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SOME FACTORS AFFECTING SEMEN QUALITY TRAITS IN NORFA COCKS

By

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Abstract : *The aim of the present study was to investigate the semen physical traits and their relation to some genetical, physiological and environmental factors in Norfa cocks. A total number of 57 pedigreed Norfa cocks represent 12 half sib families were used in the present study. The following results were obtained :*

1. Mean values of semen physical traits were 0.33 ml., 3.81 x 10^9 / ml., 81.79%, 15.64 %, 7.27 and 3.78 for ejaculate valume, sperm concentration, live sperms, abnormal sperms, semen pH and sperm motility, respectively.

2. The average values of comb length, comb width, wattle length and wattle width were 11.99, 4.21, 4.30 and 3.80 cm, respectively.

3. Heavy body weight (1740 g.) cocks had significantly higher values of sperm concentration, live sperms, sperm motility and significantly lower abnormal sperms than light (1350 g.) and control (1570 g.) body weight cocks.

4. Semen collected in December and January had significantly higher values of ejaculate volume, sperm concentration, live sperms and sperm motility and significantly lower value of abnormal sperms than semen collected in July and August.

5. Norfa cocks at 46 weeks of age had significantly higher values of sperm concentration, live sperms, sperm motility and significantly lower value of abnormal sperm than cocks at 30 and 38 weeks of age.

6. The heritability estimates of semen physical traits ranged from 0.097 for abnormal sperms to 0.432 for sperm motility.

7. The phenotypic correlations between ejaculate volume and other semen traits ranged from – 0.048 to 0.468. Whereas, the genetic correlations among all semen physical traits were mostly positive and ranged from 0.136 to 0.829.

8. 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 and ranged from 0.101 to 0.422, which can be used as indicators for high semen physical quality traits in Norfa cocks.

INTRODUCTION

Physiological studies cleared that fertility under natural mating conditions does not correlate with semen characteristics . The differential male fertility in natural mating systems is likely due to behavioral differences rather than semen quality, as reproductively successful males must satisfy additional physiological and behavioral requirements (Jones and Mench, 1991).

In the recent few decades, artificial insemination has been considered as a valuable technique in poultry industry and research work. One of advantages of its application over natural mating is the efficient use of males. This in turn, decreases the cost of artificial insemination directly by reducing the number of cocks needed (Benoff *et al*., 1981).

On the other hand, genetic selection for traits such as growth rate and meat yield have been negatively associated with the expression of morphometric traits related to reproduction (Siegel and Dunnington, 1985). Along with the potential for genetic selection to impact fertility, the degree of development of the secondary sexual characters could also affect on the semen quantity and quality traits of cocks (Zuk *et al*., 1995).

Few information is available on the importance of genetic effects on semen quantity, quality and sperm abnormalities in cocks. Therefore, the purpose of the present study was to determine the effect of some environmental factors, such as body weight, age of cocks and hot vs. cold months of year, on semen physical characteristics. Also, this experiment was planned to estimate some genetic parameters such as sire heritability of semen physical characteristics and sire genetic and phenotypic correlations either among semen physical characteristics or with cocks body weight and some secondary sexual characters in order to predict cocks fertility in Norfa cocks.

MATERIALS AND METHODS

The present study was carried out at the Poultry Research Farm, Department of Poultry Production, Faculty of Agriculture at Shibin El-Kom, Minufiya University, Egypt.

1. Chicken stock :

Norfa strain was used in the present study. It is a synthetic local strain of chicken which was developed at the Poultry Research Farm, Faculty of Agriculture, Minufiya University (Abdou, 1996).

2. Experimental design :

A total of 57 pedigreed cocks according to their sire families which represent 12 half sib sire families with at least 4 half sib cocks in each family were used in the present study . Three experiments were designed to

study some environmental factors as follows :

2.1. Body Weight:

The effect of body weight of cocks on some semen physical characteristics. Three lines of cocks according to their body weight at maturity (38 wk) were formed by using $\overline{X}$ + 1 s.d. for body weight. The average body weight of each line was 1350 g. for light line, 1570 g. for control line and 1740 g. for heavy line. The number of semen samples collected from cocks of each line was 26, 88 and 26 semen samples, respectively.

2.2. Age of Cocks:

The effect of age of cocks on semen physical characteristics. Semen was collected individually from each cock at three periods (30 – 32, 38-40 and 46-48 weeks) of age. The numbers of semen samples collected were 256, 146 and 140 samples, respectively.

2.3. Hot VS Cold Months:

The effect of hot months (July and August) versus cold months (December and January) on some semen physical characteristics. Semen was collected individually from each cock during the hot and cold months. The numbers of semen samples collected in each period were 140 samples. The average ambient temperatures and relative humidity were 32.5°C and 52.7 % in hot months and 16.1°C and 37.6 % in cold month, respectively.

3. Stock management :

At 18 weeks of age, cocks were fed *ad libitum* on a diet containing 17.5 % crude protein and 2769 Kcal ME / Kg diet, during the experimental period. All cocks were vaccinated against diseases and were treated similarly during the experimental period.

4. Semen collection :

Semen was collected individually twice per week from each cock using the massage method squeezing the capulatory organs to obtain semen as described by Kalamah *et al.* (2002). Collection was done after feeding from 57 pedigreed cocks according to their sire families.

5. Studied traits :

5.1. Semen physical traits :

5.1.1. Ejaculate volume: $\overline{x}$ Ejaculate volume was measured to the nearst 0.01 ml. in 1.0 ml tuberculin syringe according to Kalamah et al. (2002).

5.1.2. Sperm concentration: Sperm concentration was measured by Thomas-Zeis haemocytometer for counting the sperms per cubic millimeter (Smith and Mayer, 1955).

5.1.3. Live sperms percentage : The stained slides by pigments

iosine and nigrosine solution technique were used to calculate the total percentages of live sperms in the sample (Kalamah *et al.,* 2002).

5.1.4. Abnormal sperms percentage : The stained slides by iosine and nigrosine solution were used to calculate the percentage of abnormal sperms (Kalamah *et al*., 2002).

5.1.5. Semen pH : Initial semen pH was obtained by means of comparative pH paper as described by Kamar *et al.* (1979).

5.1.6. Sperm motility : Sperm motility was scored according to arbitrary scheme of classification in range from 1 – 5 grades according to Nagae *et al.* (1987).

5.2. Body weight and secondary sexual characters determinations :

5.2.1. Individual body weight at maturity was recorded for each cocks at 38 weeks of age in grams .

5.2.2. The secondary sexual characters measured individually were Comb Length, Comb Width, Wattle Length and Wattle Width for each cock. Comb Length (CL) and Wattle Length (WL) were measured as the maximum horizontal distance between the from and the rear of the Comb or Wattle. While, the Comb Width (CW) was measured as the maximum vertical distance from the highest peak of the Comb to the base and the Wattle Width (WW) as the maximum vertical distance from base of the Wattle to the distal end. Measurements were recorded individually for each cock at 38 weeks of age (cm).

6. Statistical analysis :

6.1. Analysis of variance : Least square means and their standard errors (LSM $\pm$ S.E.) for each studied trait were calculated. Data obtained were statistically analyzed using SAS (2001) as well as the SPSS (1997) computer program. Duncan's Multiple Range Test was used for the multiple comparisons of means (Duncan, 1955). All percentages data were converted to the corresponding arcsine prior statistical analysis according to Snedecor and Cochran (1977). Also, data were corrected for age and body weight of cocks as required . The following one – way classification statistical model was used :

$$\mathbf{Y_i = \mu + \alpha_j + e_{ij}}$$

Where :

Y_{ij} = The observation of the n^{th} cock. μ = The over all mean.

α_j = The fixed effect of the i^{th} trait. e_{ij} = The random error

6.2. Genetic analysis : Genetic analysis including the estimation of sire heritability, phenotypic and genetic correlations were calculated according to Harvey (1990) .

6.2.1 Heritability at 30, 38 and 46 weeks of age was computed due to the sire variance based on the following equation :

$$h^2_s = \frac{4\,\sigma^2_s}{\sigma^2_s + \sigma^2_e}$$

where, σ^2_s and σ^2_e are he effects of sire and random error, respectively.

6.2.2. Phenotypic correlations were calculated according to the following equation:

$$r_{Pij} = \frac{COV_{Pij}}{\sqrt{P_i \cdot P_j}}$$

where :

r_{pij} = The phenotypic correlation between the i^{th} and j^{th} traits.

COV_{pij} = The phenotypic covariance between the i^{th} and j^{th} traits.

P_i = The phenotypic variance of the i^{th} trait.

P_j = The phenotypic variance of the j^{th} trait.

6.2.3. Genetic correlations were calculated according to the following equation :

$$r_{Gij} = \frac{COV_{Aij}}{\sqrt{A_i \cdot A_j}}$$

Where : r_{Gij} = The genetic correlation between the i^{th} and j^{th} traits.

COV A_{ij} = The additive genetic covariance between the i^{th} and j^{th} traits.

A_i = The additive genetic variance of the i^{th} traits.

A_j = The additive genetic variance of the j^{th} trait.

RESULTS AND DISCUSSION

1. Phenotypic parameters of semen, body weight and secondary sexual traits:

1.1. Phenotypic parameters of semen physical characters of Norfa cocks:

From Table (1). It is clear that there are great variations between minimum and maximum values of each semen physical character. This variation is due to the strategy of formation of Norfa strain which was aimed to improve only the egg production. This variation will give the breeders good opportunity to improve the semen physical quality of Norfa cocks. The mean values of semen physical characteristics are given in (Table 1). These values are almost similar to the values reported by Soliman (1996) and Kalamah *et al*. (2000) for Norfa cocks. But these values were lower than the values found in Fayoumi, Rhode Island Red, Matrouh and Golden Montazah cocks (El-Wardany *et al*., 1995) and Inshas cocks (Soliman *et al*., 2007).

1.2. phenotypic parameters of body weight of Norfa cocks :

Body weight of Norfa cocks ranged from 1300 to 1923 g. with overall average 1560 g. at maturity (38 weeks of age). Norfa strain was considered as a local light body weight strain (Table 1). This is because Norfa strain was developed for high egg number and light body weight (Abdou, 1996).

1.3. Phenotypic parameters of secondary sexual characters of Norfa cocks:

The average values of comb length (CL), comb width (CW), wattle length (WL) and wattle width (WL) measurements in Norfa cocks were 11.99, 4.21 4.30 and 3.80 cm, respectively (Table 1). These values were higher than the values reported by El-Sahn, (2007 a) in Bandarah cocks. In addition, Andersson, (1994) reported that the degree of development of the secondary sexual characters could affect the reproductive potential of an individual cock. However, McGary *et al.* (2003) provide evidence that secondary sexual characters namely comb length and wattle length might be useful to predict fertility and semen quality in broiler cocks.

Table (1): Least-square means (LSM $\pm$ S.E.) of phenotypic parameters of semen, body weight and secondary sexual traits of Norfa cocks

Traits *	No.	Minimum	Maximum	LSM$\pm$ S.E.
Semen physical traits				
Volume (ml)	542	0.18	0.47	0.33 $\pm$ 0.003
Con.(10^9/ml)	290	1.97	5.49	3.81 $\pm$ 0.533
Live. sperm (%)	542	66.89	96.69	81.79 $\pm$ 0.005
Abnormal (%)	542	6.13	25.15	15.64 $\pm$ 0.39
pH	542	6.5	8.54	7.27 $\pm$ 0.019
Motility	542	2.76	4.80	3.78 $\pm$ 0.052
Body weight (g)				
Body wt (g)	140	1300	1923	1560 $\pm$ 11.14
Secondary sexual traits				
CL (cm)	140	10.0	14.0	11.99 $\pm$ 0.09
CW (cm)	140	2.0	8.0	4.21 $\pm$ 0.11
WL (cm)	140	2.5	6.1	4.30 $\pm$ 0.09
WW (cm)	140	1.7	5.9	3.80 $\pm$ 0.08

* Cl = Comb length, CW = comb width, WL = Wattle length, WW = Wattle width

2. Effect of body weight of Norfa cocks on semen physical characteristics:

Table (2) indicated that heavy body weight (1740 g.) cocks had significantly ($P \leq 0.05$) higher values of sperm concentration (4.45×10^9/ml), live sperms (85.46%) and lower value of abnormal sperms

(12.11%) than the light (1350 g.) and control (1570 g.) body weight cocks. Whereas, the light body weight cocks had significantly ($P \leq 0.05$) higher value of sperm motility (4.58) than the heavy and control body weight cocks. But, the statistical differences among heavy, control and light body weight cocks for both ejaculate volume (ml.) and semen pH were not significant (Table 2) .

It was reported that heavy body weight cocks had significantly higher sperm concentration El-Hammady *et al*., 1995 and Hanafy, 2006), higher live sperms (%) (El-Hammady *et al*., 1995 and Soliman, 1996), lower abnormal sperms (Holcman *et al*., 1993 and Soliman, 1996) and higher sperm motility (Holcman *et al*., 1993 and Soliman, 1996). In contrast, the light body weight cocks had significantly higher ejaculate volume (Holcman *et al*., 1993 and Soliman, 1996) and lower live sperms (Holcman *et al*., 1993). But, the statistical differences among body weight lines in semen pH were not significant El-Hammady *et al*., 1995 and Soliman, 1996). These results concluded that the heavy body weight cocks of Norfa strain had higher semen quality than the light body weight cocks, because Norfa strain was developed for high egg number and light body weight (Abdou, 1996).

Table(2): Least square means (LSM±S.E.) of semen physical characteristics of Norfa cocks as affected by body weight

Traits	(LSM ± S.E.)* at different body weight (g)		
	Light (1350) g	Control (1570) g	Heavy (1740) g
Volume (ml)	0.32 ± 0.009	0.33 ± 0.004	0.34 ± 0.011
Con.(10^9/ml)	3.38 ± 0.107 ^{b}	3.46 ± 0.048 ^{b}	4.45 ± 0.132 ^{a}
Live. sperm (%)	80.36 ± 0.912 ^{b}	81.19 ± 0.169 ^{b}	85.46 ± 0.632 ^{a}
Abnormal (%)	17.81 ± 0.018 ^{b}	16.48 ± 0.015 ^{b}	12.11 ± 0.078 ^{a}
pH	7.31 ± 0.084	7.24 ± 0.049	7.25 ± 0.079
Motility	4.58 ± 0.138 ^{a}	4.18 ± 0.082 ^{b}	4.11 ± 0.147 ^{b}

* Means with the same letter for each trait are not significantly different ($P \leq 0.05$).

3. Effect of hot vs. cold months on semen physical characteristics :

From Table (3), it is clear that semen physical characteristics collected in cold months had significantly ($P \leq 0.05$) higher value of ejaculate volume (0.35 vs. 0.23 ml), highly significant ($P \leq 0.01$) higher value of sperm concentration (5.26 vs. 4.16 × 10^9/ml) highly significant ($P \leq 0.01$) higher value of live sperms (87.18 vs. 67.32 %), highly significant ($P \leq 0.01$) lower value of abnormal sperms (16.09 vs. 26.94 %) and highly significant ($P \leq 0.01$) higher value of sperm motility (4.19 vs. 3.37) than the semen collected in hot months (Table 3).

In contrast, the semen PH collected in hot months had significantly

($P \leq 0.05$) lower value than the semen collected from Norfa cocks in cold months (7.26 vs. 7.46). The decline in PH values of whole semen collected from Norfa cocks in hot months (July and August) can be explained by the increasing in lactic acid production with exposure to the hot environment which results in decrease in pH values Kamar *et al.*, 1979).

These results are in good agreement with the results reported by Soliman (1996) and Kalamah *et al.* (2000) in Norfa cocks. They observed that the abnormal sperms percentages were significantly higher in hot months (July and August) than that in cold months (December and January). These results concluded that the semen physical characteristics had good quality in cold months than in hot months, which results in higher percentage of fertility in winter than in summer months .

Table (3): Least square means (LSM ± S.E.) of semen physical characteristics of Norfa cocks as affected by hot vs. cold months

Traits	(LSM ± S.E.)*	
	Hot months	Cold months
Volume (ml)	0.23 ± 0.011 [b]	0.35 ± 0.04 [a]
Concent. (10^9 / ml)	4.16 ± 0.226 [b]	5.26 ± 0.442 [a]
Live sperm (%)	67.32 ± 1.642 [b]	87.18 ± 2.358 [a]
Abn. Sperm (%)	26.94 ± 1.943 [a]	16.09 ± 1.013 [b]
Semen pH	7.26 ± 0.025 [a]	7.46 ± 0.026 [b]
Sperm motility	3.37 ± 0.171 [a]	4.19 ± 0.162 [b]

* Means with the same letters for each trait are not significantly different ($P \leq 0.05$) .

4. Effect of age of Norfa cocks on semen physical characteristics :

The Norfa cocks at 46 weeks of age had highly significant ($P \leq 0.01$) higher value of sperm concentration (4.29×10^9/m), significant ($P \leq 0.05$) lower value of abnormal sperms (14.61 %) and highly significant ($P \leq 0.01$) higher value of sperm mobility (4.41) than the cocks at 30 and 38 weeks of age (Tables 4). While, semen ejaculate volume (ml) and semen pH of Norfa cocks at 46 weeks of age were insignificant higher than that at 30 and 38 weeks of age. Similar results were reported by Hanafy (2006), El-Sheikh and Hanafy (2006).

These results concluded that sperm concentration, percentage of live sperms and sperm motility were significantly higher at 46 weeks of age than those at 38 and 30 weeks of age. The reverse trend was observed for percentage of abnormal sperms, which decreased significantly ($P \leq 0.01$) with increasing age of cocks to 46 weeks. There were no significant differences due to age of cocks effect on semen ejaculate volume and semen pH.

Table (4): Least-square means (LSM ± S.E.) of semen physical characteristics of Norfa cocks as affected by age

Traits	(LSM ± S.E.)* at different ages		
	30- wks	38- wks	46-wks
Volume (ml)	0.31 ± 0.022	0.33 ± 0.005	0.34 ± 0.003
Concent. (10^9/ml)	3.58 ± 0.228 ^{b}	3.76 ± 0.315 ^{b}	4.29 ± 0.121 ^{a}
Live sperms (%)	69.56 ± 0.046 ^{c}	79.17 ± 0.017 ^{b}	85.26 ± 0.096 ^{a}
Abnormal (%)	17.14 ± 0.044 ^{b}	16.62 ± 0.006 ^{b}	14.61 ± 0.019 ^{a}
pH	7.13 ± 0.021	7.24 ± 0.018	7.26 ± 0.038
Motility	3.36 ± 0.058 ^{b}	3.51 ± 0.067 ^{b}	4.41 ± 0.061 ^{a}

* Means with the same letters for each trait are not significantly different ($p \leq 0.05$).

5. Genetic parameters :

5.1. Sire heritability (h^2_s) of semen physical characters :

The estimates of heritability (h^2_s) ranged from 0.212 to 0.411 for ejaculate volume, 0.102 to 0.163 for sperm concentration, 0.143 to 0.274 for live sperms, 0.097 to 0.186 for abnormal sperms, 0.232 to 0.416 for semen pH and 0.319 to 0.432 for sperm motility. The estimates of heritability can be classified into low values (sperm concentration and abnormal sperms) to moderate values (ejaculate volume, live sperms, semen pH and sperm motility) (Table 5).

However, the lowest estimates of sire heritability were observed at 30 weeks of age, while the highest estimates were observed at 38 weeks of age, but the estimates of heritability at 46 weeks of age were in the middle. 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, Kamar *et al*. (1979) found that the heritability estimates for semen volume were 0.41 and 1.08 in Fayoumi and Rhode Island Red cocks, respectively. In addition, Segura *et al*. (1990) reported that heritability estimates of packed sperm volume were 0.50 and 0.42 for both the control and the selected strains of chickens, respectively. However, Osman (1991) reported that the sire heritability estimates ranged from 0.060 for semen volume to 1.414 for sperm concentration in Fayoumi and White Leghorn purebred and their corsses. These results concluded that the sire heritability estimates of semen physical characteristics ranged from low value (0.097 for abnormal sperms) to moderate value (0.432 for sperm motility). 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 .

Table (5): Heritability estimates ± standard errors (h^2_s±SE) of semen physical characteristics of Norfa cocks at different ages

Traits	(h^2_s ± SE)		
	30- wks	38- wks	46-wks
Volume (ml)	0.212 ± 0.136	0.411 ± 0.261	0.281 ± 0.182
Concent. (10^9/ml)	0.102 ± 0.112	0.163 ± 0.132	0.106 ± 0.113
Live sperms (%)	0.143 ± 0.061	0.274 ± 0.174	0.251 ± 0.201
Abnormal (%)	0.097 ± 0.102	0.186 ± 0.038	0.119 ± 0.036
pH	0.354 ± 0.204	0.416 ± 0.325	0.232 ± 0.164
Motility	0.409 ± 0.261	0.432 ± 0.416	0.319 ± 0.238

5.2. Phenotypic correlations among semen physical characteristics

Positive phenotypic correlations between semen volume and sperm concentrations (0.468), abnormal sperms (0.023), sperm motility (0.014) were obtained (Table 6). Whereas, negative estimates of phenotypic correlations between semen volume and live sperm (-0.048) and semen pH (-0.0121) were observed. The values of phenotypic correlations between semen ejaculate volume and other semen physical characters were low to moderate, and ranged from -0.048 to 0.468 Table (6). In addition, the phenotypic correlations between sperms concentration and live sperms, abnormal sperms, semen pH and sperm motility were 0.245, -0.053, 0.213 and 0.112, respectively. The estimates of phenotypic correlations between sperms concentration and live sperms, abnormal sperms, semen pH and sperm motility, were mostly positive and had low values, which ranged from -0.245 to 0.112. Moreover, negative and high phenotypic correlation between live sperms and abnormal sperms (-0.516), was observed. Whereas, the phenotypic correlation between live sperms and semen PH had positive and low value (0.178) and sperm motility had positive and high value (0.580). However, negative and high phenotypic correlation was observed between abnormal sperms and sperm motility (- 0.513), whereas the phenotypic correlations with semen PH was positive and low (0.008). The phenotypic correlation between semen PH and sperm motility was positive and low (0.132). The present results are similar to the results reported by Machel *et al*. (1996), Gohar *et al*. (1997), Saeid (1998) and Soliman *et al*. (2007).

Table (6): Phenotypic correlation estimates among semen physical characteristics of Norfa cocks

Traits	Phenotypic correlations (r_p)				
	Con.	Live	Abn.	PH	Mot.
Volume (ml)	0.468	-0.048	0.023	-0.121	0.014
Concent. (10^9/ml)		0.245	-0.053	0.213	0.112
Live sperms (%)			-0.516	0.178	0.580
Abnormal (%)				0.008	-0.513
pH					0.132

5.3. Phenotypic correlations between semen physical traits with body weight and secondary sexual characters :

5.3.1. Body weight:

Table (7) indicates that body weight of Norfa cocks had positive phenotypic correlations with semen volume (0.318), sperms concentration (0.289) and liver sperms (0.162), whereas, negative estimates were observed between body weight and abnormal sperms (-0.153), semen pH (-0.124) and sperm motility (-0.112) . These results agreed with the results reported by Harris et al. (1984) and Johari *et al*. (1986). Recently, El-Sahn (2007 b) reported that significant positive correlation between body weight and ejaculate volume in Bondarh strain cocks was observed (r = 0.47) .

5.3.2. Secondary sexual characters :

It is clear that comb length (CL) and comb width (CW) had positive phenotypic correlations with semen ejaculate volume (0.278 and 0.151), sperms concentration (0.112 and 0.183), live sperms (0.177 and 0.123) and sperm motility (0.121 and 0.108), respectively. Whereas, the CL and CW had negative phenotypic correlations with pH (-0.096 and – 0.028) and abnormal sperms (-0.042 and – 0.018), respectively (Table 7).

However, similar phenotypic correlations were observed between wattle length (WL) and wattle width (WW) with different semen physical characters. The phenotypic correlation estimates between WL and WW were positive with ejaculate volume (0.162 and 0.119), sperms concentration (0.107 and 0.201), live sperms (0.116 and 0.108), semen pH (0.108 and 0.029) and sperm motility (0.122 and 0.092), respectively. Whereas, phenotypic negative correlations were observed between WL and WW with abnormal sperms (-0.104 and – 0.101), respectively (Table 7).

In this respect, McGary *et al*. (2003) provided evidence that secondary sexual characters namely comb length and wattle length might be useful to predict fertility and semen quality in broiler cocks. Also, there was a significant strong positive correlation between comb area and fertility (El-Sahn, 2007 a and b). These results concluded that secondary sexual characters, namely comb length, comb width, wattle length and wattle width

had phenotypic positive correlations with most of semen physical characters which may be used as a useful tool for predicting cocks with high semen quality .

Table (7) : Phenotypic correlations between semen physical traits with body weight and secondary sexual characters in Norfa cocks

Traits*	Phenotypic correlations (r_p)				
	BW	CL	CW	WL	WW
Volume	0.318	0.278	0.151	0.162	0.119
Concentration	0.289	0.112	0.183	0.107	0.201
Live sperms	0.162	0.177	0.123	0.116	0.108
Abnormal sperms	-0.153	-0.042	-0.018	-0.104	-0.101
Semen pH	-0.124	-0.096	-0.028	0.108	0.029
Sperm motility	-0.112	0.121	0.108	0.122	0.092

* Cl = comb length, CW = comb width, WL = wattle length, WW = wattle width.

5.4. Genetic correlations among semen physical characters :

In general, moderate to high values of genetic positive and significant correlations were observed among ejaculate volume with sperms concentration (0.682), live sperms (0.285), abnormal sperms (0.472) and sperm motility (0.265). Whereas, genetic negative and significant correlation was observed between ejaculate volume and sperm pH (-0.771) (Table 8). In addition, the present results in Table (8) show that there were positive genetic correlations between sperms concentration with live sperms (0.367), abnormal sperms (0.376) and sperm motility (0.166). Whereas a negative genetic correlation was observed between sperm concentration and semen PH (-0.468).

On the other hand, negative genetic correlations between live sperms with abnormal sperms (-0.075) and semen pH (-0.396). Whereas, positive and high sire genetic correlation was observed between live sperms and sperm motility (0.829). Also, abnormal sperm was genetically correlated positively with semen pH (0.136) and negatively with sperm motility (-0.269). In conclusion, most of the observed sire genetic correlations in Table (8) among all semen physical traits were positive and high. 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 conform the results reported by Kamer *et al.* (1979). In addition, Osman (1991) reported that most of the sire genetic correlations for semen volume and sperms concentration with other semen quantity characters were positive with high values in both Fayoumi and White Leghorn strains and their corsses .

Table (8): Genetic correlations among semen physical characteristics of Norfa cocks .

Traits	Genetic correlations (r_G)				
	Con.	Live	Abn.	PH	Mot.
Volume (ml)	0.682	0.285	0.472	-0.771	0.265
Concent. (10^9/ml)		0.367	0.367	-0.468	0.166
Live sperms (%)			-0.075	-0.369	0.829
Abnormal (%)				0.136	-0.269
pH					-0.290

5.5. Genetic correlations between semen physical traits with body weight and secondary sexual characters :

5.5.1. Genetic correlations between semen physical traits and body weight

It was observed that body weight of Norfa cocks had positive and almost high estimates of genetic correlations (r_G) with ejaculate volume (0.476), sperms concentration (0.361), live sperms (0.422), abnormal sperms (0.618) and sperm motility (0.340), whereas, negative genetic correlation with semen pH (-0.080) was observed (Table 9) . In this respect, Johari *et al.* (1986) indicated that body weight was significantly positive correlated with sperm concentration (r = 0.31), and abnormal sperms (r = 0.32), while, the correlation between body weight and sperm motility was significantly negative (r = -0.43).

Recently, El-Sahn (2007 b) reported that significant positive correlation between body weight and ejaculate volume in Bandarh strain cocks was observed (r = 0.47). These results concluded that selecting high body weight cocks for artificial insemination will improve the semen physical quality of Norfa cocks .

5.5.2. Genetic correlations between semen physical traits and secondary sexual characters of Norfa cocks :

It was found that comb length (CL) and comb width (CW) had positive genetic correlations with semen ejaculate volume (0.259 and 0.344), sperms concentration (0.117 and 0.191), live sperms (0.191 and 0.212) and sperm motility (0.101 and 0.491) respectively. Whereas, the CL and CW had negative genetic correlations with PH (-0.125 and – 0.226), respectively (Table 9). In addition, the genetic correlations between wattle length (WL) and wattle width (WW) were positive with ejaculate volume (0.165 and 0.161), sperms concentration (0.152 and 0.267), live sperms (0.154 and 0.119) and sperm motility (0.361 and 0.371), respectively. But, the genetic correlations between WL with abnormal sperms and semen PH were positive (0.628 and 0.281, respectively) , while, the WW had negative genetic correlations with both abnormal sperms (-0.249) and

semen pH (-0.341).

It was reported that the degree of development of the secondary sexual characters could affect the reproductive potential of an individual cock (Andersson, 1994). These results supported that the comb and wattle areas are good indicators for semen physical quality in Norfa cocks .

Table (9) : Genetic correlation between semen physical traits with body weight and secondary sexual characters in Norfa cocks .

Traits*	Genetic correlations (r_G)				
	BW	CL	CW	WL	WW
Volume	0.476	0.259	0.344	0.165	0.161
Concentration	0.361	0.117	0.191	0.152	0.267
Live sperms	0.422	0.191	0.212	0.154	0.119
Abnormal sperms	0.618	-0.162	-0.304	0.628	-0.249
Semen pH	-0.080	-0.125	-0.226	0.281	-0.341
Sperm motility	0.340	0.101	0.491	0.361	0.371

* Cl = comb length, CW = comb width, WL = wattle length, WW = wattle width.

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الملخص العربي

بعض العوامل المؤثرة على صفات جودة السائل المنوى فى ديوك النورفا

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الهدف من هذه التجارب هو دراسة صفات السائل المنوي الطبيعية وعلاقتها ببعض العوامل الوراثية والفسيولوجية والبيئية في ديوك دجاج النورفا . استخدم 57 ديك منسب من سلالة دجاج النورفا حيث تمثل 12 عائلة أنصاف أشقاء في هذه التجارب وقد نوقشت النتائج ولخصت كما يلي :

1 – كان متوسط قيم صفات السائل المنـوي الطبيعية هي (0.33 مل)، (3.81×10^9 / مل)، (81.79 %)، (15.64 %)، (7.27)، (3.78) لكل من حجم القذفة، تركيز الحيوانات المنوية، الحيوانات المنوية الحية ، الحيوانات المنوية الشاذة ، تركيز أيون الأيدروجين وحركة الحيوانات المنوية ، علي التوالي .

2 – كان متوسط طول العرف ، عرض العرف ، طول الداليتان ، عرض الداليتان هو (11.99سم) ، (4.21 سم) ، (4.30 سم) ، (3.80 سم) علي التوالي .

3 – حققت الديوك الثقيلة (1740 جم) قيم معنوية عالية في تركيز الحيوانات المنوية ، الحيوانات المنوية الحية ، حركة الحيوانات المنوية ، وقيمة منخفضة ومعنوية في الحيوانات المنوية الشاذة عن الديوك الخفيفة (1350 جم) وديوك المقارنة (1570 جم) في وزن الحسم .

4 – كانت صفات السائل المنوي الذي جمع في شهري ديسمبر ويناير عالية معنويا في حجم القذفة ، تركيز الحيوانات المنوية ، ونسبة الحيوانات المنوية الحية وأقل معنويا في نسبة الحيوانات المنوية الشاذة عن صفاته في شهري يوليو وأغسطس .

5 – حققت الديوك النورفا في عمر 46 أسبوع قيم عالية ومعنوية في تركيز الحيوانات المنوية ، الحيوانات المنوية الحية ، وحركة الحيوانات المنوية ، وقيمة معنوية منخفضة في نسبة الحيوانات المنوية الشاذة عن الديوك في عمر 30 أو 38 أسبوع .

6 – تتراوح قيمة قياسات المكافئ الوراثي لصفات السائل المنوي الطبيعية من 0.097 لنسبة الحيوانات المنوية الشاذة إلي 0.432 لحركة الحيوانات المنوية .

7 – كان الارتباط المظهري بين حجم القذفة وصفات السائل المنوي الأخرى يتراوح من 0.048 إلي 0.468 . بينما كان الارتباط الوراثي بين كل صفات السائل المنوي الطبيعية غالبا موجبة وتتراوح من 0.136 إلي 0.829 .

8 – حققت صفات الجنس الثانوية وخاصة قياسات العرف والداليتين ارتباط مظهري موجب مع معظم صفات السائل المنوي الطبيعية . كانت الارتباطات الوراثية بين قياسات العرف والداليتان وصفات السائل المنوي الطبيعية غالبا موجبة وتتراوح من 0.101 إلي 0.422 ، حيث يمكن استخدامها كأدلة للحصول علي سائل منوي عالي الجودة في ديوك النورفا .