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RELATIONSHIP BETWEEN SOME BODY MEASUREMENTS AND FERTILITY IN MALES OF TWO LOCAL STRAINS OF CHICKEN.

By

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Abstract:A *total number of 100 pedigreed cocks from two strains of chickens, El-Salam and Mandarah (50 cocks each strain) at 8 weeks of age according to their sire families were used in this experiment to study the relationship between fertility with some body measurements such as body weight, lengths of shank and keel and secondary sexual characters (comb and wattle lengths and widths) in both strains. The cocks were classified at 40 weeks of age into three groups according to comb size. The 1st group: males with a large comb (LC), the 2nd group: males with a control comb (CC) and the 3rd group: males with a small comb (SC).*

The following results were obtained:

Semen ejaculate volume, sperm concentration, percentage of live sperm and sperm motility were significantly ($P \leq 0.05$) higher at 50 wks than those at 40 and 30 wks of age for both strains, in overall mean of Mandarah than El-Salam cocks at different ages and in heavy body weight cocks than control or light in both strains at 40 wk of age. Body weight, lengths of shank and keel and secondary sexual characters (length and width of both comb and wattle) increased linearly with increasing age in both strains. Cocks with (LC) had ejaculated volume, sperm concentration, percentage of live sperm, sperm motility and percentage of fertility higher than either (CC) or (SC) cocks in both strains at 40 weeks of age. Heritability estimates for ejaculate volume, semen pH and sperm motility were high and moderate of both strains at all ages studied. Phenotypic correlation in both strains was positive and moderate to high values between ejaculate volume and each sperm concentration, percentage of live sperm and sperm motility, between sperm concentration and percentage of live sperm and between body weight at 8 wk and each ejaculate volume, sperm concentration and percentage of live sperm in both strains. In Mandarah strain lengths of shank, keel and comb were highly positively correlated with ejaculate volume, sperm concentration and percentage of live sperm compared with El-Salam strain. Genetic correlation was positive and moderate to high between ejaculate volume and each percentage of live sperm, sperm concentration, and percentage of abnormal sperm and between percentage of live sperm and sperm motility in both strains. Genetic correlation was positive and moderate to high between body weight and each ejaculate volume, sperm concentration and percentages of live and abnormal sperm, and between wattle length and percentage of abnormal sperm in both strains.

Results provide evidence that phenotypic traits can be used as useful indicators to predict male's fertility in local strains, indicators for high semen physical quality traits, used in selection programs to improve local strain in early age and get rid of subfertile males for reducing production cost.

INTRODUCTION

Genetic selection procedures for important economic traits may negatively impact the subsequent productive efficiency of breeders, particularly in males (McGary *et al.*, 2002). Omeje and Marrire (1990) observed that significant genotype differences affected body size and semen characteristics of cocks, except the pH value. The assessment of semen quality characteristics of poultry birds gives an excellent indicator of their reproductive potential and has been reported to be a major determinant of fertility and subsequent hatchability of eggs (Peters *et al.*, 2004).

There are many morphometric traits (ornament and non-ornament) correlate with semen quality. In males of many species, one or more ornamental traits affect female's choice of mates (Ligon, 1999). The ornaments that have been compared to sperm quality in birds include song quality in sedge warblers (Birkhead *et al.*, 1997), tail attractiveness in peafowl (Birkhead and Petrie, 1995), and combs and wattles in chicken (Pizzari *et al.*, 2004; Bilcik and Estevez, 2005 and Galal, 2007). The non-ornaments which are correlated with semen quality in male chickens: body weight, shank length (SL) and keel length (KL) (Galal, 2007).

Ornamental traits (comb and wattle length) were good indicators of semen quality in Bandarah males (El-Sahn, 2007b). The secondary sexual traits, namely comb and wattle measurements, had positive phenotypic correlations with most semen physical traits. Whereas, the genetic correlations between comb and wattle measurements with semen traits were mostly positive, which can be used as indicators for high semen physical traits in Norfa cocks (Gebriel *et al.*, 2009), which indicates the importance of relationship between phenotype traits and fertility, and that can be a reliable indicator to facilitate the identification and removal of subfertile males from the breeder flock (McGary *et al.*, 2002).

This experiment was planned to estimate some genetic parameters such as sire heritability of semen physical characteristics and sire genetic and phenotypic correlations either between each semen physical characteristics and each secondary sexual characters and body weight in order to predict cocks fertility in early ages.

MATERIALS AND METHODS

This work was carried out at Poultry Farm of Sakha, Animal Research Station, Animal Production Research Institute, Agricultural Research Center, Ministry of Agriculture, Egypt. Two strains of chickens, El-Salam and Mandarah were used in this study.

Birds and experimental design

A total number of 100 pedigreed cocks (50 cocks each strain) according to their sire families were used in this experiment to study the relationship between fertility with some body measurements such as body weight, lengths of shank and keel and secondary sexual characters (length and width of both comb and wattle) in both El-Salam and Mandarah males. Birds were assigned randomly into cages and submitted to the same managerial condition throughout the experimental period from 8 to 50 wks of age. Feed and water were allowed *ad libitum*. Birds were fed a commercial diet (15% CP and 2700 Kcal / kg diet) up to 20 weeks followed by diet contains (16.5% CP and 2750 Kcal / kg diet) up to 50 weeks of age. A photoperiod of 16 L -8 D was provided. All cocks were vaccinated according to a vaccination program.

Cocks were classified at 40 weeks of age into three groups according to comb size; 1st group: males with a large comb (LC), the 2nd group: males with a control comb (CC) and the 3rd group: males with a small comb (SC). The comb size (comb length x comb width) was estimated according to Parker *et al,* (2006), as given in Table (1).

Table (1): Means of comb size (comb length x comb width) in both El-Salam and Mandarah cocks at 40 weeks of age.

Strain	Comb length (cm)			Comb width (cm)			Comb size (cm2)		
	Large	Control	Small	Large	control	Small	Large	Control	Small
El-Salam	1.47	1.13	0.99	3.75	3.58	3.39	5.51	4.05	3.36
Mandarah	4.98	4.64	4.49	7.51	7.22	7.03	37.40	33.50	31.56

Measurements:

Body weight and lengths of keel and shank:

Individual body weight (g), shank length (mm) and keel length (mm) were recorded for each cock in both El-Salam and Mandarah strains at 8, 12, 30, 40 and 50 weeks of age. A cloth measuring tape was used to measure keel length which was defined as the maximum distance from the anterior end of the sternum to the posterior end of the xyphoid according to El-Sahn, (2007a and b).

Secondary sexual characters:

The secondary sexual characters measured individually were comb length (CL), comb width (CW), wattle length (WL) and wattle width (WW), (CL) and (WL) were measured as the maximum horizontal distance between the front and the rear of the comb or wattle. While, (CW) was measured as the maximum vertical distance from the highest peak of the comb to the base and (WW) as the maximum vertical distance from base of the wattle to the distal end. Measurements (cm) were recorded individually for each cock for El-Salam and Mandarah strains at 8, 12, 30, 40 and 50 weeks of age according to Gebriel *et al.*(2009).

Semen physical characteristic:

Semen was collected individually twice a week for two weeks from each cock for each strain at 30, 40 and 50 weeks of age using the message method squeezing the copulatory organs to obtain semen to study strain, age, body weight and comb size effects on semen physical characteristics. Collection was done four times each cock beginning of each age. Semen samples were examined for the following characteristics.

1-The ejaculate volume was determined to the nearest 0.01 ml. using 1.00 ml. tuberculin syringe.

2-Mass motility score (from 1 to 5 grades) using light microscope at 4000 magnification.

3-Percentages of live and abnormal sperm were determined after staining with iosine and nigrosine.

4-Sperm concentration was determined by using Thomes – Zeis haemocytometer.

5- Semen pH: Initial semen pH was obtained by means of comparative pH paper.

The previous characteristics were determined according to Kalamah *et al.* (2000).

Fertility percentage:

Eggs were collected from each hen which was mated with cock using artificial insemination at 40 weeks of age. Fertility

was determined at 7th day of incubation by egg candling.

Statistical analysis:

Data were subjected to computerized two-way analysis of variance and Duncan's multiple range test procedures using SAS (2001). The percentage values were transferred to percentage angle using arcsine equation before subjected to statistical analysis.

Genetic analysis:

Heritability estimation:

Heritability was estimated by paternal half sib method according to Harvey (1990) with the following equation:-

$$h_s^2 = \frac{4\sigma_s^2}{\sigma_s^2 + \sigma_e^2}$$

Where: σ^2 s = Sire variance component σ^2e = Residual variance component

Genetic and phenotypic correlations:

Genetic and phenotypic correlations among semen physical characteristics and between each body measurements at 8 wk and each semen physical characteristics. Semen physical characteristics were estimated according to Harvey (1990) with the following equation:-

$$r_{Gsxy} = \frac{\text{cov}.s_{xy}}{\sqrt{v_{s_x}.v_{s_y}}}$$

$$r_{pxy} = \frac{\text{cov}\, p_{xy}}{\sqrt{v_{p_x}.v_{py}}}$$

Whereas;

r_{Gsxy}= Genetic correlation between two considered traits (x and y),

Cov.s_{xy} = Covariance of sire component between two traits,

v_{s_x} = Variance of sire component for the trait x,

v_{s_y} =Variance of sire component for the trait y,

r_{pxy} = Phenotypic correlation between two considered traits (x and y),

$\text{cov}\, p_{xy}$ = Phenotypic covariance between two traits,

v_{p_x} = Phenotypic variance for the trait x

v_{p_y} = Phenotypic variance for the trait y.

RESULTS AND DISCUSSION

Semen quality characteristics:

a- Strain effect:

Mean values of semen physical characteristics as affected by strain at different ages are presented in Table (2). It is clear that the total average of semen ejaculate volume, sperm concentration, percentage of live sperm and sperm motility were significantly (P≤0.05) higher in Mandarah than El-Salam cocks. The reverse results were obtained with percentage of abnormal sperm. Strain had no significant effect on semen pH. This result agrees with Peters *et al.* (2008) who found that strain significantly affected semen ejaculate volume, sperm concentration and sperm motility but not significant on semen pH. Whereas, the differences in most of semen physical characteristics between strains were found to be insignificant (Habeb, 2007; Aly and El-Sahn, 2006 and El-Fiky and Soliman, 2006).

b- Age effect:

Data in Table (2) show that all semen physical characteristics except percentage of abnormal sperm and semen pH increased with increasing age (significantly (P≤0.05) higher at 50 wks than at 40 and 30 wks of age) for both Mandarah and El-Salam cocks. The reverse trend was observed for percentage of abnormal sperm, which was significantly (P≤0.05), decreased with increasing age in both strains. There were

insignificant differences among age periods due to age effect on semen pH in both strains. These results agree with those of Hanafy (2006), El-Sheikh and Hanafy (2006) and El-Tantawy *et al.* (2007) who found that semen volume, sperm concentration, sperm motility and live sperm of Inshas and Matrouh cocks increased linearly with increasing age, while, abnormal sperm was decreased linearly with increasing age. In contrast, these results disagree with those of Ali *et al.* (2006) and Shahein *et al.* (2007) found no significant effect of age on semen volume, sperm motility, sperm concentration and live sperm.

c- Body weight effect:

From Table (3), it is clear that semen ejaculate volume, sperm concentration, percentage of live sperm and sperm motility produced from heavy body weight cocks in both El-Salam and Mandarah cocks at 40 wk were significantly ($P<0.05$) higher than that produced from control or light body weight cocks, the lowest values were recorded for light body weight cocks in both strains. Also, the overall mean was higher in Mandarah than El-Salam cocks with significant ($P\leq0.05$) for sperm concentration and sperm motility only. On the other hand, percentage of abnormal sperm was significantly ($P\leq0.05$) higher in light body weight cocks than that heavy or control cocks in both strains. There were no significant differences among lines due to body weight effect on semen pH in both strains. Also, El-Salam cocks had insignificant higher differences in both percentage of abnormal sperm and semen pH than Mandarah cocks. These findings agree with the results of Gebriel *et al.* (2009) who indicated that heavy body weight of Norfa cocks had significantly higher values of sperm concentration, percentage of live sperm and lower values of percentage of abnormal sperm than the light and control body weight cocks. In this respect, Soliman, (1996) and Kalamah *et al.* (2000) observed that the light body weight cocks had significantly higher ejaculate volume, sperm motility and percentage of abnormal sperm, and lower sperm concentration and percentage of live sperm, but the statistical differences among body weight lines in semen pH were not significant.

Some body measurements:

The average values of body measurements: body weight, lengths of shank and keel and secondary sexual characters (length and width of both comb and wattle) of both El-Salam and Mandarah cocks during early (8-12 wk) and late (30-50 wk) periods are presented in Table (3). Values generally increased linearly with increasing age in both strains. The differences in this concept, were significant ($P\leq0.05$) during early period (8-12 wk) for body weight, length of both keel and shank and comb length and width in both strains, for wattle length of El-Salam and for wattle width of Mandarah cocks, and during late period (30-50 wk) for body weight and secondary sexual characters (length and width of both comb and wattle) in both strains. Moreover, the overall mean of El-Salam cocks had body weight and length of both keel and shank higher than Mandarah cocks during early and late periods. while, the highest values of secondary sexual characters (length and width of both comb and wattle) were recorded in Mandarah compared with El-Salam cocks during early and late periods except length of both comb and wattle during early period only (8-12), the differences in this respect, were significant ($P\leq0.05$). These values were lower than the values reported by Gebriel *et al.* (2009) in Norfa cocks and El-Sahn, (2007a) in Bandarah cocks.

Effect of comb size on:

a- Semen physical characters:

Data in Table (5) represent semen physical characteristics of both El-Salam and Mandarah cocks at 40 weeks of age in relation to comb size. It was found that (LC) cocks had higher ejaculated volume, sperm concentration, percentage of live sperm and sperm motility than those for either (CC) or (SC) cocks in both strains. An opposite trend

was true for percentage of abnormal sperm, it was lower in (LC) than either (CC) or (SC) cocks. Statistical differences among comb size groups for semen pH were not statically different. The overall mean of Mandarah cocks had the highest values of ejaculate volume, sperm concentration, percentage of live sperm and sperm motility compared with El-Salam cocks, the differences in this respect, were significant ($P \leq 0.05$) for sperm concentration and sperm motility. Whereas, El-Salam cocks had higher and insignificant for both percentages of abnormal sperm and semen pH than Mandarah cocks. These findings agree with those reported by El-Sahn (2007b) who observed that males with large comb had the highest semen evaluation compared with males with small comb except for percentage of live sperm.

b- Fertility percentage:

It can be observed from Table (5) that (LC) males had percentage of fertility higher than either (CC) or (SC) males in both strains at 40 weeks of age. The differences in this respect were significant ($P \leq 0.05$). The overall mean of Mandarah cocks had percentage of fertility higher than that El-Salam cocks. From these findings comb size could potentially be a reliable indicator of male semen quality and fertility.

Semen quality and fertility in this study added another indicator (comb size) with previous reports by El-Sahn, (2007a) and McGary *et al.* (2002). Previous researches showed that fertility decline may be related to altered male reproductive endocrinology and behavior (Rosenstrauch *et al.*, 1998 and Weil *et al.*, 1999), physical impairment upon copulation (Wilson *et al.*, 1979), reduction in sperm concentration and semen volume (Sexton, 1987) or a combination of all the above El-Sahn (2007a). Also, McGary *et al.* (2002) suggested that, if female broiler breeders more frequently crouch for and subsequently mate with males having large, symmetrical combs and wattles, differential fertility may be related to the fact that high quality males secure a higher mating frequency, which should in turn, improve reproduction.

Sire heritability (h_s^2):

Heritability estimates (h_s^2) for semen physical characteristics in both strains at different ages studied are given in Table (6). Results obtained suggest that ejaculate volume, semen pH and sperm motility seem to be moderately to highly heritable (0.266 – 0.401, 0.246 – 0.435 and 0.346 – 0.424, respectively), while sperm concentration, percentage of live sperm and percentage of abnormal sperm were lowerly heritable (0.109 – 0.198, 0.139 – 0.277 and 0.089 – 0.129, respectively).

The high heritability estimate for ejaculate volume in chickens (Chalov, 1971; Pingel and Schubert, 1983; Ansah *et al.*, 1985; Stenova, *et al.*, 1989 and Galal, *et al.*, 2002) and turkey (Stenova, *et al.*, 1987 and Hales *et al.*, 1989) indicated that semen production is influenced mainly by additive genes and consequently can be improved through direct selection. The relatively low heritability values for sperm concentration, percentage of live sperm and percentage of abnormal sperm justify the need for indirect selection for improving these traits. These low estimates of heritability can be explained by high environmental effects on these traits and addition information is required from relatives to improve these traits (Gebriel *et al.*, 2009).

However, the lowest estimates for heritability in both strains were observed at 30 wk of age, while the highest estimates were observed at 40 wk, but the estimates of heritability at 50 wk were intermediate. It is clear that heritability is likely to vary not only for the different traits, but also for the same trait at different ages. Generally, most of these heritability estimates were in the biological limits. In this respect, Gebriel *et al.* (2009) showed that the estimates of heritability can be classified into low values

(sperm concentration and percentage of abnormal sperm) to moderate values (ejaculate volume, percentage of live sperm, semen pH and sperm motility).

Phenotypic and genetic correlation:

Phenotypic correlation (r_P):

1- Between semen physical characteristics:

All possible phenotypic correlation (r_P) estimates between semen physical characteristics in both El-Salam and Bandarah strains are presented in Table (7). In general, in El-Salam males there were high and positive (r_P) observed between ejaculate volume and each sperm concentration and percentage of live sperm and between sperm concentration and percentage of live sperm. Low and positive (r_P) between ejaculate volume and sperm motility, between sperm concentration and each semen pH and sperm motility, between percentage of live sperm and each semen pH and sperm motility and between semen pH and sperm motility. While negative (r_P) was found between ejaculate volume and each percentage of abnormal sperm and semen pH, between sperm concentration and percentage of abnormal sperm, between percentage of live sperm and percentage of abnormal sperm and between percentage of abnormal sperm and each semen pH and sperm motility. While, in Mandarah males there were high or moderate positive (r_P) were observed between ejaculate volume and each sperm concentration, percentage of live sperm and sperm motility, between sperm concentration and each percentage of live sperm, semen pH and sperm motility, between percentage of live sperm and each semen pH and sperm motility and between percentage of abnormal sperm and semen pH. The (r_P) between semen pH and sperm motility was low and positive. But, there were negative (r_P) between ejaculate volume and each percentage of abnormal sperm and semen pH, between sperm concentration and percentage of abnormal sperm, between percentage of live sperm and percentage of abnormal sperm and between percentage of abnormal sperm and sperm motility. These estimates are nearly similar with those obtained by Machel *et al.* (1996), Gohar *et al.* (1997), Gebriel *et al.* (2009) and Soliman *et al.* (2007) who showed that the high phenotypic positive correlation was observed between sperm motility and each live sperm and sperm concentration and between live sperm and sperm concentration. While, the low phenotypic positive correlation was observed between ejaculate volume and each sperm motility, abnormal sperm and live sperm. On the other hand, the phenotypic negative correlation was observed between sperm motility and abnormal sperm and between abnormal sperm and each live sperm and sperm concentration.

2- Between semen physical traits and some body measurements:

a- Body weight and lengths of shank and keel:

Results presented in Table (8) showed that body weight in both El-Salam and Mandarah cocks at 8 wk had positive and high phenotypic correlations with ejaculate volume, sperm concentration and percentage of live sperm, whereas, negative estimates were observed between body weight and each percentage of abnormal sperm, semen pH and sperm motility. Also, Bowling *et al.* (2003) observed that sperm motility and mobility are negatively associated with body weight. This finding due to selection for high yield causing altered musculoskeletal confirmation and difficulty in successfully transferring sperm into oviduct during mating (McGary *et al.*, 2003). In both strains, positive phenotypic correlations was obtained betweem either shank or keel lengths and each ejaculate volume, sperm concentration, percentage of live sperm and sperm motility. However, the values of phenotypic correlations were higher in Mandarah than El-Salam males. In this respect, lengths of shank and keel were negatively correlated with percentage of abnormal sperm and

semen pH in both strains. These results are in agreement with the results reported by Harris *et al.* (1984), Johari *et al.* (1986) and Gebriel *et al.* (2009) who indicated that body weight of Norfa cocks had positive phenotypic correlations with semen ejaculate volume, sperm concentration and percentage of live sperm, whereas, negative estimates were observed between body weight and each percentage of abnormal sperm, semen pH and sperm motility. Also, El-Sahn (2007b) reported significant positive correlation between keel length and each ejaculate volume and sperm concentration, and negative correlation between percentages of live sperm and forward motility. However, Galal *et al.* (2002) showed that positive phenotypic correlation was observed between shank length and each ejaculate volume, percentages of abnormal and dead sperm.

b- Secondary sexual characters:

Table (8) indicates that all secondary sexual characters (comb length, comb width, wattle length and wattle width) of El-Salam and Mandarah males at 8 wk were positively correlated with ejaculate volume, sperm concentration, percentage of live sperm and sperm motility, the highest values in this respect, were observed in Mandarah strain. The secondary sexual characters were negatively correlated with percentage of abnormal sperm and semen pH. These results are nearly similar with those observed by Galal *et al.* (2002), Galal, (2007) and Gebriel *et al.* (2009) who indicated that comb length and width in Norfa cocks had positive phenotypic correlations with semen ejaculate volume, sperm concentration, percentage of live sperm and sperm motility. Whereas, the comb length and width had negative phenotypic correlations with semen pH and percentage of abnormal sperm in both strains. However, similar phenotypic correlations were observed between wattle length and width with all semen physical characters studied except percentage of abnormal sperm, it was negatively correlated with wattle length and width. These results concluded that secondary sexual characters, namely (comb length, comb width, wattle length and wattle width) had phenotypic positive correlation with most of semen physical characteristics which may be used as a useful tool for predicting cocks with high semen quality. In this respect, McGary *et al.* (2003) provided evidence that secondary sexual characters namely length of comb and wattle might be useful to predict fertility and semen quality in broiler cocks.

Genetic correlation (r_G):

1- between semen physical characteristics:

All possible genetic correlation among semen physical characteristics in both El-Salam and Mandarah strains are presented in Table (9). In both strains, there were positive and relatively moderate to high genetic correlation between semen ejaculate volume and each sperm concentration, percentages of live and abnormal sperm and sperm motility, whereas, negative genetic correlation with semen pH. Sperm concentration was highly positively correlated with percentages of live and abnormal sperm and sperm motility, but, it was negatively correlated with semen pH in both strains. The genetic correlation was high and positive in both strains between percentage of live sperm and sperm motility, while, the genetic correlation was negative between percentage of live sperm with both percentage of abnormal sperm and semen pH. In both strains low and positive genetic correlations were noticed between percentage of abnormal sperm and semen pH, whereas, low and negative genetic correlations were noticed between sperm motility with both percentage of abnormal sperm and semen pH. The high values of sire genetic correlation between ejaculate volume and most of semen physical traits specially, the sperm concentration should be taken into consideration for any selection programs to improve these semen characters. These results nearly agree with the results reported by Gebriel *et al.* (2009) who indicated that

the genetic correlation among all semen physical traits (ejaculate volume, sperm concentration, percentages of live and abnormal sperm, semen pH and sperm motility) in Norfa cocks were mostly positive and ranged from 0.136 to 0,829. In addition, Osman (1991) reported that most of the sire genetic correlations for semen volume and sperm concentration with other semen quantity characters were positive with high values in both Fayoumi and White Leghorn and their crosses.

2- Between semen physical traits and body measurements:

a- Body weight and lengths of shank and keel:

From Table (10), it is clear that all semen physical characteristics studied except semen pH in both El-Salam and Mandarah males were positively genetically correlated with body weight and lengths of shank and keel. This correlation was high to moderate with body weight, while, it was low to moderate with lengths of shank and keel. In this concept, semen pH was negatively genetically correlated with both body weight and lengths of shank and keel. This finding confirms the results of Gebriel *et al.* (2009) who observed that body weight of Norfa cocks had positive and almost high estimates of genetic correlations with all semen physical traits studied except semen pH which had negatively correlated with body weight. In this respect, Johari *et al.* (1986) indicated that body weight was significantly positive correlated with sperm concentration and percentage of abnormal sperm, while, the correlation between body weight and sperm motility was significantly negative. On the other hand, Galal *et al.* (2002) showed that body weight had negatively genetically correlated with ejaculate volume and percentage of abnormal sperm, whereas, positive genetic correlation with sperm motility was observed. These results concluded that selecting high body weight cocks for artificial insemination will improve the semen physical quality of El-Salam and Mandarah cocks.

b- Secondary sexual characters:

Genetic correlation between secondary sexual characters and semen physical characteristics in both El-Salam and Mandarah strains are given in Table (10). Results obtained showed that, comb length and width as well as wattle width in both strains were positively genetically correlated with ejaculate volume, sperm concentration, percentage of live sperm and sperm motility. However, the values observed of correlations were moderate with comb length and width, whereas, these values were low with wattle width. In this respect, comb length and width as well as wattle width were negatively genetically correlated with percentage of abnormal sperm and semen pH in both strains. Moreover, all semen physical characteristics studied in both El-Salam and Mandarah cocks were positively genetically correlated with wattle length. These findings are in keeping with that reported by Gebriel *et al.* (2009) who found that comb length and width had positive genetic correlation with semen ejaculate volume, sperm concentration, percentage of live sperm and sperm motility, whereas, the comb length and width had negative genetic correlations with semen pH and percentage of abnormal sperm. He added that genetic correlations between wattle length and width were positive with semen ejaculate volume, sperm concentration, percentage of live sperm and sperm motility, but, the genetic correlations between both wattle length and width with abnormal sperm and semen pH were negative. Galal *et al.* (2002) showed that lengths of comb and wattle had positively correlations with both ejaculate volume and percentage of abnormal sperm. It was reported that the degree of development of the secondary sexual characters could affect the reproductive potential of an individual cock (Andersson, 1994). In conclusion, body measurements are good indicators for semen physical quality in both El-Salam and

Mandarah cocks and must be incorporated into genetic selection regimen in early age with the intent of 1) Improving fertilizing efficiency of the males, 2) Get red of subfertile males and 3) Reduce the cost of production.

Table (2): Means ±S.E. of semen physical characteristics of El-Salam and Mandarah cocks at different ages.

Traits	Strains							
	El-Salam				Mandarah			
	30 wk	40 wk	50 wk	Overall mean	30 wk	40 wk	50 wk	Overall mean
Ejaculate volume (ml)	$0.33^{c} \pm 0.002$	$0.39^{b} \pm 0.004$	$0.42^{a} \pm 0.006$	$0.38^{B} \pm 0.004$	$0.34^{c} \pm 0.002$	$0.41^{b} \pm 0.005$	$0.45^{a} \pm 0.006$	$0.40^{A} \pm 0.003$
Sperm concentration x 10^{9}/ml	$3.34^{c} \pm 0.029$	$3.78^{b} \pm 0.082$	$4.53^{a} \pm 0.041$	$3.88^{B} \pm 0.051$	$3.59^{c} \pm 0.035$	$4.09^{b} \pm 0.100$	$4.79^{a} \pm 0.045$	$4.16^{A} \pm 0.055$
Live sperm (%)	$79.68^{c} \pm 0.244$	$80.94^{b} \pm 0.312$	$84.46^{a} \pm 0.432$	$81.69^{B} \pm 0.255$	$80.58^{c} \pm 0.313$	$81.94^{b} \pm 0.399$	$86.78^{a} \pm 0.750$	$83.10^{A} \pm 0.370$
Abnormal sperm (%)	$17.88^{a} \pm 0.300$	$16.44^{b} \pm 0.314$	$12.60^{c} \pm 0.208$	$15.64^{A} \pm 0.242$	$17.36^{a} \pm 0.335$	$15.32^{b} \pm 0.246$	$11.42^{c} \pm 0.140$	$14.70^{B} \pm 0.248$
Semen pH	7.30 ± 0.023	7.23 ± 0.017	7.27 ± 0.020	7.27 ± 0.012	7.20 ± 0.023	7.15 ± 0.015	7.16 ± 0.011	7.17 ± 0.010
Sperm motility (1-5) degree	$3.22^{c} \pm 0.024$	$3.54^{b} \pm 0.022$	$4.11^{a} \pm 0.018$	$3.62^{B} \pm 0.020$	$3.49^{c} \pm 0.026$	$4.13^{b} \pm 0.017$	$4.32^{a} \pm 0.016$	$3.98^{A} \pm 0.020$

a, b and c Means in the same row with different superscript are significantly different ($P \leq 0.05$).
A and B Overall means within the same row with different superscript are significantly different ($P \leq 0.05$).

Table (3): Means ±S.E. of semen physical characteristics of El-Salam and Mandarah cocks as affected by body weight at 40 weeks of age.

Traits	Strain							
	El-Salam				Mandarah			
	Heavy (2076 g)	Control (2021 g)	Light (1979 g)	Overall mean	Heavy (1995 g)	Control (1958 g)	Light (1919 g)	Overall mean
Ejaculate volume (ml)	0.42±0.064 ^{a}	0.39±0.061 ^{b}	0.34±0.058 ^{c}	0.38±0.059	0.45±0.059 ^{a}	0.41±0.064 ^{b}	0.36±0.060 ^{c}	0.41±0.069
Sperm concentration x 10^{9}/ml	4.51±0.734 ^{a}	3.87±0.719 ^{b}	2.91±0.744 ^{c}	3.76±0.731 ^{B}	4.67±0.791 ^{a}	4.11±0.801 ^{b}	3.53±0.777 ^{c}	4.10±0.781 ^{A}
Live sperm (%)	84.94±4.807 ^{a}	79.80±4.873 ^{b}	76.94±5.118 ^{c}	80.56±4.993	85.45±5.005 ^{a}	81.95±4.913 ^{b}	78.63±4.899 ^{c}	82.01±5.001
Abnormal sperm (%)	14.61±3.686 ^{c}	16.79±3.697 ^{b}	19.21±3.712 ^{a}	16.87±3.722	12.26±3.151 ^{c}	15.58±3.157 ^{b}	17.95±3.165 ^{a}	15.26±3.173
Semen pH	7.21±0.368	7.22±0.363	7.30±0.371	7.24±0.384	7.17±0.407	7.15±0.401	7.11±0.400	7.14±0.409
Sperm motility (1-5) degree	3.80±0.271 ^{a}	3.47±0.240 ^{b}	3.40±0.263 ^{b}	3.56±0.259 ^{B}	4.30±0.267 ^{a}	4.14±0.263 ^{ab}	3.97±0.266 ^{b}	4.13±0.273 ^{A}

a, b and c Means in the same row with different superscript are significantly different ($P \leq 0.05$).

A and B Overall means within the same row with different superscript are significantly different ($P \leq 0.05$).

Table (4): Means ±S.E. of some body measurements of El-Salam and Mandarah cocks at different ages.

Traits	Strain					
	El-Salam			Mandarah		
	8 wk	12 wk	Overall mean	8 wk	12 wk	Overall mean
BW (g)	781.0 ± 10.58^{a}	1034.0 ± 20.52^{b}	907.5±10.39^{B}	770.4 ± 13.43^{a}	931.8 ±18.59^{b}	851.0±11.13^{A}
SL (cm)	6.31 ± 0.083^{a}	8.67 ± 0.072^{b}	7.49±0.043^{B}	6.40 ± 0.080^{a}	8.16 ± 0.056^{b}	7.28±0.041^{A}
KL (cm)	7.49 ± 0.081^{a}	9.67 ± 0.076^{b}	8.58±0.075^{B}	7.78 ± 0.075^{a}	8.83 ± 0.081^{b}	8.31±0.069^{A}
CL (cm)	0.336 ± 0.036^{a}	0.512 ± 0.046^{b}	0.425±0.029^{B}	1.65 ± 0.066^{a}	2.0 ± 0.077^{b}	1.825±0.077^{A}
CW (cm)	1.74 ± 0.048^{a}	2.23 ± 0.058^{b}	1.98±0.041^{A}	2.94 ± 0.10^{a}	4.0 ± 0.132^{b}	3.470±0.062^{B}
WL (cm)	0.190 ± 0.022^{a}	0.314 ± 0.035^{b}	0.252±0.029^{A}	1.34 ± 0.067	1.67 ± 0.077	1.505±0.044^{B}
WW (cm)	1.53 ± 0.076	1.86 ± 0.084	1.69±0.028^{A}	1.97 ± 0.052^{a}	2.45 ± 0.063^{b}	2.210±0.037^{B}

a, b and c Means in the same row with different superscript are significantly different (P≤0.05).
A and B Overall means within the same row with different superscript are significantly different (P≤0.05).
BW: body weight, SL: shank length, KL: keel length, CL: comb length, CW: comb width, WL: wattle length, WW: wattle width

Table (4): Contains.

Traits	Strain							
	El-Salam				Mandarah			
	30 wk	40 wk	50 wk	Overall mean	30 wk	40 wk	50 wk	Overall mean
BW (g)	1868.0±25.3^{a}	2018.0 ±33.7^{b}	2206.0±27.2^{c}	2030.0±20.1	1878.0±12.4^{a}	1954.0 ±18.0^{b}	2080.0±19.1^{c}	1970.0±12.3
SL (cm)	9.68±0.052	9.76±0.072	9.90±0.063	9.78±0.037	9.29±0.085	9.54±0.038	9.73±0.046	9.52±0.037
KL (cm)	10.41±0.067	10.55±0.048	10.80±0.087	10.59± 0.042	10.19±0.033	10.21±0.436	10.50±0.047	10.30±0.035
CL (cm)	0.946±0.060^{a}	1.13±0.079^{ab}	1.63±0.113^{b}	1.23±0.055^{A}	4.27±0.138^{a}	4.64±0.113^{ab}	4.98±0.151^{b}	4.63±0.081^{B}
CW (cm)	3.14±0.154^{a}	3.58±0.151^{ab}	3.88±0.135^{b}	3.53±0.088^{A}	6.91±0.116^{a}	7.22±0.092^{ab}	7.49±0.111^{b}	7.20±0.064^{B}
WL (cm)	0.862±0.058^{a}	1.02±0.067^{b}	1.72±0.124^{c}	1.20±0.059^{A}	3.77±0.135^{a}	4.42±0.132^{b}	5.15±0.132^{c}	4.45±0.089^{B}
WW (cm)	2.71±0.155^{a}	3.23±0.171^{b}	3.87±0.206^{b}	3.27± 0.109^{A}	4.38±0.113^{a}	5.05±0.108^{ab}	5.72±0.094^{b}	5.05±0.075^{B}

a, b and c Means in the same row with different superscript are significantly different (P≤0.05).
A and B Overall means within the same row with different superscript are significantly different (P≤0.05).
BW: body weight SL: shank length KL: keel length CL: comb length CW: comb width WL: wattle length WW: wattle width

Table (5): Means ±S.E. of semen physical characteristics of El-Salam and Mandarah cocks as affected by Comb size at 40 weeks of age.

Traits	Strain							
	El-Salam				Mandarah			
	LC	CC	SC	Overall mean	LC	CC	SC	Overall mean
Ejaculate volume (ml)	0.43±0.068 ^{a}	0.38±0.066 ^{b}	0.36±0.069 ^{b}	0.39±0.073	0.45±0.066 ^{a}	0.42±0.062 ^{a}	0.35±0.064 ^{b}	0.41±0.060
Sperm concentration x 10^{9}/ml	4.07±0.929 ^{a}	3.73±0.932 ^{ab}	3.52±0.927 ^{b}	3.77±0.944 ^{B}	4.44±0.831 ^{a}	3.96±0.837 ^{b}	3.89±0.833 ^{b}	4.10±0.821 ^{A}
Live sperm (%)	82.13±4.182 ^{a}	82.09±4.178 ^{a}	77.42±4.180 ^{b}	80.55±4.192	83.92±4.438 ^{a}	82.13±4.436 ^{ab}	79.81±4.440 ^{b}	81.95±4.421
Abnormal sperm (%)	16.15±3.672	16.53±3.670	16.91±3.679	16.53±3.666	13.72±3.048 ^{b}	16.00±3.041 ^{a}	16.30±3.044 ^{a}	15.34±3.029
Semen pH	7.18±0.397	7.22±0.391	7.28±0.396	7.23±0.381	7.21±0.405	7.18±0.408	7.06±0.404	7.15±0.401
Sperm motility (1-5) degree	3.69±0.246 ^{a}	3.64±0.249 ^{a}	3.34±0.253 ^{b}	3.56±0.249 ^{B}	4.27±0.255 ^{a}	4.20±0.261 ^{a}	3.94±0.258 ^{b}	4.14±0.237 ^{A}
Fertility %	93.45±6.260 ^{a}	91.02±6.159 ^{b}	90.57±6.145 ^{b}	91.69±6.127	94.45±7.161 ^{a}	92.04±6.914 ^{b}	91.33±7.105 ^{b}	92.61±6.905

a, b and c Means in the same row with different superscript are significantly different (P≤0.05).
A and B Overall means within the same row with different superscript are significantly different (P≤0.05).
LC: Comb large CC: Control comb SC: Small comb

Table (6): Heritability estimates ± standard errors (h^2± SE) of semen physical characteristics of El-Salam and Mandarah cocks at different ages.

Traits	(h^2 ± SE)					
	El-Salam			Mandarah		
	30-wks	40-wks	50-wks	30-wks	40-wks	50-wks
Ejaculate volume	0.301±0.126	0.401±0.211	0.337±0.157	0.266±0.116	0.399±0.321	0.356±0.144
Sperm concentration	0.119±0.181	0.178±0.171	0.121±0.109	0.109±0.141	0.198±0.149	0.142±0.101
Live sperm (%)	0.139±0.092	0.268±0.156	0.236±0.421	0.149±0.066	0.277±0.131	0.199±0.342
Abnormal sperm (%)	0.089±0.120	0.129±0.071	0.121±0.089	0.098±0.110	0.128±0.089	0.107±0.065
Semen pH	0.246±0.186	0.415±0.167	0.328±0.361	0.287±0.197	0.435±0.155	0.328 ±0.361
Sperm motility	0.346±0.111	0.416±0.368	0.381±0.257	0.351±0.152	0.424±0.213	0.402±0.128

Table (7): Phenotypic correlation estimates among semen physical characteristics of El-Salam and Mandarah cocks.

Traits	E-Salam					Mandarah				
	Sperm concentration	Live sperm	Abnormal sperm	Semen pH	Sperm motility	Sperm concentration	Live sperm	Abnormal sperm	Semen pH	Sperm motility
Ejaculate volume	0.842	0.775	-0.657	-0.221	0.152	0.978	0.851	-0.957	-0.377	0.352
Sperm concentration		0.759	-0.739	0.066	0.198		0.868	-0.940	0.396	0.348
Live sperm (%)			-0.664	0.196	0.297			-0.852	0.474	0.313
Abnormal sperm (%)				-0.116	-0.408				0.383	-0.308
Semen pH					0.188					0.131

Table (8): Phenotypic correlation between semen physical characteristics with some body measurements of El-Salam and Mandarah cocks at 8 weeks of age.

Traits	E-Salam							Mandarah						
	BW	SL	KL	CL	CW	WL	WW	BW	SL	KL	CL	CW	WL	WW
Ejaculate volume	0.873	0.123	0.208	0.289	0.229	0263	0.293	0.930	0.888	0.783	0.867	0.346	0.300	0.384
Sperm concentration	0.841	0.187	0.294	0.182	0.086	0.274	0.291	0.963	0.910	0.815	0.862	0.331	0.302	0.313
Live sperm	0.779	0.156	0.239	0.203	0.161	0.264	0.301	0.862	0.848	0.747	0.747	0.332	0.256	0.346
Abnormal sperm	-0.844	-0.099	-0.256	-0.169	-0246	-0.196	-0.286	-0.912	-0.879	-0.786	-0.812	-0.358	-0.292	-0.274
Semen pH	-0.154	-0.015	-0.018	-0.082	-0.105	-0.123	-0.147	-0.393	-0.406	-0.297	-0.297	-0.272	-0.232	-0.241
Sperm motility	-0.314	0.001	0.002	0.203	0.040	0.150	0.118	-0.340	0.296	0.283	0.254	0.203	0. 300	0.180

BW= body weight, SL= shank length, KL= keel length, CL= comb length, CW = comb width, WL = wattle length, WW = wattle width

Table (9): Genetic correlation among semen physical characteristics of El-Salam and Mandarah cocks.

Traits	E-Salam					Mandarah				
	Sperm concentration	Live sperm	Abnormal sperm	Semen pH	Sperm motility	Sperm concentration	Live sperm	Abnormal sperm	Semen pH	Sperm motility
Ejaculate volume	0.712	0.311	0.497	-0.668	0.279	0.803	0.321	0.679	-0.814	0.311
Sperm concentration		0.455	0.411	-0.489	0.169		0.478	0.399	-0.528	0.213
Live sperm			-0.112	-0.401	0.798			-0.066	-0.437	0.856
Abnormal sperm				0.159	-0.257				0.111	-0.325
Semen pH					-0.283					-0.319

Table (10): Genetic correlation between semen physical characteristics with some body measurements of El-Salam and Mandarah cocks at 8 weeks of age.

Traits	E-Salam							Mandarah						
	BW	SL	KL	CL	CW	WL	WW	BW	SL	KL	CL	CW	WL	WW
Ejaculate volume	0.499	0.237	0.362	0.238	0.367	0.198	0.186	0.511	0.326	0.349	0.269	0.413	0.259	0.223
Sperm concentration	0.385	0.189	0.165	0.236	0.221	0.173	0.215	0.415	0.219	0.188	0.313	0.286	0.199	0.238
Live sperm	0.479	0.176	0.137	0.212	0.243	0.188	0.123	0.498	0.222	0.158	0.277	0.267	0.217	0.187
Abnormal sperm	0.711	0.234	0.199	-0.197	-0.219	0.715	-0.319	0.816	0.313	0.239	-0.212	-0.211	0.695	-0.369
Semen pH	-0.094	-0.142	-0.116	-0.149	-0.337	0.367	-0.412	-0.113	-0.137	-0.099	-0.187	-0.379	0.359	-0.397
Sperm motility	0.412	0.089	0.111	0.127	0.511	0.331	0.375	0.469	0.197	0.193	0.173	0.549	0.386	0.297

BW= body weight, SL= shank length, KL= keel length, CL= comb length, CW = comb width, WL = wattle length, WW = wattle width

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الملخص العربي

العلاقة بين بعض مقاييس الجسم والخصوبة فى ديوك سلالتين محليتين من الدجاج

فوزى على عبد الغنى – علاء كمال علم الدين -محمد محمود سليمان- أحمد محمد رزق- سامى محمود السودانى

معهد بحوث الإنتاج الحيوانى – مركز البحوث الزراعيه – وزارة الزراعه – دقى – جيزه

تم اجراء هذه الدراسة فى محطة بحوث الانتاج الحيوانى بسخا- معهد بحوث الانتاج الحيوانى بهدف دراسة العلاقة بين بعض مقاييس الجسم مثل وزن الجسم وأطوال كل من عظمتى الساق والقص وكذلك صفات الجنس الثانوية (طول وعرض كل من العرف والدالبتين) وعلاقتها بخصوبة الديوك. استخدم فى هذه الدراسة عدد ١٠٠ ديك منسب عند عمر ٨ أسابيع من سلالتى السلام والمندرة (٥٠ ديك لكل سلالة) تم تقسيمهم عند عمر ٤٠ أسبوع الى ثلاث مجاميع تبعا لحجم العرف (حجم عرف كبير- حجم عرف متوسط (كنترول) – حجم عرف صغير) وأوضحت النتائج مايلى:

- وجد أن هناك تأثيرا معنويا لكل من العمر والسلالة ووزن الجسم على حجم القذفة وحركة وتركيز الحيوانات المنوية وكذلك نسبة الحيوانات المنوية الحية حيث كانت هذه الصفات اعلى معنويا عند عمر ٥٠ أسبوع مقارنة بالاعمار عند ٣٠ أو ٤٠ أسبوع ، وفى سلالة المندرة مقارنة بسلالة السلام وكذلك فى الديوك الثقيلة مقارنة بالخفيفة أو الكنترول فى كلا السلالتين.
- وجد أن حجم القذفة وحركة وتركيز الحيوانات المنوية وكذلك نسبتى الحيوانات المنوية الحية والخصوبة كانت أعلا معنويا فى الديوك ذات العرف الكبير مقارنة بالديوك ذات العرف الصغير أو الكنترول فى كلا السلالتين.
- وجد أن قيم المكافىء الوراثى بالنسبه لحجم القذفة وتركيز أيون الأيدروجين وحركة الحيوانات المنوية كانت معتدلة الى عالية فى كلا السلالتين فى جميع الأعمار المدروسة.
- وجد أن الارتباط المظهرى بين حجم القذفة مع كل من حركة وتركيز الحيوانات المنوية ونسبة الحيوانات المنوية الحية، و بين تركيز الحيوانات المنوية ونسبة الحيوانات المنوية الحية، وكذلك بين وزن الجسم عند ٨ أسابيع من العمر مع كل من حجم القذفة وتركيز الحيوانات المنوية ونسبة الحيوانات المنوية الحية كان موجبا وذا قيم معتدلة الى عالية فى كلا السلالتين.
- وجد أن أطوال كل من عظمتى الساق والقص وكذلك العرف كانوا مرتبطين ارتباطا مظهريا موجبا وذا قيم عالية مع كل من حجم القذفة وتركيز الحيوانات المنوية ونسبة الحيوانات المنوية الحية وذلك فى سلالة المندرة مقارنة بسلالة السلام.
- وجد ان هناك ارتباط وراثى موجب وذا قيم معتدلة الى عالية بين حجم القذفة مع تركيز الحيوانات المنوية ونسبتى الحيوانات المنوية الحية والشاذة، وبين نسبة الحيوانات المنوية الشاذة وحركة الحيوانات المنوية، وبين وزن الجسم عند ٨ أسابيع مع حجم القذفة و. تركيز الحيوانات المنوية ونسبتى الحيوانات المنوية الحية والشاذة، وبين طول الدالبتين ونسبة الحيوانات المنوية الشاذة وذلك فى كلا السلالتين.
- نستنتج من هذه الدراسه ان الصفات المظهرية مؤشر مفيد للتنبؤ بخصوبة الديوك فى السلالات المحلية ويمكن استخدامها كأدلة للحصول على سائل منوى عالى الجودة ويمكن أيضا استخدامها فى برامج الانتخاب لتحسين السلالات المحلية فى أعمار مبكرة والتخلص من الديوك الغير مرغوبة وبذلك يتم خفض التكلفة الانتاجية.