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**IMPACT OF STRAIN, EGG TYPE, BREEDER AGE AND THEIR INTERACTIONS ON HATCHING TRAITS AND CHICK QUALITY**

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**ABSTRACT:** Eight hundred hatching eggs from two Hy-Line chicken strains (400 Brown and 400 W-36) were acquired from two layer breeder ages (46 and 60 weeks). In each age there are four egg types (normal, large, rough and shape abnormality), each type containing fifty hatching eggs from each age either for Brown or W-36 chicken strains. Thus, this experiment was a 2×2×4 factorial design. There were no significant differences between strains for relative egg weight loss. Egg weight loss (%) increases with the breeder age. Relative egg weight loss was significantly higher in rough and abnormal eggs compared to their counterparts. Rough eggs type of brown strain at different breeder age had the lowest fertility and hatchability percentages compared to other egg types. Abnormal shape egg type had the lowest value of shape index. Brown chickens produced eggs had significantly higher relative eggshell weight compared to the white one. Shell percentage significantly decreases with advancing of hen's age. White eggs significantly recorded higher total pores per egg (7583) compared to the brown one (7249). Total pores significantly increases with breeder age. Large egg type was significantly higher in total pores compared to other egg types. Eggs with rough shell type had the highest embryonic mortality percentage in early stage (0-7 d of incubation) for each brown and W-36 strains at different ages, followed by eggs with shape abnormality compared to other egg types. Large egg type was significantly higher in hatched chick weight (46.85 g), then shape abnormality (41.12 g). There were no significant differences between strains for Tona score as indication of chick quality. Tona score decreased as the layer breeder age progressed. Rough egg type had the lowest value of Tona score (78.25 %); whereas, no significant difference was observed between other studied egg types (normal; 99.80, large; 95.65, and abnormal; 95.25 %). Tona score was significantly affected by all potential interactions, that means the expression of this trait was different based on strain, layer breeder age and egg type. It could be concluded that practically we can benefit from large and shape abnormality eggs, because there is no significant difference between them and normal eggs for most eggshell characteristics, chick quality and fertility & hatchability percentages.

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**Keywords:** Strain - Egg type - Breeder age - Chick quality - Hatching traits.

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## **INTRODUCTION**

In hatcheries, the main target is to maximize hatchability with a lot of high chick quality, saleable chicks that are demand by producers for their high performance and viability (Decuypere and Bruggeman, 2007). Study of factors that effect the production of high quality chicks is of great attention to hatching egg producers because they are paid based on the number of salable chicks produced (not hatched). Quality of hatching eggs is very important because eggs provide both physical protection and nutrition for the growing embryo. Shell quality (pores number and shell thickness) determines gas exchange and humidity loss during incubation. Poor eggshell quality has been related with a higher percentage of egg moisture loss during incubation (Peebles et al., 2001), low hatchability (Narushin and Romanov, 2002). Also, breeder age may effect on hatching quality. Lourens et al. (2006) reported that chicks hatched from large eggs have higher body weight also develop faster because of the higher availability of nutrients existing in the egg compared with those from small eggs. Hamidu et al. (2007) reported that young breeders lay eggs with thicker eggshell than those of older breeders, and therefore, less oxygen is supplied to the embryos, which may clarify their slower metabolism and development. Some reasons for low hatchability could be due to unsuitable management of the breeder flock, or failure within any step between breeder flock and final hatch i.e embryonic mortality. Therefore, optimizing of hatchery and breeder management can lead

to improve chick's production (Heier and Jarp, 2001). Factors concerning breeder that affect hatchability include strain, breeder age, size of egg, egg quality and duration of egg storage (Wilson, 1997; Tona et al., 2005). Chick quality at hatch dependent on many factors including age of breeder, strain, quality of hatching eggs, chick health, egg handling and storage (Peebles et al., 2001; Tona et al., 2003; Decuypere and Bruggeman, 2007). Tona et al. (2001) reported that age of breeders (layer and broiler) is an important to be considered by the hatchery managers. Also, they stated that eggs produced from young or older breeder don't hatch like the eggs from the breeders of 40 to 42 weeks of age. Therefore, the main objective of this research was to study the impacts of strain, egg type, breeder age and their interactions on hatching traits and chick quality.

## **MATERIALS AND METHODS**

This experiment was carried out at the hatchery of EL-Mansouria Poultry Misr Company situated at EL-Mansouria area – October Governorate. Eight hundred hatching eggs from two Hy-Line strains (400 Brown and 400 W-36) were acquired from two layer breeder ages (46 and 60 weeks). Eggs were stored for 3-7 days at 15°C and 80% relative humidity until incubation. After delivering the eggs to the hatchery, eggs were checked and sorted. In each age there are four egg types (normal, large, rough and shape abnormality), each type containing fifty hatching eggs from each age either for Brown and W-36. Thus, this experiment was a 2×2×4 factorial design, with 2 strains, 2 ages and 4 egg types. Eggs incubated in Petersime

### **Strain - Egg type - Breeder age - Chick quality - Hatching traits.**

incubator at 37° C and 65% relative humidity.

#### **Egg weight & Egg weight loss**

Before incubation, eggs from each type from the two ages within each chicken strain were individually weighed to the nearest 0.01 g using an electronic digital balance, before setting in the incubator and again at 18<sup>th</sup> day of incubation to calculate egg weight loss. Percentage of egg weight loss during incubation period (0-18 days) was calculated as follow:

Egg weight loss (%) = Egg wt. at the beginning of incubation – Egg wt. at 18 days of incubation / Egg wt. at the beginning of incubation x100

#### **Fertility & Hatchability (%)**

Eggs were candled at 7<sup>th</sup> day of incubation. Fertility (%) was calculated by dividing number of fertile eggs on number of settable eggs x 100. While, hatchability (%) was calculated by dividing number of hatched chicks on number of fertile eggs x 100.

#### **Egg and eggshell traits**

Egg length and width were individually recorded by a digital caliper. Then, shape index = (width / length) x100.

Wet shell weight (to the nearest 0.01 g) was measured after hatching.

Shell percentage = (wet eggshell weight / egg weight) x100.

Number of pores in eggshell was calculated depending on Rahn and Paganelli (1990) equation:

Pores number (N) = 304 M<sup>0.767</sup>

Where: M = Egg weight.

Eggshell surface area (SA) was calculated using the following equation according to Fathi and El-Sahar (1996):

SA = 9.07 (Egg length x Breadth)<sup>0.63</sup>

Shell index (g/100 cm<sup>2</sup>) was calculated depending on equation of Sauveur (1988):

SI = [Shell weight / shell surface area] x 100

#### **Stages of embryonic mortality**

After hatching, all unhatched eggs were opened to determine embryonic mortality stage as can as possible: early (1 to 7 d), mid (8 to 14 d) and late (15 to 21 d).

#### **Chick quality**

After hatching, all chicks were removed at 21.5 days of incubation and the chick quality tests were determined to measure the quantitative and qualitative score factors of chicks.

One-day chicks were individually weighed. Chicks were examined to identify the various traits that can be related to good, medium or poor quality chicks depending on varying physical appearances of day-old chicks. Chick quality was determined according to Tona et al. (2003).

#### **Statistical analysis:**

Data were analyzed using three-way analysis of variance for strain, layer breeder age, egg type and their interaction using the General Linear Model (GLM) procedure of SAS (2002) as following model;

$Y_{ijkl} = \mu + S_i + A_j + T_k + (S*A)_{ij} + (S*T)_{ik} + (A*T)_{jk} + (S*A*T)_{ijk} + e_{ijkl}$

Where;

$Y_{ijkl}$  = Trait measured,

$\mu$  = Overall means,

$S_i$  = Strain effect (i= 1, 2),

$A_j$  = layer breeder age effect (j= 1, 2),

$T_k$  = Egg type effect (k= 1, 2, 3, 4),

$(S*A)_{ij}$  =Interaction between Strain and Age,

$(S*T)_{ik}$  =Interaction between Strain and

## G. N. Rayan

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Egg type,

$(A*T)_{jk}$  =Interaction between Age and Egg type,

$(S*A*T)_{ijk}$  =Interaction between Strain, Age and Egg type,

$e_{ijkl}$  =Experimental error.

When significant differences between means were found, means were separated using Duncan's multiple range tests.

### RESULTS AND DISCUSSION

#### Egg weight & egg weight loss

Egg weights at 0 and 18 days of incubation as affected by strain, egg type, breeder age and their interactions are showed in Tables (1 and 2). Egg weight was significantly affected by strain, the white layer hens produced significantly heavier egg weight compared to the brown one. The previous results extended also egg weight either at 0 or 18 days of incubation period. Egg weight at 0 day of incubation significantly increased as the layers age progressed. The same trend was noticed by Rizzi and Chiericato (2005); Johnston and Gous (2007) and Rayan (2013) they pointed that the egg weight increased with the hens' age.

Egg weight at 0 and 18 days of incubation was significantly heaviest in large egg type (73 and 64.86 g, respectively) and the lowest value in rough egg type (60.10 and 52.60 g, respectively) (Table 1). Regarding interaction effect, egg weight at 0 day of incubation was significantly affected by interaction between strain and egg type only.

Data of Table (3) indicated that there were no significant differences between strains for relative egg weight loss. Weight loss (%) was significantly affected by breeder

age. The relative egg weight loss increases with advancing of breeder age. Khabisi et al. (2012) reported that egg weight loss during incubation was increased with breeder age.

Egg weight loss (%) was significantly higher in rough and shape abnormal eggs compared to their counterparts. The minimum percentage of weight loss was recorded in normal eggs (10.72 %). All potential interactions significantly affected weight loss (%), except those between strain and breeder age (S\*A).

#### Fertility & hatchability percentages

Fertility and hatchability (%) for different egg types, strain and layer breeder ages are summarized in Table (4). The normal, Large and shape abnormality eggs of brown strain had better fertility percentage (92 %); while, rough eggs of brown strain at 46 and 60 wks of breeder age had the lowest fertility percentage (74 and 54 %, respectively). Hatchability percentage of fertile eggs for rough eggs of each brown or white strains was the lowest in comparison with chicks from other egg types at different breeder ages. Hatchability percentage decreases with advancing of breeder age for chicks hatched from all studied egg types, the same trend was observed by Abudabos (2010), who stated that hen's age affected hatchability and there was reduction of hatchability with advance age.

#### Egg and eggshell traits

Data of Table (5) indicated that W-36 layer hens produced eggs with significantly higher shape index compared to the brown one. The present results revealed that there was a significant decrease in shape index

### **Strain - Egg type - Breeder age - Chick quality - Hatching traits.**

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with advanced of breeder age. Same trend of egg shape index decrease was reported by Gunlu et al. (2003) and Brand et al. (2004), who pointed that shape index of eggs decreased with age because shape index is directly proportional to egg width and it is inversely related to egg length, which implies that with increasing age, the rate at which eggs becomes longer is faster than rate of being wider. Large egg type was significantly the highest in shape index (79.88 %); conversely, shape abnormal egg type had the lowest value of shape index compared to other egg types. All potential interactions significantly affected shape index.

Brown strain produced eggs with higher ( $P \leq 0.05$ ) shell percentage compared to the white one (Table 6). Similar trend was reported by Scott and Silversides (2000), Renema et al. (2001). Shell percentage significantly decreases with hen's age. Silversides and Scott (2001), Rayan (2013) noticed that shell percentage decreases gradually with hen's ages. Shell percentage was significantly affected by interaction between strain  $\times$  egg type (S\*T) and age  $\times$  egg type (A\*T).

Data of Table (7) showed that total pores per egg was significantly affected by strain, whereas white eggs recorded significantly higher total pores per egg (7583) compared to the brown one (7249). Total pores significantly increase with breeder age. The increasing in pores number related to advancing of age could be attributed to weight and volume of egg dramatically increased with age. Large egg type was significantly higher in total pores (8165) compared to other egg types. Total pores

was significantly affected by interaction between strain  $\times$  egg type (S\*T) only.

Tables (8 and 9) clarify that white eggs significantly recorded higher eggshell surface area compared to the brown one. Shell area increased as age increased. Large egg type was significantly higher in eggshell area compared to other egg types.

Concerning shell index, brown eggs significantly recorded higher shell index compared to the white one. Eggshell index significantly decreases as age increased. This result agrees with those of Rayan et al. (2010). Large and normal egg types were significantly higher in shell index (8.61 and 8.51, respectively); while, rough egg type had the lowest value (8.07) compared to other egg types.

#### **Stages of embryonic mortality**

Data of Table (10) clarify percentages of embryonic mortality stages for different egg types, strain and layer breeder ages. Generally, embryonic mortality had varied between different layer breeder's age. Fairchild et al. (2002) observed the same trend. Kuurman et al. (2003) reported that embryonic mortality in chicken is not uniformly distributed during the incubation period, almost 65% of embryonic mortality take place in two stages: early (at 4 days), and a late phase (at 19 days) of incubation. Egg with rough shell type was the highest of embryonic mortality percentage in early stage (0-7 d of incubation) for each brown and W-36 strains (35.1, 29.5, 55.6 and 29.3, respectively) at 46 and 60 wks of age. compared to other egg types; followed by eggs with shape abnormality.

## **G. N. Rayan**

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### **Chick quality**

Day-old chick weights as affected by strain, egg type, breeder age and their interactions are presented in Table (11). Chicks of W-36 strain significantly recorded higher body weight compared to the brown one. The heavier chick weight associated with white breeder hens could be attributed to that white breeder hens significantly produced heavier egg weight compared to the brown one. While, Silversides and Scott (2001) and Tona et al. (2002) clarified that egg weight is a dominant factor affecting chick weight at hatch. Chick weight did not significantly affect by age. This result in agreement with those reported by Khabisi et al. (2012) who mentioned that large egg type was significantly higher in chick weight (46.85 g), followed by abnormal eggs (41.12 g) compared to other egg types. All potential interactions significantly affected chick weight, except interaction between S\*A.

Data of Table (12) clarifies Tona score as affected by strain, egg type, breeder age, and their interactions. There were no significant differences between strains for Tona score as indication of chick quality. Tona score decreased as the layer breeder age progressed.

Rough egg type had the lowest value of Tona score (78.25 %); whereas, there were no significant differences between other studied egg types ((normal (99.80), large (95.65), and abnormal (95.25)).

Tona score was significantly affected by all potential interactions, that means the expression of this trait was different based on strain, layer breeder age and egg type.

### **FINALLY,**

It could be concluded that practically we can benefit from large and shape abnormality eggs, because there is no significant difference between them and normal eggs for most eggshell characteristics, chick quality and fertility & hatchability percentages. Conversely, rough eggshell type.

**Table (1):** Egg weight at zero day of incubation as affected by strain, egg type, breeder age and their interactions (Mean ±SE).

Strain (S)	Age (A)	Egg type (T)				Overall	Prob.						
		Normal	Large	Rough	Shape abnormal		Strain (S)	Age (A)	Egg type (T)	S*A	S*T	A*T	S*A*T
Egg weight at 0 day of incubation													
Brown	46	59.43 ±0.52	71.67 ±0.39	56.87 ±0.82	59.27 ±0.87	62.66	0.0001	0.001	0.0001	NS	0.001	NS	NS
	60	62.07 ±0.55	71.88 ±0.39	58.45 ±0.83	61.13 ±0.99	64.13							
	Overall	60.75	71.78	57.66	60.20								
W-36	46	62.83 ±0.50	73.15 ±0.45	62.21 ±0.93	65.77 ±1.02	65.99							
	60	63.40 ±0.60	75.30 ±0.43	62.86 ±0.77	65.35 ±0.97	66.73							
	Overall	63.12	74.23	62.54	65.56								
Overall	Strain				Breeder age, (wk)				Egg type				
	Brown	W-36			46	60			Normal	Large	Rough	abnormal	
	62.60 <sup>b</sup>	66.36 <sup>a</sup>			63.90 <sup>b</sup>	65.06 <sup>a</sup>			61.93 <sup>b</sup>	73.00 <sup>a</sup>	60.10 <sup>c</sup>	62.88 <sup>b</sup>	

<sup>a</sup> and <sup>b</sup> Means within the same main effects with different letters are significantly differed, NS= Non-significant.

**Table (2):** Egg weight at 18 days of incubation as affected by strain, egg type, breeder age and their interactions (Mean  $\pm$ SE).

Strain (S)	Age (A)	Egg type (T)				Overall	Prob.						
		Normal	Large	Rough	Shape abnormal		Strain (S)	Age (A)	Egg type (T)	S*A	S*T	A*T	S*A*T
Egg weight at 18 days of incubation													
Brown	46	55.45 $\pm 0.53$	66.47 $\pm 0.54$	50.85 $\pm 0.93$	51.04 $\pm 1.03$	55.95	0.0001	NS	0.0001	0.01	0.0001	NS	0.0001
	60	54.37 $\pm 0.68$	62.58 $\pm 0.65$	49.42 $\pm 1.03$	52.73 $\pm 1.42$	54.78							
	Overall	54.91	64.53	50.14	51.89								
W-36	46	55.67 $\pm 0.55$	65.59 $\pm 0.55$	56.85 $\pm 1.09$	61.07 $\pm 1.09$	59.80							
	60	55.53 $\pm 0.65$	64.88 $\pm 0.68$	51.82 $\pm 1.00$	53.57 $\pm 1.09$	56.45							
	Overall	55.60	65.24	54.34	57.32								
Overall	Strain				Breeder age, (wk)				Egg type				
	Brown	W-36			46	60			Normal	Large	Rough	abnormal	
	55.93 <sup>b</sup>	58.23 <sup>a</sup>			57.99	56.18			55.27 <sup>b</sup>	64.86 <sup>a</sup>	52.60 <sup>c</sup>	54.72 <sup>b</sup>	

<sup>a</sup> and <sup>b</sup> Means within the same main effects with different letters are significantly differed, NS= Non-significant.



**Table (3):** Relative egg weight loss (0-18 days) as affected by strain, egg type, breeder age and their interactions (Mean  $\pm$ SE).

Strain (S)	Age (A)	Egg type (T)				Overall	Prob.						
		Normal	Large	Rough	Shape abnormal		Strain (S)	Age (A)	Egg type (T)	S*A	S*T	A*T	S*A*T
Egg weight loss (%)													
Brown	46	6.27 $\pm 0.38$	7.28 $\pm 0.47$	11.61 $\pm 1.04$	13.93 $\pm 1.21$	9.77	NS	0.0001	0.0001	NS	0.0001	0.01	0.0001
	60	12.90 $\pm 0.68$	12.84 $\pm 0.73$	17.57 $\pm 1.14$	15.01 $\pm 1.22$	14.58							
	Overall	9.59	10.06	14.59	14.47								
W-36	46	11.39 $\pm 0.29$	10.32 $\pm 0.26$	9.52 $\pm 0.79$	7.23 $\pm 0.62$	9.62							
	60	12.28 $\pm 0.52$	13.89 $\pm 0.74$	18.34 $\pm 0.98$	18.01 $\pm 0.62$	15.63							
	Overall	11.84	12.11	13.93	12.62								
Overall	Strain				Breeder age, (wk)				Egg type				
	Brown	W-36			46	60			Normal	Large	Rough	abnormal	
	11.79	12.48			9.66 <sup>b</sup>	14.84 <sup>a</sup>			10.72 <sup>b</sup>	11.10 <sup>b</sup>	13.96 <sup>a</sup>	13.31 <sup>a</sup>	

<sup>a</sup> and <sup>b</sup> Means within the same main effects with different letters are significantly differed, NS= Non-significant.

**Table (4):** Fertility and hatchability percentages for different egg types, strains and layer breeder ages.

Egg type	Strain	46 wks		60 wks	
		Fertility (%)	Hatchability (%)	Fertility (%)	Hatchability (%)
Normal eggs	Brown	92	87	90	80
	W-36	98	91.8	96	81.3
Large eggs	Brown	92	60.9	94	48.9
	W-36	88	50	92	43.5
Rough shell	Brown	74	32.4	54	14.8
	W-36	88	36.4	82	24.4
Shape abnormality	Brown	92	54.3	72	41.7
	W-36	90	62.2	78	33.3

Fertility and hatchability percentages calculated from fertile eggs.

**Table (5):** Egg shape index as affected by strain, egg type, breeder age and their interactions (Mean ±SE).

Strain (S)	Age (A)	Egg type (T)				Overall	Prob.						
		Normal	Large	Rough	Shape abnormal		Strain (S)	Age (A)	Egg type (T)	S*A	S*T	A*T	S*A*T
Egg shape index (%)													
Brown	46	79.92 ±0.29	82.32 ±0.35	79.11 ±0.39	79.52 ±0.58	80.22	0.001	0.0001	0.0001	0.001	0.0001	0.001	0.05
	60	78.01 ±0.36	78.75 ±0.50	76.52 ±0.37	73.67 ±0.55	76.74							
	Overall	78.97	80.54	77.82	76.60								
W-36	46	79.30 ±0.27	80.46 ±0.38	81.00 ±0.42	80.49 ±0.51	80.31							
	60	77.64 ±0.40	77.99 ±0.46	78.83 ±0.48	78.10 ±0.79	78.14							
	Overall	78.47	79.23	79.92	79.30								
Overall	Strain				Breeder age, (wk)				Egg type				
	Brown	W-36			46	60			Normal	Large	Rough	abnormal	
	78.48 <sup>b</sup>	79.23 <sup>a</sup>			80.26 <sup>a</sup>	77.44 <sup>b</sup>			78.72 <sup>b</sup>	79.88 <sup>a</sup>	78.87 <sup>b</sup>	77.94 <sup>c</sup>	

<sup>a</sup> and <sup>b</sup> Means within the same main effects with different letters are significantly differed, NS= Non-significant.

**Table (6):** Shell percentage as affected by strain, egg type, breeder age and their interactions (Mean  $\pm$ SE).

Strain (S)	Age (A)	Egg type (T)				Overall	Prob.						
		Normal	Large	Rough	Shape abnormal		Strain (S)	Age (A)	Egg type (T)	S*A	S*T	A*T	S*A*T
Shell percentage													
Brown	46	10.51 $\pm$ 0.18	9.41 $\pm$ 0.17	10.17 $\pm$ 0.35	9.61 $\pm$ 0.30	9.92	0.0001	0.0003	0.0001	NS	0.05	0.0003	NS
	60	9.82 $\pm$ 0.19	8.57 $\pm$ 0.30	9.10 $\pm$ 0.99	10.92 $\pm$ 0.28	9.60							
	Overall	10.16	8.99	9.63	10.26								
W-36	46	9.51 $\pm$ 0.16	8.99 $\pm$ 0.21	9.08 $\pm$ 0.26	8.78 $\pm$ 0.28	9.09							
	60	8.33 $\pm$ 0.21	7.90 $\pm$ 0.29	8.36 $\pm$ 0.48	8.54 $\pm$ 0.47	8.28							
	Overall	8.92	8.44	8.72	8.66								
Overall	Strain				Breeder age, (wk)				Egg type				
	Brown	W-36			46	60			Normal	Large	Rough	Shape abnormal	
	9.84 <sup>a</sup>	8.81 <sup>b</sup>			9.56 <sup>a</sup>	8.95 <sup>b</sup>			9.58 <sup>a</sup>	8.80 <sup>b</sup>	9.22 <sup>a</sup>	9.39 <sup>a</sup>	

<sup>a</sup> and <sup>b</sup> Means within the same main effects with different letters are significantly differed, NS= Non-significant.

**Table (7):** Total pores per egg as affected by strain, egg type, breeder age and their interactions (Mean  $\pm$ SE).

Strain (S)	Age (A)	Egg type (T)				Overall	Prob.						
		Normal	Large	Rough	Shape abnormal		Strain (S)	Age (A)	Egg type (T)	S*A	S*T	A*T	S*A*T
Total pores per egg													
Brown	46	6973 $\pm 46.4$	8051 $\pm 33.7$	6737 $\pm 74.7$	6954 $\pm 78.8$	7178	0.0001	0.001	0.0001	NS	0.002	NS	NS
	60	7209 $\pm 49.0$	8069 $\pm 33.9$	6880 $\pm 75.4$	7119 $\pm 88.3$	7319							
	Overall	7091	8060	6808	7036								
W-36	46	7277 $\pm 44.6$	8178 $\pm 38.8$	7217 $\pm 83.2$	7531 $\pm 91.4$	7550							
	60	7327 $\pm 53.4$	8362 $\pm 36.1$	7277 $\pm 67.8$	7494 $\pm 86.0$	7615							
	Overall	7302	8270	7247	7512								
Overall	Strain				Breeder age, (wk)				Egg type				
	Brown	W-36			46	60			Normal	Large	Rough	abnormal	
	7249 <sup>b</sup>	7583 <sup>a</sup>			7365 <sup>b</sup>	7467 <sup>a</sup>			7196 <sup>b</sup>	8165 <sup>a</sup>	7028 <sup>c</sup>	7274 <sup>b</sup>	

<sup>a</sup> and <sup>b</sup> Means within the same main effects with different letters are significantly differed, NS= Non-significant.

**Table (8):** Eggshell surface area as affected by strain, egg type, breeder age and their interactions (Mean  $\pm$ SE).

Strain (S)	Age (A)	Egg type (T)				Overall	Prob.						
		Normal	Large	Rough	Shape abnormal		Strain (S)	Age (A)	Egg type (T)	S*A	S*T	A*T	S*A*T
Eggshell surface area (mg/cm <sup>2</sup> )													
Brown	46	68.81 $\pm$ 0.24	74.62 $\pm$ 0.22	69.07 $\pm$ 0.33	68.95 $\pm$ 0.46	70.36	0.0001	0.02	0.0001	NS	0.01	NS	0.001
	60	68.79 $\pm$ 0.29	74.08 $\pm$ 0.25	69.05 $\pm$ 0.41	70.63 $\pm$ 0.48	70.64							
	Overall	68.8	74.35	69.06	69.79								
W-36	46	69.33 $\pm$ 0.27	74.25 $\pm$ 0.21	70.75 $\pm$ 0.42	72.09 $\pm$ 0.46	71.60							
	60	69.96 $\pm$ 0.32	75.89 $\pm$ 0.26	70.87 $\pm$ 0.35	71.95 $\pm$ 0.47	72.17							
	Overall	69.64	75.07	70.81	72.02								
Overall	Strain				Breeder age, (wk)				Egg type				
	Brown	W-36			46	60			Normal	Large	Rough	Shape abnormal	
	70.50 <sup>b</sup>	71.89 <sup>a</sup>			70.98 <sup>b</sup>	71.40 <sup>a</sup>			69.22 <sup>d</sup>	74.71 <sup>a</sup>	69.93 <sup>c</sup>	70.90 <sup>b</sup>	

<sup>a</sup> and <sup>b</sup> Means within the same main effects with different letters are significantly differed, NS= Non-significant.

**Table (9):** Shell index as affected by strain, egg type, breeder age and their interactions (Mean  $\pm$ SE).

Strain (S)	Age (A)	Egg type (T)				Overall	Prob.						
		Normal	Large	Rough	Shape abnormal		Strain (S)	Age (A)	Egg type (T)	S*A	S*T	A*T	S*A*T
Shell index (g/100 cm <sup>2</sup> )													
Brown	46	9.00 $\pm 0.16$	9.06 $\pm 0.16$	8.57 $\pm 0.29$	8.16 $\pm 0.25$	8.70	0.0001	0.002	0.05	0.01	NS	0.0001	0.05
	60	8.88 $\pm 0.16$	8.35 $\pm 0.31$	7.69 $\pm 0.95$	9.67 $\pm 0.21$	8.65							
	Overall	8.94	8.70	8.13	8.91								
W-36	46	8.56 $\pm 0.14$	8.91 $\pm 0.22$	8.09 $\pm 0.19$	8.06 $\pm 0.18$	8.40							
	60	7.48 $\pm 0.17$	7.81 $\pm 0.28$	7.58 $\pm 0.44$	7.71 $\pm 0.32$	7.64							
	Overall	8.02	8.36	7.83	7.88								
Overall	Strain				Breeder age, (wk)				Egg type				
	Brown	W-36			46	60			Normal	Large	Rough	Shape abnormal	
	8.79 <sup>a</sup>	8.11 <sup>b</sup>			8.60 <sup>a</sup>	8.21 <sup>b</sup>			8.51 <sup>a</sup>	8.61 <sup>a</sup>	8.07 <sup>b</sup>	8.32 <sup>ab</sup>	

<sup>a</sup> and <sup>b</sup> Means within the same main effects with different letters are significantly differed, NS= Non-significant.

**Table (10):** Percentages of embryonic mortality stages for different egg types, strain and layer breeder ages.

Egg type	Strain	Mortality stage							
		46 wks				60 wks			
		Early	Mid	Late	Pipped	Early	Mid	Late	Pipped
Normal eggs	Brown	2.2	6.5	2.2	2.2	2.2	6.7	8.9	0
	W-36	0	0	8.2	0	6.3	4.1	6.3	0
Large eggs	Brown	6.5	8.7	8.7	13	17	6.4	23.4	0
	W-36	13.6	11.4	15.9	9.1	15.2	10.9	19.6	2.2
Rough shell	Brown	35.1	13.5	13.5	0	55.6	18.5	11.1	0
	W-36	29.5	18.2	9.1	2.3	29.3	19.5	24.4	0
Shape abnormality	Brown	15.2	10.9	8.7	2.2	30.6	13.9	8.3	0
	W-36	11.1	8.9	11.1	2.2	28.2	17.9	7.7	2.6

Early stage (1 to 7 d), Mid stage (8 to 14 d), and Late stage (15 to 21 d).



**Table (11):** Day-old chick weight as affected by strain, egg type, breeder age and their interactions (Mean  $\pm$ SE).

Strain (S)	Age (A)	Egg type (T)				Overall	Prob.						
		Normal	Large	Rough	Shape abnormal		Strain (S)	Age (A)	Egg type (T)	S*A	S*T	A*T	S*A*T
Chick weight (g)													
Brown	46	37.83 $\pm 0.43$	46.66 $\pm 0.60$	37.72 $\pm 1.04$	35.19 $\pm 0.80$	39.35	0.0001	NS	0.0001	NS	0.0001	0.01	0.004
	60	38.62 $\pm 0.60$	44.14 $\pm 0.62$	34.59 $\pm 0.91$	39.80 $\pm 0.82$	39.29							
	Overall	38.22	45.40	36.15	37.49								
W-36	46	40.74 $\pm 0.54$	48.80 $\pm 0.55$	42.45 $\pm 1.48$	45.82 $\pm 0.96$	44.45							
	60	40.38 $\pm 0.48$	47.97 $\pm 0.70$	39.61 $\pm 0.94$	43.94 $\pm 1.55$	42.97							
	Overall	40.56	48.38	41.03	44.88								
Overall	Strain				Breeder age, (wk)				Egg type				
	Brown	W-36			46	60			Normal	Large	Rough	abnormal	
	39.84 <sup>b</sup>	43.43 <sup>a</sup>			41.79	41.51			39.43 <sup>c</sup>	46.85 <sup>a</sup>	39.67 <sup>c</sup>	41.12 <sup>b</sup>	

<sup>a</sup> and <sup>b</sup> Means within the same main effects with different letters are significantly differed, NS= Non-significant.

**Table (12):** Tona score as affected by strain, egg type, breeder age and their interactions (Mean  $\pm$ SE).

Strain (S)	Age (A)	Egg type (T)				Overall	Prob.						
		Normal	Large	Rough	Shape abnormal		Strain (S)	Age (A)	Egg type (T)	S*A	S*T	A*T	S*A*T
<b>Tona score (%)</b>													
Brown	46	100 $\pm 0.01$	99.2 $\pm 0.80$	96.8 $\pm 1.31$	97.4 $\pm 1.12$	98.35	NS	0.0001	0.0001	0.0003	0.0001	0.0001	0.0001
	60	100 $\pm 0.01$	98.8 $\pm 0.61$	34.6 $\pm 4.15$	97 $\pm 1.61$	82.60							
	Overall	100	99	65.7	97.2								
W-36	46	100 $\pm 0.01$	92 $\pm 3.98$	92.4 $\pm 2.54$	92.6 $\pm 4.30$	94.25							
	60	99.2 $\pm 0.53$	92.6 $\pm 3.20$	89.2 $\pm 3.10$	94 $\pm 1.84$	93.75							
	Overall	99.6	92.3	90.8	93.3								
<b>Overall</b>	Strain				Breeder age, (wk)				Egg type				
	Brown	W-36			46	60			Normal	Large	Rough	abnormal	
	90.48	94.00			96.30 <sup>a</sup>	88.18 <sup>b</sup>			99.80 <sup>a</sup>	95.65 <sup>a</sup>	78.25 <sup>b</sup>	95.25 <sup>a</sup>	

<sup>a</sup> and <sup>b</sup> Means within the sam main effects with different letters are significantly differed, NS= Non-significant

## **Strain - Egg type - Breeder age - Chick quality - Hatching traits.**

### **REFERENCES**

- Abudabos, A. 2010.** The effect of broiler breeder strain and parent flock age on hatchability and fertile hatchability. *Int. J. Poult. Sci.*, 9 (3): 231-235.
- Brand, H.V.D., Parameter H.K. and Kemp B. 2004.** Effects of housing system out door vs cages and age of laying hens on egg characteristics. *Br. Poult. Sci.*, 45: 745-752.
- Decuypere, E. and Bruggeman, V. 2007.** The endocrine interface of environmental and egg factors affecting chick quality. *Poult. Sci.*, 86: 1037-1042.
- Fairchild, B.D., Christensen, V.L., Grimes, J.L., Wineland, M.J. and Bagley, L.G. 2002.** Hen age relationship with embryonic mortality and fertility in commercial turkeys. *J. of Appl. Poult. Res.*, 11: 260–265.
- Fathi, M.M. and El-Sahar E.A. 1996.** Determining the strength of eggshell by using an appropriate apparatus and an equation to calculate egg surface depending on its dimensions. *Egypt. Poult. Sci.*, 16: 285-303.
- Gunlu, A., Kiriki, K., Cetin, O. and Carip, M. 2003.** Some external and internal quality characteristics of partridge (*A. graeca*) eggs. *Food Agri. Environ.*, 1: 197-199.
- Hamidu, J.A., Fassenko, G.M., Feeddes, J.J.R., O'dea, E.E., Ouellette, C.A. 2007.** The effect of broiler breeder genetic strain and parent flock age on eggshell conductance and embryonic metabolism. *Poult. Sci.* 86: 2420-2432.
- Heier, B.T. and Jarp, J. 2001.** An epidemiological study of the hatchability in broiler breeder flocks. *Poult. Sci.*, 80:1132–1138.
- Johnston, S.A. and Gous, R.M. 2007.** Modelling the changes in the proportions of the egg components during a laying cycle. *Br. Poult. Sci.*, 48: 347-353.
- Khabisi, M.M.; Salahi, A. and Mousavi, S.N. 2012.** The influence of egg shell crack types on hatchability and chick quality. *Turkish J. Vet. and Anim. Sci.*, 36: 289-295.
- Kuurman, W.W., Bailey, B.A., Koops, W. J. and Grossman, M. 2003.** A Model for failure of a chicken embryo to survive incubation. *Poult. Sci.*, 82: 214-222.
- Lourens, A., Molenaar, R., Van den Brand, H.E., Heetkamp, M.J.W., Meijerhof, R., Kemp, A. 2006.** Effect of egg size on heat production and the transition of energy from egg to hatchling. *Poult. Sci.* 85: 770-776.
- Narushin, V. G., and M. N. Romanov. 2002.** Egg physical characteristics and hatchability. *World's Poult. Sci. J.* 58:297–303.
- Peebles, E.D.; Doyle, S.M.; Zumwalt, C.D.; Gerard, P.D.; Latour, M.A.; Boyle, C.R. and Smith, T.W. 2001.** Breeder age influences embryogenesis in broiler hatching eggs. *Poult. Sci.*, 80: 272-277.
- Rahn, H. and Paganelli, C.V. 1990.** Gas fluxes in avian eggs: Driving forces and the pathway for exchange. *Comparative Biochemistry and Physiology*, 95: 1-15.

**G. N. Rayan**

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- Rayan, G.N. 2013.** Genetic differences of productive performance and immunocompetence in two commercial layer strain of chickens. Ph.D. Thesis, Ain Shams University. Cairo, Egypt.
- Rayan, G.N., Galal, A., Fathi, M.M. and El-Attar, A.H. 2010.** Impact of layer breeder flock age and strain on mechanical and ultrastructural properties of eggshell in chicken. *Int. J. Poult. Sci.* 9:139–147.
- Renema, R.A., Robinson, F.E., Feddes, J.J.R., Fasenko, G.M., and Zuidhof, M.J. 2001.** Effects of light intensity from photo photostimulation in four strains of commercial egg layers: 2. Egg production parameters. *Poult. Sci.* 80:1121–1131.
- Rizzi, C., and Chiericato, G.M. 2005.** Organic farming production. Effect of age on the productive yield and egg quality of hens of two commercial hybrid lines and two local breeds. *Ital. J. Anim. Sci.*, 4: 160-162.
- SAS institute 2002.** SAS/STAT User's Guide statistics Ver. 9.1; SAS institute Inc., Cary, NC.
- Sauveur, B. 1988.** Reproduction des volailles et production d'aufs (Paris, INRA Editions).
- Scott, T.A. and Silversides F.G. 2000.** Effect of storage and strain of hen on egg quality. *Poult. Sci.* 79: 1725 – 1729.
- Silversides, F.G. and Scott, T.A. 2001.** Effect of storage and layer age on quality of eggs from two lines of hens. *Poult. Sci.*, 80: 1240–1245.
- Tona, K., Bamelis, F.; Coucke, W. ; Bruggeman, V. and Decuyper, E. 2001.** Relationship between broiler breeder's age and egg weight loss and embryonic mortality during incubation in large-scale conditions. *J. Appl. Poult. Res.*, 10: 221-227.
- Tona, K., Bamelis, F., De Ketelaere, B., Bruggeman, V., and Decuyper, E. 2002.** Effect of induced molting on albumen quality, hatchability, and chick body weight from broiler breeders. *Poult. Sci.* 81:327–332.
- Tona, K., Bamelis, F., De Ketelaere, B., Bruggeman, V., Moraes, V.M.B., Buyse, J., Onagbesan, O., and Decuyper, E. 2003.** Effects of egg storage time on spread of hatch, chick quality and chick juvenile growth. *Poult. Sci.*, 82: 736-741.
- Tona, K., Bruggeman, V., Onagbesana, O., Bamelis, F., Gbeasor, M., Mertens, K and Decuyper, E. 2005.** Dayold chick quality: Relationship to hatching egg quality, adequate incubation practice and prediction of broiler performance. *Avian Poult. Biolo. Rev.*, 16: 109-119.
- Wilson, H.R. 1997.** Effects of maternal nutrition on hatchability. *Poult. Sci.*, 76: 134-143.

## الملخص العربي

### تأثير السلالة، نوع البيض، وعمر أمهات الدجاج والتداخل بينهما على صفات التفريخ وجودة الكتاكيت الناتجة

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تم الحصول على عدد 800 بيضة تفريخ من سلالتي هاى لاين (400 بنى، 400 أبيض) وذلك فى أعمار مختلفة للأمهات (46 ، 60 أسبوع). يوجد فى كل عمر أربعة أنواع من البيض (طبيعى، كبير الحجم، ذو القشرة الخشنة، ذو شكل غير طبيعى)، كل نوع يحتوى على 50 بيضة تفريخ لكل عمر لكل من سلالة هاى لاين البنى و W-36، وبالتالي هذه التجربة تتبع التصميم العاملى 2×2×4. وكانت أهم النتائج المتحصل عليها ما يلى:

وجد أنه لا يوجد فرق معنوى بين السلالات بالنسبة لمعدل الفقد النسبى فى وزن البيض. يزداد الفقد فى وزن البيض (%) مع تقدم عمر الأمهات. أيضا الفقد فى وزن البيض (%) كان أعلى معنويا فى البيض ذو القشرة الخشنة، ذو الشكل غير الطبيعى. لوحظ أن البيض ذو القشرة الخشنة للسلالة البنية فى كلا العمرين، كان الأقل فى كل من نسبتي الخصوبة والفقس مقارنة بباقي أنواع البيض. أنتجت الدجاجات من سلالة W-36 بيضا أعلى معنويا فى دليل الشكل وذلك مقارنة بالسلالة البنية، وسجل البيض ذو الشكل غير الطبيعى أقل قيمة لدليل شكل البيضة. أنتجت السلالة البنية بيضا أعلى معنويا فى نسبة القشرة مقارنة بسلالة W-36. تقل نسبة القشرة معنويا مع زيادة عمر الأمهات. سجلت سلالة W-36 عدد ثغور بالبيضة أعلى معنويا (7583) مقارنة بمثلتها البنية (7249). كما وجد أن عدد الثغور الكلية بالبيضة يزداد مع تقدم عمر الأمهات، أيضا وجد أن نوع البيض كبير الحجم كان الأعلى معنويا فى عدد الثغور الكلية مقارنة بباقي أنواع البيض. وجد أن البيض ذو القشرة الخشنة كان الأعلى فى نسبة النفوق الجنينى فى المرحلة المبكرة (0-7 أيام من التفريخ) وذلك لكل من السلالة البنية وسلالة W-36 فى كلا العمرين، يليه البيض ذو الشكل غير الطبيعى مقارنة بأنواع البيض الأخرى. وزن الكتاكيت الناتجة من البيض كبير الحجم كان أثقل معنويا (46.85 جرام)، يليها الكتاكيت الناتجة من البيض ذو الشكل غير الطبيعى (41.12 جرام). لا يوجد فروق معنوية بين السلالات لمقياس Tona score كدليل على جودة الكتاكيت، ووجد أنه يقل معنويا مع تقدم عمر الأمهات. سجل البيض ذو القشرة الخشنة أقل قيمة لمقياس Tona score (78.25%)، فى حين أنه لم يوجد أى إختلافات معنوية بين باقى أنواع البيض المدروسة: البيض الطبيعى (99.80)، البيض كبير الحجم (95.65)، البيض ذو الشكل غير الطبيعى (95.25). مقياس Tona score تأثر معنويا بكل التداخلات المحتملة والذي يعنى أن تعبير هذه الصفة يختلف اعتمادا على السلالة، عمر أمهات الدجاج البياض، نوع البيض. نستطيع أن نستخلص أنه من الناحية العملية يمكن أن نستفيد من البيض كبير الحجم والبيض ذو الشكل غير الطبيعى، لأنه لا يوجد فروق معنوية بينهم وبين البيض الطبيعى وذلك بالنسبة لكل من نسبتي الخصوبة والفقس، معظم صفات القشرة، وجودة الكتاكيت الناتجة. على العكس من ذلك، البيض ذو القشرة الخشنة.