found that white (ATABEY) hens laid more than brown (ATAK) hens. In general almost all previous results indicate that brown hens lay more eggs than white hens but the difference in production varies between different studies. Therefore, higher egg production is one of the advantages of raising brown hens over white hens.

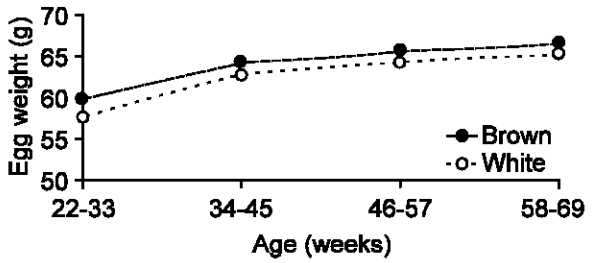

Fig. 3: Egg weight for hy-line brown and white hens at different age periods.
Values are expressed as Means±SD
[ab]Means within the same period with different superscripts are significantly different at (P<0.05)

Egg weight: Data for egg weight for both Hy-Line white and brown eggs for 4 periods (12 wks per period) are shown in Fig. 3 The data are presented for 4 periods and each was a period that consisted of 12 wks. Results showed that not only egg weight of the brown eggs is significantly (P<0.05) higher than the white eggs for all the four periods studied but also the overall weight of the Hy-Line brown eggs was significantly (P<0.05) more (63.9 g) than the Hy-Line white eggs (62.4 g) (Fig. 4). Our results agree with the findings of Scott and Silversides (2000) who found that eggs from ISA-Brown hens were heavier than those from ISA-White hens. In addition, Singh *et al*. (2009) and Riczu *et al*. (2004) also found that eggs from the brown hens were heavier than white eggs. Furthermore, Rizz and Marangon (2012) found that Hy-Line brown eggs were significantly heavier than the Hy-Line white eggs and Bonekamp *et al*. (2010) found that Lohmann Brown Classic layers laid heavier eggs than Lohmann LSL Classic layers. However, (Wall,

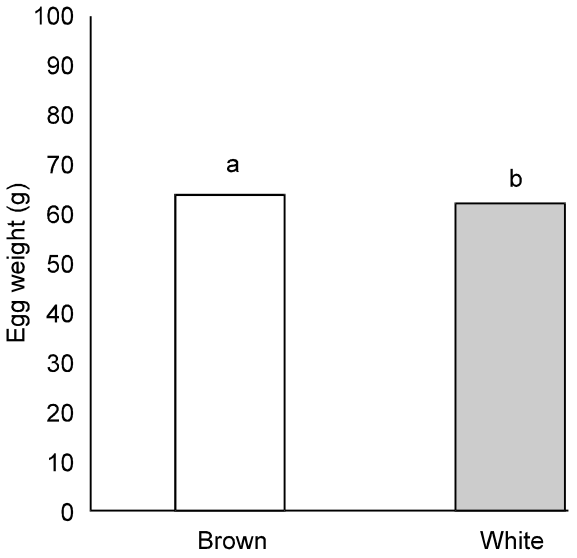

Fig. 4: Overall egg weight for brown and white hy-line hens from 22-69 weeks of age.
Values are expressed as Means±SD
[ab]Means with different superscripts are significantly different (P<0.05)

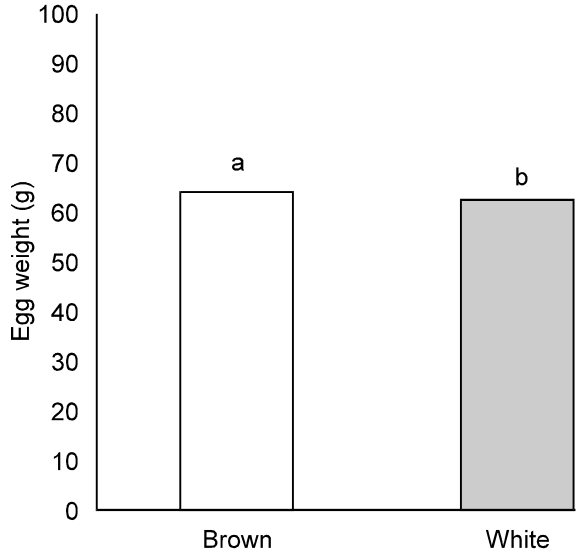

Fig. 5: Egg mass for brown and white hy-line hens at different age periods.
Values are expressed as Means±SD
[ab]Means within the same period with different superscripts are significantly different (P<0.05)

2011, 2010) found no significant differences between weights of brown and white eggs. In general, it can be said that our results indicate that brown hens not only lay more eggs than white hens but could also produce heavier eggs.

Egg mass: Data for egg mass for both Hy-Line white and brown eggs at different ages are shown in Fig. 5. The

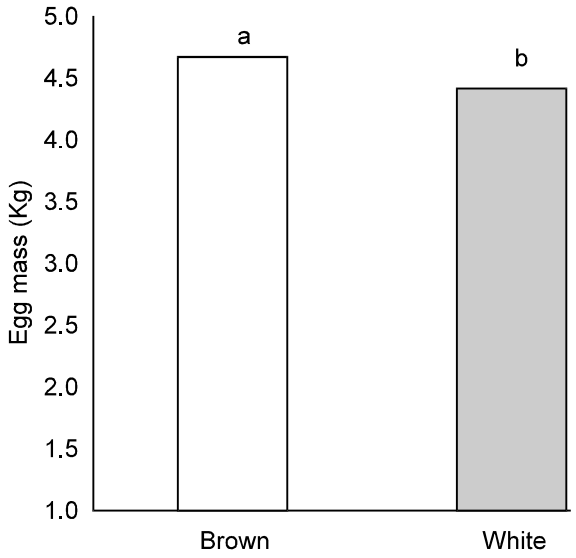

Fig. 6: Overall egg mass for brown and white hy-line hens from 22-69 weeks of age.
Values are expressed as Means±SD
[ab]Means with different superscripts are significantly different (P<0.05)

data are presented for 4 periods and each was a period of 12 wks. The results for egg mass for the Hy-Line brown hens for all the four periods studied was significantly (P<0.05) higher than the egg mass for the Hy-Line white hens. Furthermore, cumulative egg mass (22-69 weeks) for brown hens was significantly (P<0.05) more (18.6 kg) than that of the Hy-Line white hens (17.67 kg) (Fig. 6). These results are expected since both egg production and egg weight for brown strain were higher than that of the white strain. Our results agree with the findings of Grobas *et al*. (2001) who compared production performance of ISA-Brown hens with Dekalb Delta, a White Leghorn egg layer strain and found that egg mass from ISA-Brown was more than that from Dekalb Delta. Again our results emphasis the advantages of using brown layers over white layers.

Feed consumption and feed efficiency: Data for feed consumption and feed efficiency for both Hy-Line brown and Hi-Line white at different ages are shown in Fig. 7 and 8, respectively. The data are presented for 4 periods and each was a period of 12 wks.

Results shown in Fig. 7 indicate that feed consumption of both strains was not significantly different (P>0.05) over the 4 periods. Also, overall feed consumption (Fig. 9a) was not significantly different (P>0.05) between both strains (8.23 and 8.22 kg for brown and white hens, respectively). However, since egg mass for Hy-Line brown hens was more than that of the Hy-Line white hens, the feed efficiency, as expected, for the four periods that were studied for the brown hens (Fig. 8), as

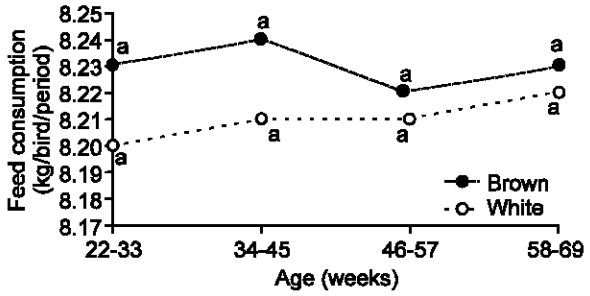

Fig. 7: Feed consumption (kg/bird/period) for brown and white hy-line hens at different age period.
Values are expressed as Means±SD
No significant difference at any of the period (P<0.05)

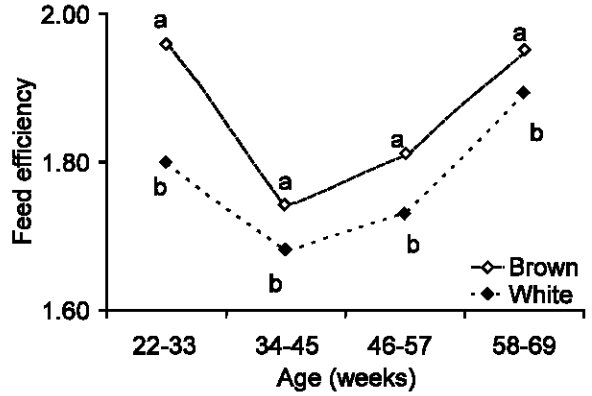

Fig. 8: Feed efficiency (kg feed/kg egg mass) for brown and white hy-line hens at different age period.
Values are expressed as Means±SD
[ab]Means within the same period with different superscripts are significantly different (P<0.05)

well as overall feed efficiency (Fig. 9b) were significantly (P<0.05) better than that of the white hens. Grobas *et al.* (2001) found similar results. They found that feed efficiency from ISA-Brown was better than that from Dekalb Delta white. In addition Benyi *et al.* (2006) found that feed efficiency for Hyline brown layers was better than that of Hyline (W-98) white laying hens this is another indicator that production performance of brown hens is better than white hens. The better performance of the Hy-Line brown hens was very clear and very consistent. This is important, implying that the profit of producing brown eggs could be more than that of white eggs. This information is of great significance to the egg industry, in general and in Kuwait in particular.

Egg laying period. Egg quality: Results on overall egg quality of brown and white eggs are shown in Table 2. Results showed that overall average of yolk weight and yolk percentage of the Hy-Line brown eggs were less than that of the Hy-Line white eggs even though the difference was not significant (P>0.05). Scott and

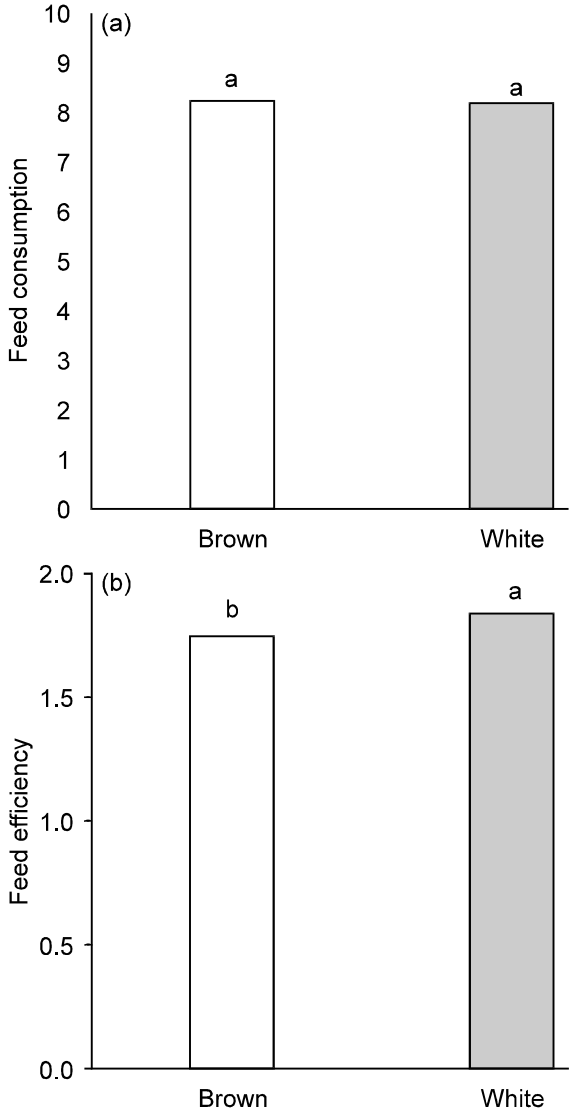

Fig. 9(a-b): (a) Total feed consumption
(b) Feed efficiency for brown and White hy-line hens from 22-69 weeks of age.
Values are expressed as Means±SD
[ab]Means with different superscripts are significantly different (P<0.05)

Table 2: Egg quality for hy-line brown and hy-line white eggs

	Strain	
Parameters	Hy-line brown	Hy-line white
Yolk Weight(g)	*16.4±1.1[a]	16.9±1.2[a]
Yolk (%)	25.7±1.9[a]	26.5±1.9[a]
Albumen Weight (g)	39.0±4.2[a]	39.3±4.1[a]
Albumen (%)	60.8±3.0[a]	61.2±2.8[a]
Shell Weight (g)	8.5±1.0[a]	7.8±0.8[b]
Shell (%)	13.3±1.7[a]	12.2±1.3[b]
Haugh Unit	76.7±8.4[a]	75.6±10.0[a]

*Values are expressed as Means±SD.
[ab]Means within the same row with different letters are significantly different (P<0.05).

Silversides (2000) found that eggs from ISA-Brown hens had less yolk than those from ISA-White hens and Wall *et al.* (2010) found that % yolk of Hy-line brown egg was less than that of Hy-line white eggs.

It should be mentioned that the overall albumen weight and overall percent albumen, in the present study (Table 2) for the Hy-Line brown eggs were similar to that for the Hy-Line white eggs. However, Scott and Silversides (2000) found that eggs from ISA-Brown eggs had more albumen than ISA-White hen eggs and Sigh *et al.* (2009) found that Lohmann brown eggs had more albumen than Lohmann white eggs. Furthermore, Wall *et al.* (2010) found that % albumen of Hy-Line brown eggs was higher than that of Hy-Line white eggs.

Results of this study and others could imply that brown eggs might have less total lipids (less yolk) and more protein (more albumen) than white eggs which gives brown eggs more advantages over white eggs.

As to the shell weight and percent shell shown in Table 2, our results showed that the overall average of the Hy-Line brown eggs had significantly ($P<0.05$) more shell and more percent shell than the Hy-Line white eggs. Our results agree with what is reported by Scott and Silversides (2000) and Silversides and Scott (2001), who found that eggs from ISA-Brown hens had more shell than ISA-White hen eggs. In addition, using brown laying hens (Shaver 579) and white laying hens (Shaver 2000), Riczu *et al.* (2004) found that eggs from the brown hens had more egg shell and had a higher specific gravity than the white eggs. Furthermore, Wall *et al.* (2010) found that % shell of Hy-Line brown eggs was higher than that of Hy-Line white eggs . These results indicate that brown eggs have better shell quality than white eggs.

Results on Haugh Unit (HU) (an indicator of internal egg quality) which are shown in Table 2, showed that there were no significant differences ($P>0.05$) between the Hy-Line brown and the Hy-Line white eggs. Similar results were found by Wall *et al.* (2010).

It should be mentioned that brown eggs could have other advantages over white eggs. Wall (2011) and Wall *et al.* (2010) found that Hy-Line brown eggs have less % of dirty eggs than that of Hy-Line white eggs. Furthermore, Hannah *et al.* (2011) reported that Hy-Line washed brown eggs have less microbial contamination than Hy-Line washed white eggs. Finally, Silversides *et al.* (2012) found that Lohmann brown hens have heavier bones than Lohmann white hens.

Conclusion: It could be reported that the results of the current study indicate that the production performance of the Hy-Line brown pullets was better than that of the Hy-Line white pullets. Furthermore, production performance during the laying period was better for the Hy-Line brown than that of the Hy-Line white hens. Finally, brown eggs could have less fat and more protein than white eggs. It is important to reemphasis that in Kuwait, where the current study was conducted, as well as other countries in the Gulf area, the major consumption is of white and not brown eggs. Therefore, there is a need to promote the brown eggs since it could have advantages over white eggs.

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