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THE INTERACTION EFFECT AMONG AGE OF LAYER, STRAIN OF CHICKEN AND YEAR OF LAYING ON EXTERNAL QUALITY TRAITS

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ABSTRACT : ***The present study was conducted to compare the egg quality traits in two local developed strains (Sinai and Norfa) with two foreign commercial strains (Lohman Selected Leghorn and Lohman Brown) of chicken at sexual maturity, 32, 42, 52 and 62 – wk of age for two consecutive laying years. The results were summarized as follows.***

1. ***Comparison of local versus foreign strains : It was found that foreign strains (L.S.L and L.B) had significantly (P ≤ 0.05) higher values of egg weight, egg shape index, egg volume, egg surface area and lower specific gravity as compared to local strains (S. and N.).***
2. ***Effect of layer age : It was found that egg weight, egg volume and egg surface area were increased with increasing age of layer.***
3. ***The interaction effect : The interaction effects between age and strain, age and laying year, strain and laying year or among those three factor were significant (P ≤ 0.05) or highly significant (P ≤ 0.01) for most external egg quality traits studied.***
4. ***Conclusion : This variation in external egg quality traits was mainly due to the increasing egg weight with increasing age. It may be more beneficial for egg producers and processors to use young hens (32 – 42 wk. old) for table egg production and birds of old age (52 – wk. old or more) for liquid egg production. Also, the local strains need more improvement in their external egg quality traits, specially egg weight.***

Key words: ***Chicken strain, age, year of laying, External egg quality traits.***

INTRODUCTION

Egg quality had been defined as the characteristics of an egg that had acceptability to the consumer's. Therefore, the economical success of a laying flock depends on the total number of quality eggs produced (Monira *et al.*, 2003). It is of great importance to produce eggs with high quality in order to sell them at high prices which will cover all production costs and to provide some profit. But now with respect to GAT rules for tradition, quality of eggs is very important in determining the price of eggs. Commercial poultry farms must develop their productive process to produce eggs with high quality trait in order to face the new rules of GAT (FAO, 1997)

The age of layer can affect external egg quality traits and its solids because egg weight increases with increasing age of layers (Suk and Park, 2001). Therefore, the aim of the present experiment is to study the interaction effect among age of layer, strain of chicken and year of laying on external egg quality traits in chicken eggs.

MATERIALS AND METHODS

The present study was carried out at the poultry Research Farm, Department of Poultry Production, Faculty of Agriculture at Shibin El-Kom, Minufiya University, Egypt. The experiment started from December, 2004 to May, 2007.

1. Chicken stock :

Two local improved strains of chickens, Sinai, S (Soltan, 1985) and Norfa, N (Abdou, 1996) and two foreign commercial strains, Lohman selected Leghorn (L.S.L.) and Lohman Brown (L.B) were used in the present study.

2. Experimental design :

A total number of 293 and 337 one day old chicks in the first laying year and 290 and 334 in the second laying year were used in the present study from S. and N. strains, respectively. Also, a total number of 200 one day old female chicks from each L.S.L. and L.B. strain per each laying year were used in the present experiment. External egg quality traits were determined at five different ages of laying hens, including age at sexual maturity, 32, 42, 52, and 62 weeks of age for two consecutive laying years.

3. Experimental stock management :

All chicks were wing banded for identification at one day old. All chick were brooded in floor brooder for 6 to 7 weeks of age, then all chickens were moved to rearing house from 8-wks of age to 18-wks of age. At 18-wks of age, chickens were housed individually in individual cages with increasing artificial light gradually to reach 16 – hrs light a day. All chickens were fed *ad libitum* during brooding and rearing periods on protein and 2721 and 2853 Kcal / Kg diet, respectively. At 18-wks of age, pullets were fed on a diet containing 17.46 % crude protein and 2769 Kcal ME / Kg diet throughout the experimental period. All chickens were vaccinated against diseases and were treated similarly during the experimental period.

4. Samples of eggs collected :

Samples of eggs were chosen at random. Each sample contains 20 eggs from each strain (Sinai, Norfa, L.S.L and L.B.), at each age for two consecutive laying years.

5. Studied traits and measurements :

5.1. Egg weight (E.W.) : Eggs were weighed individually to the nearest 0.01 gram by using electronic balance and both egg length and egg width were measured by using an Ames (caliper) in millimeters.

5.2. Egg shape index (E.S.I.) : Egg shape index was determined by using the following formula (Reddy *et al*., 1979).

$$\text{E.S.I.} = \frac{\text{width of egg (mm)}}{\text{length of egg (mm)}} \times 100$$

5. 3. Specific gravity (S.G.) : Specific gravity of an egg was determined by using the saline flotation method according to Hamilton (1978) using salt solution ranging from 1.062 to 1.106 (g / cm^3) with gradients of 0.004 in specific gravity.

5. 4. Egg volume (E.V.) : Egg volume was determined according to the formula given by Narushin (2005) as the following :

$$E.V. = (0.6057 - 0.0018\ B)\ LB^2$$

Where : B is the egg breadth in millimeters, and L is the egg length in millimeters.

5. 5. Egg surface area (E.S.A.) : Egg surface area was determined using the formula given by Narushin (2005) as the following :

$$E.S.A. = (3.155 - 0.0136\ L + 0.0115\ B)\ LB$$

Where B and L as given above.

6. Statistical analysis :

Data obtained were statistically analyzed using SPSS PC (1997) computer programs. Duncan's Multiple Range Test was used for comparisons of means (Duncan, 1955). All percentages data were converted to the corresponding arcsine prior statistical analysis according to Snedecor and Cochran (1977). Data were computerized and analyzed by using the following model .

$$y_{ijkh} = \mu + A_i + S_j + Y_k + (AS)_{ij} + (AY)_{ik} + (SY)_{jk} + (ASY)_{ijk} + e_{ijkh}$$

Where

y_{ijkh} = observation of the (k) from A_i ages, S_j strain and Y_k year
μ = Overall mean
A_i = Fixed effect of (i) layer age
S_j = Fixed effect of (j) strain
Y_k = Fixed effect of (k) year
$(AS)_{ij}$ = Interaction effect of A_i and S_j
$(AY)_{ik}$ = Interaction effect of A_i and Y_k
$(SY)_{jk}$ = Interaction effect of S_j and Y_k
$(ASY)_{ijk}$ = Interaction effect of A_i, S_j and Y_k, and
e_{ijkh} = Residual effect

RESULTS AND DISCUSSION

1. Egg weight (E.W) :

Age of hen had a greater influence on egg weight. It was found that egg weight averages (Table 1) was increased significantly with advancing age of hen. The egg weight were 42.19 vs. 43.13, 45.57 vs. 46.59, 53.77 vs. 50.74, 55.22 vs. 51.36 and 55.99 vs. 52.37 g. at sexual maturity, 32, 42, 52 and 62 weeks of age in the first and second years of laying, respectively. Also, the averages egg weight for foreign commercial strains (Lohman selected Leghorn, L.S.L and Lohman Brown, L.B) were superior from those local strains (Sinai and Norfa). The averages of egg weight were 66.04, 58.00, 48.26 and 48.56 g. at 52 wks. of age in the first year of laying for L.B, L.S.L, N and S strains of chickens, respectively (Table 1). The averages of egg weight at 52 wks. of age in the second year of laying were 56.47, 55.40, 45.99 and 43.59 g. in the same order.

There were highly significant ($P \leq 0.01$) differences in egg weight among ages (A), strains (S) and years of laying (Y). Also, the interactions between (A x S), (A x Y), (S x Y) and (A x S x Y) were highly significant. These results are in good agreement with those found by Hussein *et al.* (1993), Souza *et al.* (1994), Scott and Silversides (2000) and Silversides and Scott (2001). They reported that egg weight was increased with increasing age of hen and age of layer had a significant effect on egg weight. Also, the effect of strain on egg weight in the present study supported the previous findings reported by some investigators. Mahapatra *et al.* (1989) observed that egg weight was lower in native (Kadakath, Assel and Nondescript breeds) than in commercial breeds (White Leghorn and Red Cornish) hens. Also, Goher *et al.* (1990) reported that the egg weight average was 59.15, 55.53, 55.17 and 54.05 g for White Leghorn, Rhode Island Red, Silver Montazah and Matrough chickens, respectively.

In some Egyptian native breeds, Soltan (1992) reported that Sinai fowl laid heavier egg weight (43.3 g) than both Fayoumi (37.3 g) and Baladi (39.2 g). Also, Abd-El-Galil (1993) concluded that the average of egg weight was 43.9, 43.4, 42.8, 40.6, 38.9 and 36.1 g for Bandara, Golden Montazah, Gimmizah, Dokki-4, Fayoumi and Dandarawi layers, respectively, while, it was 52.1 g for L.S.L. In addition, Mahgoub (2002) reported that the average of egg weight for Sinai layers untreated (control) was 49.21 g.

2. Egg shape index (E.S.I) :

It was found that the egg shape index tends to decrease with advancing age of hen. But, the E.S.I percentage at 62 and 42 weeks of age in the first and second years of laying was slightly increased (Table 2). The average egg shape index for two foreign commercial strains (L.B and L.S.L) and two local strains (N and S) was 77.25 vs. 75.68, 75.18 vs. 75.29, 75.73 vs. 76.41, 75.17 vs. 75.88 and 76.36 vs. 75.39 % at sexual maturity, 32, 42, 52 and 62 weeks of age in the first and second years of laying, respectively.

Table (1) : Effect of layer age, strain and year of laying on egg weight trait (means ± S.E)

Age (WK)	Strain	No. of eggs	Means ± S.E (g)*	
			1st year	2nd year
S.M.				
	Sinai	20	36.24 ± 0.91 b	39.79 ± 0.91 c
	Norfa	20	37.80 ± 0.91 b	38.08 ± 0.91 c
	L.S.L	20	47.48 ± 0.91 a	45.22 ± 0.91 b
	L.B	20	47.26 ± 0.91 a	49.45 ± 0.91 a
Total average		80	42.19 ± 0.46 D	43.13 ± 0.46 D
32 WK				
	Sinai	20	39.96 ± 0.91 c	42.50 ± 0.91 b
	Norfa	20	39.80 ± 0.91 c	40.45 ± 0.91 b
	L.S.L	20	48.05 ± 0.91 b	50.62 ± 0.91 a
	L.B	20	54.46 ± 0.91 a	52.81 ± 0.91 a
Total average		80	45.57 ± 0.46 C	46.59 ± 0.46 C
42 WK				
	Sinai	20	47.12 ± 0.91 c	45.13 ± 0.91 c
	Norfa	20	47.50 ± 0.91 c	46.60 ± 0.91 c
	L.S.L	20	57.80 ± 0.91 b	536.57 ± 0.91 b
	L.B	20	62.68 ± 0.91 a	57.67 ± 0.91 a
Total average		80	53.77 ± 0.46 B	50.74 ± 0.46 B
52 WK				
	Sinai	20	48.56 ± 0.91 c	43.59 ± 0.91 b
	Norfa	20	48.26 ± 0.91 c	45.99 ± 0.91 b
	L.S.L	20	58.00 ± 0.91 b	55.40 ± 0.91 a
	L.B	20	66.04 ± 0.91 a	56.47 ± 0.91 a
Total average		80	55.22 ± 0.46 AB	51.36 ± 0.46 B
62 WK				
	Sinai	20	47.92 ± 0.91 b	44.78 ± 0.91 b
	Norfa	20	50.13 ± 0.91 b	47.22 ± 0.91 b
	L.S.L	20	61.29 ± 0.91 a	58.05 ± 0.91 a
	L.B	20	64.61 ± 0.91 a	59.45 ± 0.91 a
Total average		80	55.99 ± 0.46 A	52.37 ± 0.46 A

*** a,b,c = Means have the same superscript in each strain are not differ significantly at P ≤ 0.05**

*** A,B,C,D = Means have the same superscript in each layer age are not differ significantly at P ≤ 0.05**

These results are almost similar to those reported by Choprakarn *et al.* (1998), Gunlu *et al.* (2003) and Brand *et al.* (2004) who showed that egg shape index was decreased with increasing age of hen. Also, Abanikannda *et al.* (2007) found similar results in Harco black strain. But, Radwan (2007) reported that the egg shape index insignificantly increased with progressive age of hen.

It is also clear that the foreign commercial strains (L.S.L and L.B.) had a significant effect on the egg shape index (Table 2), which recorded 75.55 vs. 78.58, 74.48 vs. 76.86, 74.02 vs. 77.38, 74.09 vs. 76.44 and 75.88 vs. 77.08 % at sexual maturity, 32, 42, 52 and 62 weeks of age in the first year of laying, respectively. Similar results were found in the second year of laying. But, the local strains (S and N) had insignificant effect on the egg shape index, which recorded 77.85 vs. 77.03, 74.41 vs. 74.94, 76.19 vs. 75.32, 75.04 vs. 75.11 and 75.27 vs. 77.23 % at sexual maturity, 32, 42, 52 and 62 weeks of age in the first year of laying, respectively.

In this respect, El-Sharkawy (1991) noticed that no significant differences were found in egg shape index among Fayoumi, Matrouh, L.S.L and Hisex strains of chickens. He observed that the averages of egg shape index were 74.7, 75.5, 74.8 and 75.1 % for Fayoumi, Matrouh, L.S.L and Hisex strains, respectively. Also, Soltan (1992) reported that no significant differences were found among Sinai control group (77.6 %), Baladi (77.9 %) and Fayoumi (78.5%) for egg shape index. But, Essa (2005) found that the Lohman Brown and White strains had a significant effect on the egg shape index, which recorded 76.7 and 74.7 %, respectively.

The statistical differences of egg shape index were highly significant ($P \leq 0.01$) among hen ages (A), and among strains (S) of chickens. While, insignificant difference was observed between years of laying. Also, significant ($P \leq 0.05$) differences were observed with respect to the interactions between (A x S) and (A x S x Y). Highly significant differences ($P \leq 0.01$) were observed between (A x Y). But, insignificant difference was found with respect to the interaction between (S x Y).

3. Specific gravity (S.G) :

It is clear that age of hen was significantly affect egg specific gravity values (Table 3). The egg specific gravity tended to be decreased with advancing age of layer during the period from sexual maturity to 32 weeks of age. The average values of egg specific gravity were 1.089 vs. 1.095 and 1.086 vs. 1.094 g / cm^3 at sexual maturity and 32 weeks of age in the first and second years of laying, respectively. Then, the egg specific gravity tended to be increased with increasing age. The average values of egg specific gravity recorded 1.091 vs. 1.102, 1.093 vs. 1.103 and 1.098 vs. 1.102 g / cm^3 at 42, 52 and 62 weeks of age in the first and second years of laying, respectively. Also, It was observed that foreign commercial strains had significantly lower

Table (2) : Effect of layer age, strain and year of laying on egg shape index trait (means ± S.E)

Age (WK)	Strain	No. of eggs	Means ± S.E (%)*	
			1st year	2nd year
S.M.				
	Sinai	20	77.85 ± 0.61 a	77.11 ± 0.61 a
	Norfa	20	77.03 ± 0.61 a	74.57 ± 0.61 b
	L.S.L	20	75.55 ± 0.61 b	75.20 ± 0.61 b
	L.B	20	78.58 ± 0.61 a	75.86 ± 0.61 ab
Total average		80	77.25 ± 0.31 A	75.68 ± 0.31 A
32 WK				
	Sinai	20	74.41 ± 0.61 b	77.24 ± 0.61 a
	Norfa	20	74.94 ± 0.61 b	75.26 ± 0.61 a
	L.S.L	20	74.48 ± 0.61 b	72.81 ± 0.61 b
	L.B	20	76.86 ± 0.61 a	75.84 ± 0.61 a
Total average		80	75.18 ± 0.31 B	75.29 ± 0.31 A
42 WK				
	Sinai	20	76.19 ± 0.61 ab	76.28 ± 0.61 ab
	Norfa	20	75.32 ± 0.61 ab	76.79 ± 0.61 a
	L.S.L	20	74.02 ± 0.61 b	74.96 ± 0.61 b
	L.B	20	77.38 ± 0.61 a	77.61 ± 0.61 a
Total average		80	75.73 ± 0.31 B	76.41 ± 0.31 A
52 WK				
	Sinai	20	75.04 ± 0.61 ab	75.33 ± 0.61 ab
	Norfa	20	75.11 ± 0.61 ab	76.12 ± 0.61 ab
	L.S.L	20	74.09 ± 0.61 b	74.51 ± 0.61 b
	L.B	20	76.44 ± 0.61 a	77.55 ± 0.61 a
Total average		80	75.17 ± 0.31 B	75.88 ± 0.31 A
62 WK				
	Sinai	20	75.27 ± 0.61 b	75.26 ± 0.61 ab
	Norfa	20	77.23 ± 0.61 a	75.98 ± 0.61 a
	L.S.L	20	75.88 ± 0.61 b	73.73 ± 0.61 b
	L.B	20	77.08 ± 0.61 a	76.60 ± 0.61 a
Total average		80	76.36 ± 0.31 AB	75.39 ± 0.31 A

*** a,b = Means have the same superscript in each strain are not differ significantly at P ≤ 0.05**

*** A,B,C = Means have the same superscript in each hen age are not differ significantly at P ≤ 0.05**

Table (3) : Effect of layer age, strain and year of laying on specific gravity trait (means ± S.E)

Age (WK)	Strain	No. of eggs	Means ± S.E (g / cm^3)*	
			1st year	2nd year
S.M.				
	Sinai	20	1.093 ± 0.001 ^{a}	1.098 ± 0.001 ^{a}
	Norfa	20	1.096 ± 0.001 ^{a}	1.096 ± 0.001 ^{a}
	L.S.L	20	1.081 ± 0.001 ^{b}	1.096 ± 0.001 ^{a}
	L.B	20	1.087 ± 0.001 ^{b}	1.090 ± 0.001 ^{b}
Total average		80	1.089 ± 0.001 ^{C}	1.095 ± 0.001 ^{B}
32 WK				
	Sinai	20	1.085 ± 0.001 ^{b}	1.093 ± 0.001 ^{ab}
	Norfa	20	1.084 ± 0.001 ^{b}	1.096 ± 0.001 ^{a}
	L.S.L	20	1.094 ± 0.001 ^{a}	1.098 ± 0.001 ^{a}
	L.B	20	1.080 ± 0.001 ^{b}	1.090 ± 0.001 ^{b}
Total average		80	1.086 ± 0.001 ^{D}	1.094 ± 0.001 ^{B}
42 WK				
	Sinai	20	1.097 ± 0.001 ^{a}	1.102 ± 0.001
	Norfa	20	1.093 ± 0.001 ^{ab}	1.103 ± 0.001
	L.S.L	20	1.088 ± 0.001 ^{bc}	1.103 ± 0.001
	L.B	20	1.085 ± 0.001 ^{c}	1.102 ± 0.001
Total average		80	1.091 ± 0.001 ^{BC}	1.102 ± 0.001 ^{A}
52 WK				
	Sinai	20	1.095 ± 0.001 ^{ab}	1.103 ± 0.001 ^{ab}
	Norfa	20	1.097 ± 0.001 ^{a}	1.104 ± 0.001 ^{a}
	L.S.L	20	1.090 ± 0.001 ^{b}	1.103 ± 0.001 ^{ab}
	L.B	20	1.089 ± 0.001 ^{b}	1.102 ± 0.001 $_{b}$
Total average		80	1.093 ± 0.001 ^{B}	1.103 ± 0.001 $_{A}$
62 WK				
	Sinai	20	1.098 ± 0.001	1.102 ± 0.001
	Norfa	20	1.099 ± 0.001	1.102 ± 0.001
	L.S.L	20	1.098 ± 0.001	1.102 ± 0.001
	L.B	20	1.099 ± 0.001	1.102 ± 0.001
Total average		80	1.098 ± 0.001 ^{A}	1.102 ± 0.001 ^{A}

*** a,b,c = Means have the same superscript in each strain are not differ significantly at P ≤ 0.05**

*** A,B,C,D = Means have the same superscript in each layer age are not differ significantly at P ≤ 0.05**

values of specific gravity than those of local strains. The values of egg specific gravity at sexual maturity were 1.093 vs. 1.098, 1.096 vs. 1.096, 1.081 vs. 1.096 and 1.087 vs. 1.090 g / cm^3 for Sinai, Norfa, L.S.L and L.B in the first and second years of laying, respectively. (Table 3).

There were highly significant (P ≤ 0.01) differences among age of hen (A), strains (S) and between years of laying and the interactions between (A x S), (A x Y), (S x Y) and (A x S x Y). The present results are in agreement with the results reported by Nordstrom and Ousterhout (1982) and Izat *et al.* (1985). They reported that age of hen was significantly affected egg specific gravity values. While, Premavalli and Viswanathan (2004) noticed that egg specific gravity was decreased significantly with advancing age of layer. Similar results were reported by Radwan (2007) who attributed this to shell strength decreased which caused with increasing age.

In addition, Pandey *et al.* (1989) found that specific gravity in 6 strains from White Leghorn were ranged from 1.093 to 1.097 and the differences among strains were significant. Also, El-Sharkawy (1991) observed that commercial strains, Hisex and L.S.L had significantly lower values of specific gravity (1.089 and 1.086, respectively) than that of Matrouh and Fayoumi eggs (1.099 and 1.100, respectively). But, Essa (2005) concluded that the mean values for specific gravity ranged from 1.082 for the Lohman White strain to 1.084 g / cm^3 for the Lohman Brown strain, and eggs from Brown strains were higher in specific gravity.

4. Egg volume (E.V.) :

It was observed that age of hen had a significantly affect on egg volume (Table 4). Egg volume was increased significantly with increasing age of hen. The mean values of egg volume were 40.23 vs. 41.58, 43.56 vs. 44.79, 51.30 vs. 48.29, 52.30 vs. 48.48 and 53.13 vs. 50.32 (cm^3) at sexual maturity, 32, 42, 52 and 62 weeks of age in the first and second years of laying, respectively.

In addition, the foreign commercial strains, L.S.L and L.B, had significantly higher values of egg volume than the local strains, Sinai and Norfa, at all ages of hen and in both years of lyaing (Table 4). The values of egg volume recorded were 35.03 vs. 38.56, 35.72 vs. 36.78, 45.17 vs. 43.64 and 44.99 vs. 47.35 cm^3 at sexual maturity for Sinai, Norfa, L.S.L and L.B strains in the first and second year of laying.

The statistical differences for egg volume were highly significant (P ≤ 0.01) among ages of layer, strains and between years of laying and the interactions between (A x S), (A x Y) and (S x Y). While, the interaction differences between (A x S xY) was significant (P ≤ 0.05). These results are similar to the results reported by Essa (2007) and Radwan (2007). Who concluded that egg volume increased with advancing age of hen, which is due to the increase of egg weight. On the other hand, Essa (2005) reported that there is not significant difference between two strains of Lohman (Brown and White) for egg volume. While, Radwan (2007) concluded that Fayoumi breed was highly significant increased egg volume trait compared to Dandarawi breed (40.13 vs. 38.80 cm^3).

Table (4) : Effect of layer age, strain and year of laying on egg volume trait (means ± S.E)

Age (WK)	Strain	No. of eggs	Means ± S.E (cm^3)*	
			1st year	2nd year
S.M.				
	Sinai	20	35.03 ± 0.84 ^{b}	38.56 ± 0.84 ^{c}
	Norfa	20	35.72 ± 0.84 ^{b}	36.78 ± 0.84 ^{c}
	L.S.L	20	45.17 ± 0.84 ^{a}	43.64 ± 0.84 ^{b}
	L.B	20	44.99 ± 0.84 ^{a}	47.35 ± 0.84 ^{a}
Total average		80	40.23 ± 0.42 ^{D}	41.58 ± 0.42 ^{D}
32 WK				
	Sinai	20	38.50 ± 0.84 ^{c}	41.20± 0.84 ^{b}
	Norfa	20	38.44 ± 0.84 ^{c}	39.13 ± 0.84 ^{b}
	L.S.L	20	46.10 ± 0.84 ^{b}	48.45 ± 0.84 ^{a}
	L.B	20	51.19 ± 0.84 ^{a}	50.38 ± 0.84 ^{a}
Total average		80	43.56 ± 0.42 ^{C}	44.79 ± 0.42 ^{C}
42 WK				
	Sinai	20	45.06 ± 0.84 ^{c}	42.99 ± 0.84 ^{c}
	Norfa	20	45.52 ± 0.84 ^{c}	44.42 ± 0.84 ^{c}
	L.S.L	20	55.40 ± 0.84 ^{b}	50.94 ± 0.84 ^{b}
	L.B	20	59.20 ± 0.84 ^{a}	54.81 ± 0.84 ^{a}
Total average		80	51.30 ± 0.42 ^{B}	48.29 ± 0.42 ^{B}
52 WK				
	Sinai	20	46.26 ± 0.84 ^{c}	43.66 ± 0.84 ^{b}
	Norfa	20	45.87 ± 0.84 ^{c}	43.54 ± 0.84 ^{b}
	L.S.L	20	55.27 ± 0.84 ^{b}	52.58 ± 0.84 ^{a}
	L.B	20	61.82 ± 0.84 ^{a}	54.12 ± 0.84 ^{a}
Total average		80	52.30 ± 0.42 ^{AB}	48.48 ± 0.42 ^{B}
62 WK				
	Sinai	20	45.57 ± 0.84 ^{b}	43.67 ± 0.84 ^{b}
	Norfa	20	47.30 ± 0.84 ^{b}	45.46 ± 0.84 ^{b}
	L.S.L	20	58.36 ± 0.84 ^{a}	55.71 ± 0.84 ^{a}
	L.B	20	61.28 ± 0.84 ^{a}	56.42 ± 0.84 ^{a}
Total average		80	53.13 ± 0.42 ^{A}	50.32 ± 0.42 ^{A}

*** a,b,c = Means have the same superscript in each strain are not differ significantly at P ≤ 0.05**

*** A,B,C,D = Means have the same superscript in each layer age are not differ significantly at P ≤ 0.05**

5. Egg surface area (E.S.A) :

Age of layer had a greater effect on the egg surface area. It was found that egg surface area (Table 5) was increased significantly with increasing age of layer, which is due to the increase of egg weight. The average values of egg surface area were 56.47 vs. 57.88, 59.74 vs. 60.83, 66.53 vs. 63.90, 67.42 vs. 63.63 and 68.04 vs. 65.70 at sexual maturity, 32, 42, 52, and 62 weeks of age in the first and second years of laying, respectively. On the other hand, egg surface area was significantly affected by the strains of chickens (Table 5). It was observed that the local strains had lower egg surface area as compared to the foreign commercial strains. The values of egg surface area were 51.53 vs. 55.01, 52.24 vs. 53.48, 61.25 vs. 59.86 and 60.88 vs. 63.18 (cm^2) at sexual maturity in the first and second year of laying for Sinai, Norfa, L.S.L and L.B strains, respectively.

There were highly significant ($P \leq 0.01$) differences among ages of layers (A), strains of chickens (S) and between years of laying (Y). Also, highly significant differences were observed with respect to the interactions between (A x S) and (S x Y). In addition, significant difference was found with respect to the interaction (A x S x Y), while, insignificant difference was found with respect to the interaction (A x Y). The present results are in good agreement with the findings reported by Pandey *et al.* (1989) and Mohan *et al.* (1992), attributed that to increase egg weight. Also, the present results are in harmony with the the results reported by Pandey *et al.* (1989) and Anderson *et al.* (2004). They found significant differences among strains of chickens in egg surface area. In addition Alos, Zaky (2006) found that White Leghorn had significantly increase surface of eggshell area as compared to Fayoumi strain.

Table (5) : Effect of layer age, strain and year of laying on egg surface area trait (means ± S.E)

Age (WK)	Strain	No. of eggs	Means ± S.E (cm^2)*	
			1st year	2nd year
S.M.				
	Sinai	20	51.53 ± 0.74 b	55.01 ± 0.74 c
	Norfa	20	52.24 ± 0.74 b	53.48 ± 0.74 c
	L.S.L	20	61.25 ± 0.74 a	59.86 ± 0.74 b
	L.B	20	60.88 ± 0.74 a	63.18 ± 0.74 a
Total average		80	56.47 ± 0.37 D	57.88 ± 0.37 D
32 WK				
	Sinai	20	55.12 ± 0.74 c	57.49 ± 0.74 b
	Norfa	20	55.17 ± 0.74 c	55.66 ± 0.74 b
	L.S.L	20	62.22 ± 0.74 b	64.35 ± 0.74 a
	L.B	20	66.45 ± 0.74 a	65.845 ± 0.74 a
Total average		80	59.74 ± 0.37 C	60.83 ± 0.37 C
42 WK				
	Sinai	20	61.08 ± 0.74 b	59.20 ± 0.74 c
	Norfa	20	61.57 ± 0.74 b	60.47 ± 0.74 c
	L.S.L	20	70.24 ± 0.74 a	66.38 ± 0.74 b
	L.B	20	73.21 ± 0.74 a	69.54 ± 0.74 a
Total average		80	66.53 ± 0.37 B	63.90 ± 0.37 B
52 WK				
	Sinai	20	62.26 ± 0.74 c	58.04 ± 0.74 b
	Norfa	20	61.90 ± 0.74 c	59.72 ± 0.74 b
	L.S.L	20	70.15 ± 0.74 b	67.82 ± 0.74 a
	L.B	20	75.38 ± 0.74 a	68.94 ± 0.74 a
Total average		80	67.42 ± 0.37 AB	63.63 ± 0.37 B
62 WK				
	Sinai	20	61.59 ± 0.74 b	59.87 ± 0.74 b
	Norfa	20	63.02 ± 0.74 b	61.47 ± 0.74 b
	L.S.L	20	72.63 ± 0.74 a	70.54 ± 0.74 a
	L.B	20	74.92 ± 0.74 a	70.94 ± 0.74 a
Total average		80	68.04 ± 0.37 A	65.70 ± 0.37 A

*** a,b,c = Means have the same superscript in each strain are not differ significantly at P ≤ 0.05**

*** A,B,C,D = Means have the samesuper script in each layer age are not differ significantly at P ≤ 0.05**

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تأثير التداخل بين عمر الدجاج البياض ، سلالة الدجاج البياض ، وسنة الوضع علي صفات جودة البيضة الخارجية

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الملخص العربي

أجريت هذه الدراسة لمقارنة صفات جودة البيضة في سلالتين من الدجاج المحلي المحسن (سيناء ونورفا) مع سلالتين من الدجاج التجاري الأجنبي (لوهمان المنتخب الأبيض ، ولوهمان البني) عند عمر النضج الجنسي٣٢ ، ٤٢ ، ٥٢ ، ٦٢ أسبوع من العمر لمدة سنتين متتاليتين. ويمكن تلخيص النتائج كما يلي :

١ – مقارنة السلالات المحلية مع الأجنبية : وجد أن السلالات الأجنبية (لوهمان الأبيض ولوهمان البني) حققت قيم معنوية عالية ($P \leq 0.01$) في وزن البيضة ، دليل شكل البيضة ، حجم البيضة ، مساحة سطح البيضة ، وانخفاض قيم الكثافة النوعية بمقارنتها بالسلالات المحلية (سيناء ونورفا) .

٢ – تأثير عمر الدجاج البياض : وجد أن كل من وزن البيضة ، حجم البيضة ، مساحة سطح البيضة ، تزداد بزيادة عمر الدجاج البياض بالمقارنة بدليل شكل البيضة الذي يقل بزيادة عمر الدجاج .

٣ – تأثير التداخل : كانت تأثيرات التداخل بين العمر والسلالة ، العمر وسنة الوضع ، السلالة وسنة الوضع أو بين العمر والسلالة وسنة الوضع معنوية ($P \leq 0.05$) أو عالية المعنوية ($P \leq 0.01$) في معظم صفات جودة البيضة الخارجية التي درست .

٤ – الخلاصة : ربما يرجع التباين في صفات جودة البيضة الخارجية أساسا إلى زيادة وزن البيضة بزيادة العمر .

ربما يكون أكثر استفادة للمنتجين والمصانع إستخدام الدجاج الصغير السن (٣٢ – ٤٢ أسبوع) في إنتاج بيض المائدة والطيور الأكبر في العمر (٥٢ أسبوع أو أكثر) في إنتاج البيض السائل . أيضا تحتاج السلالات المحلية لمجهود أكثر لتحسين صفات جودة البيض الخارجية وخاصة وزن البيضة .