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EGG QUALITY CHARACTERISTICS FROM SOME DEVELOPED STRAINS OF CHICKENS AND THEIR CROSSES

By

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Abstract: *The current experiment was conducted to investigate some egg quality characteristics from Mandarah, Silver Montazah and Matrouh developed strains and the effect of crossing of these traits. Regarding the parental strains, Silver Montazah was superior in egg weight 52.0 g., shell weight 7.0 g., shell thickness 36.4 mm, egg shape index 78 % and albumin weight 29.0 g., over other developed strains, and Mandarah was superior in yolk weight (16.2 g.) and yolk index (47 %) than other strain and Matrouh was better in yolk index (47 %) and Haugh unit (89.5 %) traits. Moreover, egg quality characteristics like egg weight, egg shape index, yolk weight, shell weight and Haugh unit could be improved by crossing such traits exhibit positive heterotic effects ranged from 0.7 to 16.9 %. Also the dominance toward high parent was controlling the inheritance of these traits, since results of the degree of dominance ($\hat{h}$) indicated that dominance was complete to over dominance for the most loci of the studied traits. On the other hand, selection for increasing yolk weight and Haugh unit can benefit egg quality commercially, because of their additive genetic variations (σ^2A) accounted a high portion of the total genetic variations 13.1 and 10.03, respectively. Generally, most of egg quality characteristics had negative estimates of additive σ^2A and dominance σ^2d genetic variations and this may be due to the presence of genes with negative effects in high frequencies and/or the environmental effects were large and masked the observable genetic variation.*

INTRODUCTION

Egg quality has been defined by Stadelman (1977) as the characteristics of an egg that affect it's acceptability to the consumer. Poor egg quality causes economic losses at all production stages. Broken eggshells are the cause of approximately 10 % of production losses and also provide a route for pathogen contamination. Therefore the most important price contributing factor in table and hatching eggs is egg quality. The two economically most important hereditary quality characteristics are the strength and integrity of the eggshell and the quality of Yolk and albumen. Nowadays eggs and meat production are the most important sources of income generation and supplementary livelihood activity of rural areas. The developed strains of chickens are gaining wider importance and acceptance among the rural people in Egypt. Because their suitability for backyard farming similar to the traditional poultry keeping in the villages. So they are popular and well accepted by the small landless farmers across the country. Because of the success of poultry farming largely depends on the total number of good quality eggs produced especially in layers and dual purpose birds.

A lot of work has been carried out on egg quality traits, because the information about egg quality on developed strains are limited. Therefore the developed strains Mandarah, Silver Montazah, Matrouh and their crosses were used to evaluate the external and internal quality of the egg and the effect of crossing on better egg quality traits. Many factors influence the egg quality i.e., breed, strain, variety, temperature, relative humidity, rearing practices and season (Sauter et al. 1954; Washburn 1990). Weight and proportion of represented by albumen, yolk and shell varied significantly between strain of hens (Pandey et al., 1986). Inherited differences between strains of White Leghorn in egg weight and shape index have been reported by Arafa et al. (1982) and Carter and Jones (1970), respectively. Eisen and Bohren (1963) found it was possible to list albumin quality as quantitative genetic traits. Thickness of the shell is significantly influenced by strain (Pandey et al., 1986). Higher egg size may also be a factor influencing the shell quality traits. The proportion of albumin had high heritability and is controlled by additive multiple factors (Scheinberg et al., 1953). The aims of the present study were to investigate the effect of Mandarah, Silver Montazah, Matrouh and their crosses strains on some egg quality traits and to estimate the components of genetic variability of these traits.

MATERIALS AND METHODS

This experiment had been carried out at El-Sabhiah Research Station, Animal Production Research Institute, Agriculture Research Center, throw 2007-2008.

Experimental Design: At the age of 42 weeks, a total number of 435 eggs were collected randomly from five genetic groups i.e. Mandarah, Silver Montazah, Matrouh and their crosses Mandarah x Matrouh (Mn x Mt) and Silver Montazah x Matrouh (SM x Mt). Each group was randomly divided into 5 replicates and they were kept in family pins each contains 12 layer hens. Egg quality data were recorded on random samples from each replicate daily to evaluate various external and internal egg quality traits. All managerial practices were similar as possible as throughout the experiment.

The Studied Traits: The external characters like egg weight (EW), shell weight (Sh.W), shell thickness (Sh.Th) including shell membranes was measured using a micrometer at three locations on the egg (air cell, equator and sharp end), egg shape index % (E.Sh.I, Carter and Jones, 1970). Thereafter the eggs were broken and the internal traits like albumin weight (Al.W), yolk weight (Y.W), were recorded using standard procedure. Yolk index (Y.I) % was calculated according to Funk (1948), Haugh unit score (HU) was applied according to Haugh (1937).

Statistical Analysis: The data were derived from 2 crosses along with their 3 parents (i.e. Mandarah, Silver Montazah parental lines and the common parent Matrouh). These data were analyzed using analysis of variance appropriate for Complete Randomized Block Design with 5 Replicates and the observations were recorded on random samples from each replicate. All percentages were first converted to arcsine transformation prior to statistical analysis. Partitioning of variance into its components was done by using the method of (Kearsey and Jinks, 1968). Heterosis percentages (H) based on the mid-parents (MP) were determined according to equations given by (Sinha and Khanna, 1975) as follows:

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

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

The degree of dominance ($\hat{h}$) was estimated according to equations given by (Griffing, 1950).

$$(\hat{h}) = (\sigma^2 d / \sigma^2 A)^{0.5}$$

$\sigma^2 A$ = additive mean square, $\sigma^2 d$ = dominance mean square.

RESULTS AND DISCUTIONS

Egg weight: It is obvious in (Table, 1) that Silver Montazah developed strain had heavier egg weight (52.0 g.) than Mandarah 49.8 and Matrouh 49.6 g. Likewise, the cross Mandarah x Matrouh (Mn x Mt) was heavier egg weight than the corresponding egg weight of Silver Montazah x Matrouh (S.M x Mt) cross 50.2 vs. 48.7 g. It is evident from the results (Table 2) that egg weight from the different genetic groups (Treatments) was statistically differ significantly (P<0.01). The same trend was found between hybrids, parents, between Mandarah and Silver Montazah, within Matrouh and Mandarah and Silver Montazah vs. Matrouh (P<0.01). Also the interactions effect hybrids vs. parents and hybrids vs. Matrouh were highly significant different. The genetic differences between strains for egg weight were reported by Carter and Jones (1970) and Arafa et al. (1982).

It appears from Table. 3 that the cross Mn x Mt showed positive heterosis effect (1 %) for egg weight. This means that dominance tended to the higher parent of this trait. The cross S.M. x Mt showed negative heterotic values (-4.1 %) for egg weight. Therefore, it could be concluded that dominance toward the lower parent was found. Boutrous (1998) found positive heterotic effects for egg weight. The results presented in Table, 4 reflected negatively low estimate of additive genetic variations ($\sigma^2 A$ -8.2) and dominance variations $\sigma^2 d$ (-6.2) for egg weight. These results suggested that the environmental effects were large and masked the variation due to additive and non additive effects of genes. The estimated degree of dominance ($\hat{h}$) 0.9 for egg weight showed that complete dominance is present in the majority of the loci of egg weight. The same findings were found by Abou El-Ghar et al. (2007).

Shell weight: As seen in Table (1) shell weight in Silver Montazah being the heaviest (7.0 g.) among all different genetic groups the corresponding shell weights were 6.9, 6.5, 6.1 and 5.2 g. for SM x Mt, Mn x Mt crosses, Mandarah and Matrouh, respectively. There were significant differences (P<0.01) and (P<0.05) among the different genetic groups and the interactions of hybrids vs. parents and hybrids vs. Matrouh for shell weight (Table 2). The same findings were reported by Pandey et al. (1986).

Concerning heterotic effects on shell weight the crosses Mn x Mt and SM x Mt showed 14.0 and 13.1 %, respectively (Table 3). Iraqi (2002) found positive and negative heterotic effects for egg shell weight. These positive results mean that dominance for high parent was found for shell weight. Also these findings supported by the values of ($\hat{h}$) 1.5 (Table 4). Such values indicated that complete dominance was found in the inheritance of shell weight. Regarding the negative estimates of σ^2A -0.4 and σ^2d -0.9 may be due to the genes with negative effects were present with the high frequencies. The same result was reported by (Cannings et al., 1978). Also the previous results indicated that non-additive genetic effects may control the variation in F1 crosses.

Shell thickness: Shell thicknesses of different genetic groups are shown in Table (1). It was noticed that Silver Montazah had the highest value (36.4 mm.) among all groups, while the other values were 34.3, 34, 32.4 and 30.9 for Matrouh, Mandarah, SM x Mt and Mn x Mt, respectively. Similar results were obtained by El-Soudany et al., 2003. Concerning the variations in shell thickness, results in Table 2 showed that there were significant differences ($P<0.01$) between the different genetic groups and the interactions of hybrids vs. parents and hybrids vs. Matrouh.

It could be seen from Table, 3 that the crosses Mn x Mt and SM x Mt showed negative heterotic affects on shell thickness -9.6 and -8.5 %, respectively. The same results were obtained by Iraqi (2002). These results reflect that genes with negative effects were controlled the inheritance of shell thickness. Moreover, the degree of dominance ($\hat{h}$) was 0.02 and this means that No-dominance is present in the inheritance of shell thickness. The former results dealt with those listed in Table 4, reflected low proportion of non-additive mean square σ^2d 0.001, while the negatively additive mean square σ^2A -1.9 of was controlling the inheritance of shell thickness. These results suggested that the genetic variation for this trait was largely unexpressed or that environmental effects were large and masked observable genetic variation. The same finding was reported by (Cannings et al., 1978).

Egg shape index: The cross Mn x Mt had nearly similar egg shape index of that Matrouh 0.76 and 0.76, while the cross SM x Mt had the lowest egg shape index value (0.72). Contrarily, Silver Montazah exhibited the highest egg shape index value 0.78, and the eggs from Mandarah had a 0.75 value of egg shape index (Table 1). The observed differences among genetic groups for egg shape index presented in Table, 2 showed that no-significant differences were found between replicates and within Matrouh, while significant differences (P<0.01) were shown for egg shape index in between hybrids, among parents, between Mandarah and Silver Montazah, Mandarah and Silver Montazah vs. Matrouh. The interactions effect hybrids vs. parents and hybrids vs. Matrouh were highly significant differences. These results agreed with those reported by Arafa et al. (1982) and Zeba et al. (2000).

It appears from Table, 3 that the cross Mn x Mt showed positive Heterosis percentage 0.7 for egg shape index and this means that dominance tended to the higher parent of the trait. Contrarily, the cross SM x Mt showed negative heterotic value (-6.5), therefore, it could be concluded that dominance toward the lower parent was found. Concerning the additive and dominance genetic variations, Table 4 showed that the estimate of $\sigma^2 d$ was larger than additive for egg shape index 0.0005 vs. -0.0003. This result indicated that there were some degrees of dominance in the in heritance of this trait. Also, these results are dealing with the value of $\hat{h}$ 1.3, and complete dominance was controlling the inheritance of egg shape index.

Albumin weight: Albumin weights from Mn x Mt, S.M x Mt, Mandarah, Silver Montazah and Matrouh were 25.0, 24.4, 27.4, 29.0 and 24.0 g., respectively (Table 1). There were significant differences (P<0.01) between the different genetic groups and the interactions of hybrids vs. parents and hybrids vs. Matrouh for albumin weight (Table 2). It could be seen from Table, 3 that the crosses Mn x Mt and SM x Mt showed negative heterotic effects on albumin weight -3.1 and -7.9 %, respectively. These results reflected that dominance toward lower parent found in albumin weight. The degree of dominance ($\hat{h}$) was 1.5 and this means that complete dominance is controlling the inheritance of albumin weight.

From Table, 4 it is valuable to discuss the genetic variance components. The same results were reported by Nawar (2009). The negative estimates of $\sigma^2 A$ -4.3 and $\sigma^2 d$ -9.7 indicated that dominance was the major source of variation in F1 crosses and the negative direction of additive and dominance variance may be due to the genes with negative effects were present with the high frequencies. The same result was reported by (Cannings et al., 1978).

Yolk weight: Mandarah pure strains had significantly heaviest yolk weight (16.2) followed by Silver Montazah (16.0) and Matrouh (15.6 g.), while the heaviest yolk weights were achieved by the two crosses Mn x Mt (18.6) and SM x Mt (17.3 g.) Table (1). No significant differences were found between replicates and within Matrouh concerning yolk weight. Significant differences (P<0.01) were shown for yolk weight in between hybrids, parents, between Mandarah and Silver Montazah, Mandarah and Silver Montazah vs. Matrouh. The interactions effect hybrids vs. parents and hybrids vs. Matrouh were also highly significant differences (Table 2). The same findings were reported by Pandey et al. (1986). It could be seen from Table, 3 that both crosses Mn x Mt and S.M x Mt showed highly positive heterotic effects on yolk weight 16.9 and 9.5 %, respectively. These results together with the values of $\hat{h}$ 1.7 Table, 4 suggested that over dominance to Mandarah and Silver Montazah was more important in the inheritance of yolk weight. The same results were reported by Nawar (2009). Moreover, the estimates of σ^2A 13.1 and σ^2d 37.6 indicated that non-additive portion of genetic variance was controlling the inheritance of this trait.

Yolk index: It appears from Table 1 that Mandarah and Matrouh pure strains and their cross Mn x Mt had significantly highest yolk index 0.47, while the lowest yolk index was achieved by Silver Montazah 0.40. And the cross SM x Mt had 0.44 of yolk index. Concerning the analysis of variance Table 2, showed insignificant differences in within Matrouh for yolk index, while, the other mean squares due to between hybrids, parents, Mandarah and Silver Montazah, Mandarah and Silver Montazah vs. Matrouh. The interactions effect hybrids vs. parents and hybrids vs. Matrouh were highly significant differences. Similar results were found by Nawar (2009) who found significant differences among genetic groups for yolk index. Generally, the crosses reflected relatively small variations from parents concerning with yolk index. Whereas, both cross Mn x Mt and S.M x Mt showed no heterotic affects on yolk index (Table 3). These results together with the values of $\hat{h}$ 0.09 Table, 4 suggested that no-dominance was found in the inheritance of yolk index. Moreover, the estimates of σ^2A (-865.6) and σ^2d (-7.0) suggested that genetic variation for these traits was largely unexpressed or that environmental effects were large and masked observable genetic variation.

Haugh unit: The most desirable Haugh unit percentage 94.6 was achieved by the cross Mn x Mt flowed by the cross SM x Mt 92.9 then Matrouh 89.9, Mandarah 82.8 and Silver Montazah 74.4 (Table 1). There were significant differences ($P<0.01$) and ($P<0.05$) among the different genetic groups and the interactions of hybrids vs. parents and hybrids vs. Matrouh for Haugh unite (Table 2). Similar results were reported by Ledur et al. (2002). Concerning Heterotic effects on Haugh unit the crosses Mn x Mt and SM x Mt showed 9.7 and 13.0 %, respectively (Table 3). This means that dominance toward high parent was found for the trait. These findings supported by the values of ($\hat{h}$) 1.3 (Table 4). Such value indicated that complete dominance was found in the inheritance of Haugh unit. Moreover, the estimates of σ^2A 10.03 and σ^2d -16.9 listed in Table 4, indicated that additive portion of genetic variance was controlling the inheritance of this trait. The same findings were reported by Scheinberg et al. (1953).

CONCLUSION

Based on the results of the current study, it could be concluded that Silver Montazah was superior in egg weight, shell weight, shell thickness, egg shape index and albumin weight over other developed strains, and Mandarah was superior in yolk weight and yolk index than other strain and Matrouh was better in yolk index and Haugh unit traits. Moreover, egg quality characteristics like egg weight, egg shape index, yolk weight, shell weight and Haugh unit could be improved by crossing, such traits exhibit positive heterotic effects and the dominance toward high parent was controlling the inheritance of these traits. On the other hand, selection for increasing yolk weight and Haugh unit can benefit egg quality commercially, because of their additive genetic variations (σ^2A) accounted a high portion of the total genetic variations. Generally, most of egg quality characteristics had negative estimates of additive σ^2A and dominance σ^2d genetic variations and this may be due to the presence of genes with negative effects in high frequencies and/or the environmental effects were large and masked the observable genetic variation.

Table (1) Means ± S.D. of egg quality traits from some developed strains and their crosses

Genotypes crosses	No.	Traits							
		E.W	Sh.W	Sh.Th	E.Sh.I	Al.W	Y.W	Y.I	H.U
Mn x Mt	45	50.2±4.3	6.5±0.7	30.9±1.9	0.76±0.03	25.0±3.7	18.6±1.6	0.47±0.04	94.6±9.5
SM x MT	55	48.7±4.7	6.9±1.1	32.4±3.4	0.72±0.04	24.4±2.5	17.3±4.4	0.44±0.03	92.9±4.3
Mean Crosses	100	49.3±4.6	6.7±0.9	31.7±2.9	0.74±0.04	24.7±3.1	17.9±3.5	0.46±0.04	93.7±7.1
Parental strains									
Mn	140	49.8±4.0	6.1±0.9	34.0±3.4	0.75±0.06	27.4±3.3	16.2±1.6	0.47±0.04	82.8±8.0
SM	100	52.0±4.2	7.0±1.0	36.4±5.7	0.78±0.07	29.0±3.1	16.0±2.9	0.40±0.04	74.4±12.9
Mean of parental strains	240	50.6±4.3	6.5±1.1	35.1±4.6	0.76±0.07	28.1±3.3	16.2±2.2	0.44±0.05	79.3±11.1
Common parent									
Mt	95	49.6±4.6	5.2±0.8	34.3±3.0	0.76±0.03	24.0±3.4	15.6±2.0	0.47±0.03	89.5±10.0
Mean of total parents	335	50.5±4.4	6.2±1.2	34.8±4.2	0.76±0.06	28.1±3.3	16.0±2.0	0.45±0.05	82.2±11.7

E.W = egg weight, Sh.W= egg shell weight, Sh.Th = shell thickness, E.Sh.I = egg shape index, Al.W = albumin weight, Y.W = yolk weight, Y.I = yolk index, HU = Haugh units, Mn = Mandarah, SM = Silver Montazah, Mt = Matrouh.

Table (2) Mean squares of egg quality traits from some developed strains and their crosses

S.O.V	d.f	Traits							
		E.W	Sh.W	Sh.Th	E.Sh.I	Al.W	Y.W	Y.I	H.U
Bet. Rep.	4	27.7^{NS}	5.2**	90.9**	0.001^{NS}	16.6**	8.6^{NS}	0.01**	570.9**
Bet. Treat.	4	530.6**	61.8**	524.7**	0.1**	505.6**	176.1**	0.10**	6521.5**
Bet. Hybrids	1	2131.2**	95.6**	1199.9**	0.2**	963**	1244.1**	0.17**	5080.2**
Bet. Parents	2	3311.9**	239.5**	2470**	0.6**	1886.2**	820.8**	0.43**	23167.7**
Hybr. vs. Parents	1	2413364**	30185.8**	1274696**	550.6**	870457.1**	192681.5**	184.6**	4857510**
Bet. P_1&P_2	1	600444.6**	10176.7**	287860**	135.1**	185138.1**	61924.3**	46.4**	1483581**
Within P_3	94	21.8**	1.1*	17.2**	0.001^{NS}	11.7**	4.1^{NS}	0.002^{NS}	100.9*
Mn &SM vs. Mt	1	257444.1**	10759.1**	118608**	48.7**	68761.4**	28121.2**	9.1**	137643.8**
Hybrids vs. Mt	1	671828.3**	3641.9**	374455.6**	164.8**	271012.3**	46389.4**	65.96**	1947171**
error	426	15.5	0.8	10.4	0.003	8.3	5.7	0.001	77.9

E.W = egg weight. Sh.W= egg shell weight. Sh.Th = shell thickness. E.Sh.I = egg shape index. Al.W = albumin weight, Y.W = yolk weight. Y.I = yolk index. HU = Haugh units. Mn = Mandarah, SM = Silver Montazah. Mt = Matrouh.

Table (3) Means of crosses (F1), mid parent (MP) and Heterosis (H %)

Crosses		Traits							
		E.W	Sh.W	Sh.Th	E.Sh.I	Al.W	Y.W	Y.I	H.U
Mn x Mt	FI	50.2	6.5	30.9	0.76	25.0	18.6	0.47	94.6
	M.P	49.7	5.7	34.2	0.755	24.8	15.9	0.47	86.2
	H%	1.0	14	-9.6	0.7	-3.1	16.9	0.0	9.7
SM x Mt	FI	48.7	-6.9	32.4	0.72	24.4	17.3	0.44	92.9
	M.P	50.8	6.1	35.4	0.77	26.5	15.8	0.44	81.9
	H%	-4.1	13.1	-8.5	-6.5	-7.9	9.5	0.0	13

MnxMt = Mandarah x Matrouh. SMxMt = S.Montazah x Matrouh. F1 = F1 crosses. MP = mid parent.
H% = Heterosis percentage. E.W = egg weight. Sh.W= egg shell weight. Sh.Th = shell thickness. E.Sh.I = egg shape index.
Al.W = albumin weight. Y.W = yolk weight. Y.I = yolk index. HU = Haugh units

Table (4) Components of genetic variance

Traits	$\sigma^2 A$	$\sigma^2 d$	$\hat{h}$
Egg Weight	**-8.2**	**-6.2**	**0.9**
Shell Weight	**-0.4**	**-0.9**	**1.5**
Shell Thickness	**-1.9**	**0.001**	**0.02**
Egg Shape Index	**-0.0003**	**0.0005**	**1.3**
Albumin Weight	**-4.3**	**-9.7**	**1.5**
Yolk Weight	**13.1**	**37.6**	**1.7**
Yolk Index	**-865.6**	**-7.0**	**0.09**
Haugh Units	**10.03**	**-16.9**	**1.3**

$\sigma^2 A$ = additive genetic variance. $\sigma^2 d$ = dominance variance. h = the degree of dominance.

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الملخص العربي

صفات جودة البيض لبعض سلالات الدجاج المستنبطة وخلطانها

رضا شعبان أبوالغار و هداية محمد شعلان و حنان حسن غانم وأسامه محمود على

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أجريت هذه التجربة لدراسة صفات جودة البيض لبعض سلالات الدجاج المستنبطة مثل المندرة و المنتزه الفضي و مطروح وتأثير الخلط بينها علي بعض صفات جودة البيض. بالنظر الي متوسطات السلالات الأبوية نجد أن سلالة المنتزة الفضي قد تفوقت عن باقي السلالات فى صفات وزن البيضة ٥٢ جم، وزن القشرة ٧ جم، سمك القشرة 36.4 ميكروميتر، دليل شكل البيضة ٧٨% ووزن البياض 29.5 جم فى حين تفوقت سلالة المندرة عن باقي السلالات فى وزن الصفار 16.2 جم ودليل الصفار 47 ٪ بينما كانت سلالة مطروح هى الأفضل فى صفات دليل الصفار 47 ٪ ووحدات هوف 89.5 %. علاوة على أنه يمكن القول أن صفات جودة البيض مثل وزن البيضة ودليل شكل البيضة ووزن الصفار ووزن القشرة ووحدات هوف يمكن تحسينها وراثيا بإستخدام الخلط بين السلالات لأن تلك الصفات أظهرت تأثيرات موجبة للخليط تراوحت من 0.7 إلي 16.9٪ وكانت السيادة فى إتجاه الأب الأعلى فى قيمه الصفة كما أظهرت تقديرات درجة السيادة لهذه الصفات أن السيادة تقع فى حيز من سيادة تامة الى سيادة فائقة. على الجانب الأخر يمكن الإستنتاج أن الإنتخاب لصفات وزن الصفار ووحدات هوف ربما يكون مجديا من الناحية الإقتصادية وذلك لأن هاتان الصفتان أظهرتا تبايناً وراثياً مضيفا (تجميعياً 13.1 و 10.03 على التوالي). هذا على الرغم من أن هذه الدراسة اثبتت ان معظم صفات جودة البيض أظهرت قيم سالبة لكل من التباين الوراثب التجميعي وتباين السيادة وهذا ربما يرجع الى وجود الجينات ذات التاثير السالب بتكرارات كبيرة أو ربما يكون بسبب أن البيئة قد أثرت على هذه الصفات بدرجة كبيرة لدرجة أن التأثيرات البيئية قد حجبت تأثير العوامل الوراثية على هذه الصفات.