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EFFECT OF CROSSING ON THE PERFORMANCE OF LOCAL CHICKEN STRAINS

4- Effect of Strain and Laying Age on Egg Quality Characteristics

By

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Abstract: *An experiment was conducted to evaluate the effect of Gimmizah (G), and Bandara (B) chicken strains and their crosses (G x B) and (B x G) on egg quality characteristics throughout two laying age periods (38-42) and (62-66) weeks. Chickens of each genotype were kept in family pens and randomly divided into 5 replicates (12 layer hens per pen). External and internal egg quality parameters were determined for both strains and their crosses at each laying age period. The phenotypic correlations between external and internal egg quality characteristics were detected. Also, hybrid vigor between crosses for egg quality characteristics was detected at two age periods.*

Gimmizah chickens strain significantly (p<0.01) produced heavier egg weight compared to those produced from B ones and crosses. Egg weight was significantly (p<0.01) increased with advancing layer age among all experimented genotypes. Eggshell weight was significantly heavier in eggs produced from G strain and its crosses (G x B) and (B x G) compared to those produced from B strain which recorded the lowest one. The highest numerical eggshell percentage was produced from G strain and its cross at early age period but this observation is not true in the later laying period. Age had a significant effect on eggshell thickness as it decreased with hen age. Bandara chicken strain recorded the lowest significant (p<0.01) yolk weight compared with those for crossing with G x B. The yolk weight was not affected by layers age in all experimented genotypes. The yolk percentage in G x B cross was significantly (p<0.01) superior to those for G and B strains. Haugh units were not significantly different between experimented pure strains and their crosses, but hen age significantly (p<0.01) affected this trait. Moreover, hen age had a *significant (p<0.05) effect on yolk/albumen ratio and the interaction between genotype and age in this trait is significant.*

Significant positive correlation was obtained between egg weight and shell weight and non-significant negative correlation was also found between egg weight and the average of eggshell with membranes thickness. Moreover, significant positive correlation was recorded between albumen weight and albumen ratio and albumen height.

The crossing between G and B had no hetrotic effect on each of shell thickness, albumen weight and percentage and egg weight in first experimented period. Where, this crossing represented positive hetrotic effect on egg index . shell weight and percentage, yolk weight and percentage, yolk index, haugh unit and yolk / albumen ratio. Also, the same trend of effect was observed for egg weight at the late laying age period.

INTRODUCTION

Egg quality characters monitoring is important mainly in terms of production economy. Islam *et al.* (2001) found that the external and internal egg quality traits of the breeds affect the future generations and their performance. Tumova *et al.* (2007) showed that genotype significantly affected the egg shape index, yolk and albumen quality and yolk index. The genotype affects mainly egg weight and eggshell traits (Zita *et al.*, 2009). Also, yolk / albumen ratio is affected by breed or the strain within a breed (Curtis *et al.*, 1986). Whereas, Basmacioglu and Ergul (2005) reported that there was no significant effect of the genotype on eggshell percentage and thickness.

Another factor which influences egg quality is layer age (Lapao *et al.*, 1999, Silversides and Scott, 2001). The mean performance of the egg quality traits declined with advancing age with the exception of egg weight which increased with age (ledur *et al.*, 2002: Rizzi and Chiericato, 2005 and Johnston and Gous, 2007). While Yannakopoulos *et al.* (1994) found no significant effect of the hen age on eggshell traits. Moreover, Zemkova *et al.* (2007) demonstrated that the egg weight was not influenced significantly by age. Hen age has also been shown to increase yolk weight (Suk and Park, 2001: Van den Brand *et al.*, 2004) albumen weight (Suk and Park, 2001) and yolk proportion (Rizzi and Chiericato, 2005) but decreased albumen percentage (Van den Brand *et al.*, 2004 and Rizzi and Chiericato, 2005). Scott and Silversides (2000) and Silversides and Scott (2001) showed that albumen height is based by the age and strain of hen.

Many investigators reported that crossbreeding tended to increase eggshell quality (El-Turky *et al.*, 1981). El-Srwy (1980) reported that the average of egg shape of crossbreds was higher than that of purebreds. The proportion of yolk purebred eggs is smaller than those in their crosses, which may be due the smallest egg weight (Ahn *et al.*, 1997).

The correlations between the egg weight and the albumen weight, yolk weight, eggshell weight.are high and ranged from 0.67 to 0.97(Zhang *et al.*, 2005). The correlation between yolk percentage and yolk weight was 0.52, whereas the correlations with egg weight and albumen weight were -0.51 and -0.74, respectively (Hartmann *et al.*, 2000). Highly significant ($p< 0.001$) negative correlation was found between egg weight and proportion of the eggshell on the egg (-0.40). Moreover, Zita *et al.* (2009) found highly significant ($p<0.01$) positive correlation between eggshell percentage and thickness (0.550).

Hybrid vigor is considered to be an important tool for producing several strains of chickens. Results of most crossbreeding experiments carried out in Egypt (Nawar and Abdou, 1999; Nawar and Bahie El-Deen, 2000) reported that crossing between local breeds or strains of chickens with other local ones was generally associated with an existence of considerable heterotic effects on egg quality. Conversely, Kosba, (1978) stated that crossbreeding had no advantageous heterotic effect on egg quality.

This experiment was conducted to evaluate the effect of chicken strains, their crosses and hen age periods on external and internal egg quality characters.

MATERIALS AND METHODS

The present study was conducted at El-Sabahia Poultry Research Station, Alexandria, Animal Production Research Institute, Agricultural Research Center, Egypt. A total number of 320 eggs was collected randomly from two chicken strains (Gimmizah, G and Bandara, B) and their crosses G male x B female (G x B),and B male x G female (B x G) throughout two laying age periods (38-42) and (62-66) weeks. Chicken genotypes which representing each age period were kept in family pens and randomly divided into five replicates (12 layer hens per pen).All managerial practices were similar throughout the experiment. Random samples from eggs of each replicate within four hours after collection were used to evaluate some external and internal egg quality characters. The eggs were numbered and weighed on a sensitive scale to the nearest 0.1 g. The width and length of each egg were measured to determine egg shape index. Each egg was broken out on a table and its contents poured into a flat plate in order to measure the yolk height and diameter and albumen height. The yolk was separated from the albumen and then weighed, while the albumen weight was detected by subtracting the weights of yolk and eggshell from egg weight. The shells were washed under slightly flowing water so that the albumen remains were removed. The washed shells were left to dry in the open air for 24 hours then they were weighed with eggshell membranes. Samples taken from sharp, blunt and equatorial parts were measured, and the average of eggshell thickness with membranes was calculated from the average values of these three parts. Some external and internal quality characters of the egg were estimated using the following formulas.

Egg shape index	= [width (cm) / length (cm)] x100
Eggshell ratio	= [(eggshell weight (g) / egg weight (g)] x100
Egg albumen ratio	= [albumen weight (g) / egg weight (g)] x100
Yolk index	= [yolk height (mm) / yolk diameter (mm)] x100
Yolk ratio	= [yolk weight (g) / egg weight (g)] x100
Albumen weight (g)	= Egg weight (g) – [yolk weight (g) + eggshell weight (g)]
Haugh unit (H U)	= 100 log $(H + 7.57 - 1.7w^{0.37})$
where:	H= albumen height (mm), w =egg weight (g)

The phenotypic correlation values related to the internal and external egg quality characters irrespective of chicken strain or hen age were determined according Snedecor and Cochran, 1980. The estimates were made by using SAS (1994).

Statistical Analysis

Data were analyzed based on genotype and age of hen by using the general linear models procedure (SAS Institute, 1994). Data of egg quality were analyzed by the following model:

$$Y_{ijk} = \mu + G_i + A_j + (GA)_{ij} + E_{ijk}$$

Where μ is the overall mean, G_i is the effect of the i th genotype, A_j is the fixed effect of the j th age, $(GA)_{ij}$ is the interaction of the i th genotype with the j th age and E_{ijk} is the random error.

Heterosis percentages (H%) based on the mid-parents (MP) were determined according to equation given by Sinha and Khanna (1975) as follows:

$$(H)\% = \frac{F_1 - MP}{MP} \times 100$$

where: (H)% = heterosis percentage, F_1= mean of crosses, MP = mid-parents.

RESULTS AND DISCUSSION

Table 1 shows the effect of genotype, age and their interaction on external egg quality characters. It is obvious that G chicken strain produced significantly ($p < 0.01$) heavier egg weight (56.33 g) than those produced from B strain (51.22g) and their crosses B x G and G x B (52.75 g and 53.91g) , respectively . Likewise, the eggs produced from crossing between G x B (53.91g) were numerical heavier than those of the corresponding egg weights of cross B x G (52.75g). Also, B chicken strain recorded the lowest significant egg weight compared with those for G chickens and other crosses. Similar differences between egg weights for the different genotypes were recorded by Afifi *et al.* (2007) and Abou El-Ghar *et al.* (2009). Regarding the effect of age on egg weight, it appears from the data of the same table that egg weight increased with the increase of layer age among all experimented genotypes. These results are in agreement with the data reported by Rizzi and Chiericato (2005); Johnston and Gous (2007) and Zita *et al.* (2009) who showed that egg weight increased with the age of hens. Also, there were no significant differences among purebreds and their crosses in egg shape index. This result is keeping with those reported by El-Labban (2000) and El-Soudany *et al.* (2003). Moreover, this trait was significantly ($p<0.01$) affected and decreased with the hen age .

There were highly significant differences ($p<0.01$) in eggshell weight due to genotype and layer age. Eggshell weight was significantly heavier in eggs produced from G strain (7.18g) and its crosses B x G (6.94 g) and G x B (7.07g) compared to eggs produced from B strain (6.59g) which recorded the lowest value. The data of eggshell refer to that eggshell weight significantly decreased as the hens aged. Moreover, there were no significant differences in eggshell percentages between experimented purebreds and their crosses, whereas the crosses recorded the higher numerical shell percent compared to those for purebreds. In addition, eggshell percentage was decreased numerically with hen's age among all experimented genotypes. Moreover, the highest eggshell percentages were produced from G strain and its cross at early age period of egg production (38-42 wk) but this observation is not true in the late period (62-66 wk) as B strain and its cross produced eggs with the highest eggshell percentages. Results herein regarding shell percentage are in accordance with the data reported by Basmacioglu and Ergul (2005).

The differences between shell with membranes thickness of experimented genotypes and their crosses were not significant. From this table, it could be noticed that eggs of G strain had numerical thicker shell followed by B strain and both crosses. Besides, age had a highly significant effect on eggshell with membrane thickness as it decreased with hen age increase. Moreover, Eggshell thickness produced in the first laying hen age period was thicker than those in the later one. Some workers have asserted the same conclusion (El-Labban, 2000 and Rizk *et al.*, 2008). Egg quality characters in the results herein were affected by the interaction of genotype and age which support what is observed by Campo *et al.* (2007) who found that the eggshell traits may be affected by interactions of age and breed.

It can be observed from the mentioned results that crosses of both B and G strains had no detrimental effect on some parameters of external egg quality such as egg weight and shell weight. This observation do not support the notion of El-Soudany *et al.*(2003) who reported that mating of G hens with Matrouh males improved eggshell quality characters. Ozcelic (2002) reported that egg weight values are more appropriate in determining the shell quality.

Table 2 shows the effect of strain, layer age and their interactions on internal egg quality. The quality of yolk is given by data of yolk weight, yolk percentage and yolk index. Bandara strain recorded the lowest significant ($p<0.01$) yolk weight (16.26 g) compared with those for crossing G x B (17.76 g). This observation is true for G chickens strain and cross B x G only and not with cross G x B. The yolk weight was not affected by layers age in all experimented genotypes. The yolk percent in cross G x B was superior to those for G and B strains with highly significant differences. Whereas, yolk percent of cross B x G did not differ significantly compared with those for G and B strains. In addition, there were highly significant differences in this trait due to hen age as yolk percentage had increased with increase of hen's age. Rizzi and Chiericato (2005) confirmed this observation. Cross of B x G had the highest significant ($p<0.05$) yolk index compared to G x B and strains. In addition, age had a significant effect on yolk index, as yolk index decreased with advanced hen age in all experimented genotypes.

Gimmizah strain eggs had a significant heaviest albumen weight compared with B strain and its cross. Also, albumen weight decreased with hen age increase, significantly ($p<0.05$). Albumen percentages had higher values in pour strains compared to those for crosses, significantly ($p<0.01$). The lonely trait which related to albumen and not affected with hen age was albumen percentage. Also, in the same table, Haugh units were not significantly different between pure strains and their crosses, but hen age affected significantly ($p<0.01$) this trait. Moreover, this table reveals that there were significant differences between genotypes ($p<0.01$) with respect to yolk / albumen ratio. Moreover, hen age had a significant ($p<0.05$) effect on this trait and the interaction between genotype x age was significant ($p<0.05$). Besides, data of yolk / albumen ratio revealed that there were significant difference between both strains and their crosses. The two crosses B x G and G x B were significantly ($p<0.05$) superior than those for both pure experimented strains. Also, yolk / albumen ratio increased with hen age increase among strains and their crosses except for G x B cross.

The conflicting results in the quality of egg produced from crossing between G and B strains could be due to that G strain was used as the parent for synthezing B strain.

The phenotypic correlation values related to the external egg quality are shown in Table 3. Statistically, phenotypic correlation was highly positive significant between the egg weight and eggshell weight (0.65) while it was non-significant negative between egg weight and the average of eggshell thickness with membranes (-0.06). Kull and Seker (2004) reported that egg weight has an indirect relation with the eggshell quality of the egg. Thus it has been stated by most of the researchers that the eggshell thickness has a direct relation with the egg weight (Choi *et al.*, 1983) and it has a positive significant correlation with the eggshell weight (Farooq *et al.*, 2001) In this study, the eggshell ratio and eggshell thickness have an opposite correlation with the increase of the egg weight On the other hand, Farooq *et al.* (2001) and Zita *et al.* (2009) mentioned a positive correlation between egg weight and the eggshell thickness. Moreover, eggshell weight indicated highly positive significant correlation with egg length (0.34) and egg width (0.56) but this relation was detected as negative non- significant with eggshell thickness (-0.06). These data are in harmony with those reported by Olawumi and Ogunlade (2008) who found that direct relation between eggshell weight with egg width and egg length. Ozcelic (2002) reported that the egg weight values are more appropriate in determining the eggshell quality. Significant ($p<0.01$) positive and negative correlations were obtained between the shape index and the width (0.609) and length (-0.63) of the egg. These results are in agreement with those reported by Ozcelic (2002) and Kull and Seker (2004). In this study, the positive significant correlation value (0.75) between eggshell weight and eggshell ratio was nearest with the research findings (0.82) by Kul and Seker (2004). However, the shape index might give an idea about the eggshell weight and egg width due to the results of significant positive correlation value between the shape index with the eggshell weight (0.18) and egg width (0.61). Therefore, the values of these relations are good indicators for shape index.

In Table 4, significant negative phenotypic correlation ($p<0.01$) value was found between albumen weight and yolk ratio (-0.56) and yolk / albumen ratio (-0.58), whereas, significant positive correlation was recorded between the other characters except for Haugh unit. Positive correlation was detected between Haugh unit and albumen ratio (0.18), albumen height (0.98). Moreover, positive correlation ($p<0.01$) was found between the albumen height and albumen weight (0.19) and albumen ratio (0.20), whereas, positive phenotypic correlation was determined between the yolk weight and the yolk ratio (0.60), yolk height (0.32) and yolk diameter (0.47). These results indicated that as the yolk weight, height and diameter increased, the albumen weight also increased and the albumen quality became better. Moreover, the results showed significant (0.01) negative correlation between yolk ratio with each of albumen weight, albumen ratio and Haugh unit (-0.56, -0.88 and -0.19), respectively, but positive correlation was detected with yolk / albumen ratio (0.98). These results are keeping with those reported by Olawumi and Ogunlade (2008). Similar to the results obtained in this study, Ozcelic (2002) and Kul and Seker (2004) have found significant phenotypic correlation between yolk height and albumen height and between albumen height and Haugh unit.

The improvements of albumen weight and the albumen ratio beside albumen height parameters are presenting an idea about the albumen quality as well as albumen height being used for the estimation of the Haugh unit which is one of the internal egg quality characters.

In Table 5, the results of phenotypic correlations which detected between the external and internal egg quality characters indicated that there were significant negative correlations between egg weight and yolk ratio (-0.19) and yolk/albumen ratio(-0.18) and there were significant positive correlations between egg weight and the other experimented characters. These results were found in conformity with the research findings of Ozcelic (2002), Kul and Seker (2004) and Olawumi and Ogunlade (2008). Statistically, significant positive correlations were obtained between the eggshell weight and the egg internal quality characters, such as yolk weight (0.35) yolk height (0.36) and albumen weight (0.47), whereas significant negative correlation values were obtained between eggshell weight and yolk ratio (-0.23) and albumen ratio (-0.14). As the eggshell ratio increased, significant decreases occurred in internal egg quality characters except yolk height, but the correlations between eggshell ratio and each of Haugh unit (0.00) and yolk/albumen ratio (0.04) were not significant. The negative significant correlations between the eggshell ratio and albumen weight (-0.16) and albumen ratio (-0.35) were similar to the findings of Ozcelic

(2002) Kul and Seker (2004) and Olawumi and Ogunlade (2008). Shape index was found to be negative non-significant correlation with all experimented characters of internal quality characters except yolk / albumen ratio. In addition, there was negative non-significant correlation between average eggshell thickness and all internal egg quality characters except yolk ratio, albumen ratio and yolk/albumen ratio.

The average degrees of hetrosis (H %) for egg quality characters at early stage of production (38-42 wk) for B x G cross are shown in Table 6. Estimates of egg shape index, shell weight, shell percentage, yolk percentage, yolk index, Haugh unit and yolk / albumen ratio were positive (0.58, 0.21, 2.14, 1.34, 5.49, 2.64 and 3.50%), respectively. The corresponding values in the reciprocal cross (G x B) were 0.41, 3.59, 3.21, 4.64, 1.09, 1.67 and 8.77%, respectively. The results concerning G x B cross showed also, positive hetrotic effect (4.79%) for yolk weight which mean that dominance effects tended to approach to the means of higher parent G at all previous characters (Tables,1and 2). On the other hand, negative H% values in B x G cross for egg weight, eggshell thickness, yolk weight, albumen weight and albumen percentage were -2.37, -6.45, -0.70, -0.03 and -1.28%, respectively. The estimates of H % for G x B cross were also negative for egg weight (-2.0%), eggshell thickness (-3.22%), albumen weight (-2.99%) and albumen percent (-3.39%). Therefore, it could be concluded that dominance toward the lower parent B was found for these characters (Tables, 1and2). Concerning the late eggs laid during 62-66 wk of age period, there are positive heterotic effects on egg shape index (2.29%), eggshell thickness (2.85%), yolk weight (4.03%), yolk percent (6.28%), yolk index (2.32%), Haugh unit (1.31%) and yolk / albumen ratio (13.79%) for B x G cross. The corresponding characters of the reciprocal cross (G x B) had positive H% values (0.52, 0.0, 2.21, 2.52, 2.32, 0.50, and 5.17%, respectively. Also, the H% estimates of eggshell percent were positive (2.29%) for the B x G cross and egg weight (0.29%) for G x B cross. These findings indicated that dominance toward the high parent G was found for all previous characters where the means of crosses between those of high parent and the mid-parent (Tables1and2). On contrary, negative H% values were observed for shell weight, eggshell thickness, albumen weight and albumen percent (-0.15,-6.45, -6.55 and -4.21%), respectively. The corresponding H% values for the reciprocal cross (G X B) were -1.4, -3.22,-1.49 and-1.24%, respectvly. It could be concluded that dominance toward the lower parent (B) was found for these characters. Hetrosis degree percentage of egg weight was negative for B x G cross (-0.28%), while it was positive in its reciprocal (0.29%). Contrarily, eggshell percentage of B x G cross had a positive H% (2.69%), while that of the cross G x B was negative (-1.11%). High estimates of hetrosis were 2.96,2.39 and 4.44% for shell percent, yolk percent and yolk index for B X G cross and the values were 2.68, 2.30, 4.16, 4.03,2.22 and 6.08% for shell weight, shell percent, yolk weight, yolk percent, yolk index and yolk/albumen ratio for G x B cross. These high estimates could be due that small differences were observed between the parental lines regarding to these parameters. The results of this study are in agreement with that reported by Iraqi (2002) and Nawar (2009) who found positive H% for egg shape index. Nawar (2009) showed positive hetrotic effect for eggshell weight, while negative H% herein was found by Iraqi (2002). Opposite to those results, Abou El-Ghar *et al.*(2009) found positive effects of crossing on egg weight. Moreover, Iraqi (2002) and Abou El-Ghar *et al.* (2009) reported negative heterotic effect on eggshell thickness. Whereas, Nawar (2009) showed positive and high heterosis percentage for the same trait. Results reported herein are in agreement with the results of Abou El-Ghar *et al.* (2009) and Nawar (2009) who reported that dominance toward lower parent was found for albumen weight. In contrast, positive heterosis percentage was found by Iraqi (2002). Moreover, the results of this study are in harmony with those reported by Nawar (2009) and Abou El-Ghar *et al.* (2009) who showed highly positive heterotic effect on yolk weight, while, negative heterosis percentage was found by Zaky (2006). Abou El-Ghar *et al.* (2009) and Nawar (2009) reported that cross had no significant effect on yolk index. Results of yolk index in this experiment are in agreement with Nawar (2009). Also, Nawar (2009) reported positive heterosis for yolk percentage, while Zaky (2006) reported negative heterosis for yolk percentage for the same trait. The results reported herein are in agreement with Abou El-Ghar et al, (2009) who reported positive heterotic values for Haugh units. Where, dominance effect toward the high parent was found.

In conclusion, Gimmizah chicken strain realized the best characters of egg quality, therefore this strain could be used in crossing with others for improving egg quality characters but the relative with other strains should be taken into consideration.

Table (1): Effect of genotype, hen age and their interaction on external egg quality characters

Characteristic of egg quality	Hen age	Genotype(Gen)					Significant		
		Bandara (B)	Gimmizah (G)	B x G	G x B	Overall mean	(Gen)	Age	Gen x age
Egg weight (g)	38-42 wk	50.74±4.55	54.66±4.31	51.45±4.67	52.55±4.33	52.55±4.64			
	62-66 wk	51.39±3.97	57.09±4.05	53.15±4.41	54.40±4.59	53.99±4.72			
	Overall mean	51.22±4.10^C	56.33±4.27^A	52.75±4.50^B	53.91±4.57^B		**	**	
Egg shape index	38-42 wk	79.47±4.58	79.50±4.11	79.95±4.20	79.81±3.79	79.68±4.15			
	62-66 wk	74.94±4.31	77.50±4.11	77.97±4.91	76.62±2.37	76.78±4.08			
	Overallmean	78.32±4.91	78.87±4.19	79.49±4.42	78.96±3.74			**	
Eggshell weight (g)	38-42 wk	6.68±0.82	7.51±0.77	7.11±1.02	7.35±0.93	7.16±0.94			
	62-66 wk	6.32±0.77	6.46±0.62	6.38±0.44	6.30±0.69	6.37±0.63			
	Overall mean	6.59±0.82^B	7.18±0.87^A	6.94±0.97^A	7.07±0.98^A		**	**	
Eggshell percent (%)	38-42 wk	12.99±1.11	13.17±1.14	13.36±1.50	13.50±1.19	13.25±1.25			
	62-66 wk	12.48±1.31	11.83±0.87	12.47±1.09	12.02±1.27	12.16±1.15			
	Overall mean	12.86±1.18	12.75±1.23	13.15±1.46	13.10±1.37				
Egg shell thickness (mm)	38-42 wk	0.36±0.04	0.34±0.03	0.36±0.03	0.35±0.05	0.35±0.03			
	62-66 wk	0.30±0.03	0.32±0.03	0.29±0.02	0.30±0.03	0.31±0.03			
	Overall mean	0.31±0.04^B	0.33±0.03^A	0.31±0.04^B	0.31±0.04^B			**	**

* Significant at ($p<0.05$), **significant at ($p<0.01$).

Table (2): Effect of genotype, hen age and their interaction on internal egg quality characters

Characteristic of egg quality	Hen age	Genotype(Gen)				Overall mean	Significant		
		Bandara (B)	Gimmizah (G)	B x G	G x B		(Gen)	Age	Gen x age
Yolk weight (g)	38-42 wk	16.27±1.79	17.91±1.48	16.97±1.51	17.91±1.65	17.26±1.75			
	62-66 wk	16.24±1.48	17.69±1.96	17.65±3.06	17.34±1.82	17.05±2.15			
	Overall mean	16.26±1.71 C	17.84±1.64 A	17.13±1.99 B	17.76±1.70 A		**		
Yolk percent (%)	38-42 wk	31.66±2.39	31.41±2.05	31.96±1.81	33.00±2.56	32.00±2.28			
	62-66 wk	32.12±2.68	32.37±2.40	34.27±4.84	33.06±3.06	32.88±3.29			
	Overall mean	31.77±2.46 B	31.71±2.20 B	32.50±2.96 AB	33.02±2.68 A		**	**	
Yolk index	38-42 wk	0.45±0.03	0.46±0.03	0.48±0.03	0.46±0.04	0.46±0.03			
	62-66 wk	0.44±0.03	0.42±0.05	0.44±0.05	0.44±0.02	0.43±0.04			
	Overall mean	0.45±0.03 B	0.45±0.04 B	0.47±0.03 A	0.46±0.04 B		*	**	*
Albumen weight (g)	38-42 wk	28.43±2.47	31.67±2.91	29.07±2.81	29.15±3.24	29.58±3.10			
	62-66 wk	28.18±3.45	30.51±2.84	27.42±3.83	28.91±3.48	28.92±3.51			
	Overall mean	28.37±2.73 B	31.31±2.92 A	28.68±3.13 B	29.08±3.28 B		**	*	
Albumen percent(%)	38-42 wk	55.35±2.49	55.43±2.12	54.68±2.09	53.51±2.67	54.74±2.46			
	62-66 wk	55.41±2.87	55.80±2.53	53.26±4.83	54.91±3.44	54.96±3.48			
	Overall mean	55.36±2.57 A	55.54±2.24 A	54.34±2.99 B	53.88±2.94 B		**		*
Haugh units	38-42 wk	76.09±11.17	74.84±8.19	77.46±9.82	76.73±8.52	76.27±9.49			
	62-66 wk	87.71±5.81	83.42±7.94	86.69±5.56	86.00±7.29	85.75±6.94			
	Overall mean	79.03±11.27	77.52±9.00	79.64±9.79	79.21±9.14			**	
Yolk / albumen ratio	38-42 wk	0.57±0.07	0.57±0.06	0.59±0.05	0.62±0.08	0.58±0.07			
	62-66 wk	0.58±0.08	0.58±0.07	0.66±0.16	0.61±0.09	0.61±0.11			
	Overall mean	0.58±0.07 B	0.57±0.06 B	0.60±0.09 A	0.61±0.08 A		**	*	*

* Significant at ($p<0.05$), **significant at ($p<0.01$).

Table (3): The phenotypic correlation between external egg quality characters

External egg quality characters	Egg width	Egg length	Shape index	Average eggshell thickness	Eggshell weight	Eggshell percent ratio
Egg weight	0.65**	0.61**	0.02	-0.06	0.65**	-0.01
Egg width		0.23**	0. 61**	-0.06	0.56**	0.18**
Egg length			-0.63**	0.05	0.34**	-0.09
Shape index				-0.01	0.18**	0.22**
Average shell thickness					-0.06	-0.03
Eggshell weight						0.75**

**significant at (p<0.01).

Table (4): The phenotypic correlation between internal egg quality characters

Internal egg quality characters	Yolk ratio	Yolk diameter	Yolk height	Albumen weight	Albumen ratio	Albumen height	Haugh unit	Yolk/albumen ratio
Yolk weight	0.60**	0.47**	0.32**	0.30**	-0.51**	0.07	- 0.19**	0.59**
Yolk ratio		0.24**	-0.016	-0.56**	-0.88**	- 0.21**	- 0.19**	0.98**
Yolk diameter			0.099	0.21**	-0.15**	0.10	0.03	0.20**
Yolk height				0.30**	-0.04	0.11*	0.04	-0.004
Albumen weight					0.61**	0.19**	0.05	-0.58**
Albumen ratio						0.20**	0.18**	-0.95**
Albumen height							0.98**	-0.20**
Haugh unit								-0.18**

*Significant at (p<0.05), **significant at (p<0.01).

Table (5): The phenotypic correlation between external and internal egg quality characters

Internal egg quality characters	External egg quality traits						
	Egg weight	Egg length	Egg width	Shape index	Average eggshell thickness	Eggshell weight	Eggshell percent ratio
Yolk weight	0.67**	0.40**	0.40**	-0.01	-0.04	0.35**	-0.12*
Yolk ratio	-0.19**	-0.13*	-0.16**	-0.03	0.01	-0.23**	-0.14**
Yolk diameter	0.35*	0.23**	0.19**	-0.05	-0.05	0.11	-0.15**
Yolk height	0.40**	0.31**	0.29**	-0.02	-0.07	0.36**	0.12*
Albumen weight	0.89**	0.57**	0.55**	-0.02	-0.04	0.47**	-0.16**
Albumen ratio	0.18**	0.17**	0.07	-0.08	0.01	-0.14**	-0.35**
Albumen height	0.12*	0.06	-0.003	-0.05	-0.08	0.08	0.00
Haugh unit	-0.05	-0.05	-0.10	-0.04	-0.07	-0.03	0.00
Yolk/albumen ratio	-0.18**	-0.14**	-0.12*	0.01	0.00	-0.09	0.04

*Significant at (p<0.05), **significant at (p<0.01),

Table (6): Average of degree of heterosis percentages (H %) for egg quality characters

Egg quality traits	B x G			G x B		
	38-42 wk	62-66 wk	Total	38-42 wk	62-66 wk	Total
Egg weight	-2.37	-0.28	-1.90	-2.00	0.29	0.25
Egg shape index	0.58	2.29	1.13	0.41	0.52	0.46
Eggshell weight	0.21	-0.15	0.79	3.59	-1.40	2.68
Eggshell percentage	2.14	2.69	2.69	3.21	-1.11	2.30
Eggshell thickness	2.85	-6.45	-4.61	0.00	-3.22	-4.61
Yolk weight	-0.70	4.03	0.46	4.79	2.21	4.16
Yolk percent	1.34	6.28	2.39	4.64	2.52	4.03
Yolk index	5.49	2.32	4.44	1.09	2.32	2.22
Albumen weight	-0.03	-6.55	-3.88	-2.99	-1.49	-2.54
Albumen percent	-1.28	-4.21	-2.00	-3.39	-1.24	-2.83
Haugh units	2.64	1.31	1.74	1.67	0.50	1.19
Yolk/albumen ratio	3.50	13.79	0.86	8.77	5.17	6.08

Crosses G x B and B x G are crossing between Bandara and Gimmizah trains

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الملخص العربى

تأثير الخلط على اداء سلالات الدجاج المحلي

٢- تأثير السلالة وعمر الامهات على مقاييس جودة البيض

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أجريت التجربة لدراسة تاثير كل من السلالة لدجاج الجميزة و البندرة والخلط بينهم وكذلك عمر الامهات على صفات جودة البيض الخارجية و الداخليـــــة خلال فترتين من العمر ٣٨-٤٢ و ٦٢-٦٦ اسبوع ٠تم توزيع دجاجات لكل مجموعة و الخاصة بكل تركيب وراثى الى خمسة مكررات وبكل مكررة ١٢ دجاجة بياضة٠ تم تسجل بيانات جودة البيض على عينات عشوائية من كل مكررة ٠ وقدرت قياسات جودة البيض الخارجية و الداخلية لكل سلالة و خلطانها عند كل فترة عمرية٠ تم تقدير قيمة الارتباط الظاهرى بين صفات جودة البيض الخارجية والداخلية٠وايضا تم تقدير قوة الخليط٠

سجلت سلالة الجميزة وزن بيض اعلى معنويا مقارنة بوزن بيض سلالة البندرة و الخلطان٠ كما اظهرت الدراسة ان وزن البيض يزيد بزيادة عمر الامهات داخل كل تركيب وراثى٠ كما سجلت سلالة الجميزة و خليط البندرة مع الجميزة وزن قشرة اعلى من خليط الجميزة مع البندرة وسجلت سلالة البندرة اقل وزن قشرة، كما سجلت سلالة الجميزة والخلطان اعلى نسبة قشرة للبيض فىالفترة الاولى من عمرالامهات ،كما اظهرت النتائج ان سمك القشرة يقل معنويا مع زيادة عمر الامهات- سجلت سلالة البندرة اقل وزن صفار مقارنة بسلالة الجميزة و الخلطان بينما لم يتاثر وزن الصفار بالعمر فى جميع التراكيب الوراثية المدروسة٠ تفوقت نسبة الصفار فى خليط الجميزة مع البندرة على كل من سلالتى الجميزة و البندرة و الخليط العكسى لهما٠ ووجد ان معامل الصفار يقل معنويا مع تقدم عمر الامهات فى كل التراكيب الوراثية ٠

وقد وجد ان لعمر الامهات تاثير معنوى على وحدات هو بينما لم تتاثر تلك الوحدات بالتراكيب الوراثية – بينما تأثرت نسبة الصفار/البياض معنويا بكل من العمر و التركيب الوراثى وكذلك التفاعل بينهما٠

كما اظهرت النتائج ارتباطا موجبا و معنويا بين وزن البيضة و وزن القشرة، وبين وزن البياض و كل من نسبة البياض

وارتفاع البياض بينما كان هناك ارتباط غير معنوى و سالب بين وزن البيضة و سمك القشرة٠

اظهرت نتائج الدراسة ان الخلط لم يوثر على كل من سمك القشرة و وزن و نسبـــــة البياض ووزن البيض الناتج فى العمر المبكر للامهات٠ بينماالخلط اعطى قوة موجبة فى كل من معامل البيضة و وزن و نسبة القشرة وكذلك الوزن والنسبة المنوية للصفار ومعامل الصفارو وحدات هو ونسبة الصفار للبياض وايضا كانت قوة الخلط موجبة لوزن البيضة عند العمر المتاخر للامهات٠