

Studies on Semen Characteristics, Fertility and Hatchability of Fayoumi, Plymouth Rock and Rhode Island Red Cocks

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FIFTEEN males were randomly chosen from each of three breeds (Fayoumi, Plymouth Rock and Rhode Island Red), semen characteristics were examined. Plymouth Rock gave superiority for the overall means of semen volume, concentration, total sperms, normal sperms, live sperms per ejaculate, motility rate, live sperms % and sperm/plasma % than Fayoumi and Rhode Island cocks. Fayoumi males produce a high percentage of total abnormalities with respect to the other two breeds. The most of sperm abnormalities in Fayoumi cocks were those of tailless. High positive correlation was observed between most of semen characteristics. While the total abnormalities were correlated negatively with all quantitative traits.

A total of 136 Fayoumi females were artificially inseminated with the examined males (Fayoumi, Plymouth and Rhode Island). The eggs were collected and ten consecutive weekly hatches were obtained. The mating of Plymouth males to Fayoumi females seem to be more effective for significant improving hatchability and hatching weight. This mating is due also to decrease the embryonic mortality in all periods and the malposition percentage at 21th day of incubation. While fertility and hatchability were significant positively correlated with semen characteristics, they were negatively correlated with the percentage of abnormal sperms.

The influence of male fertility on net chick production per laying hen and hence on chick cost, is of considerable importance in poultry production. Many factors were reported to be affecting the fertilizing ability of cocks. Many workers reported that cock fertilizing ability is mainly determined by percent of live sperms and motility of semen. Kamar (1960 a) ; Pilipei (1970) and Carvalho and Megall (1978) reported a positive correlation between sperm concentration, motility and volume with egg fertility. Kamar (1960 a) ; Zabolotshil and Vovonima (1970) and Kamar and Razik (1972) found a significant positive correlation between sperm concentration, motility and number of live sperms % with hatchability. Kamar (1960 a and b) and

Kamar and Razik (1972) showed a negative significant correlation between percentage of abnormal sperms with fertility or hatchability. Kamar and Badreldin (1959) found that male sterility occurs when total abnormalities increase over 25 %.

The purpose of the present study was to evaluate the semen characteristics of Fayoumi, Plymouth Rock and Rhode Island Red cocks and its relationship to egg fertility and hatchability.

Material and Methods

Fifteen males were randomly chosen from each of three breeds (Fayoumi, Plymouth Rock and Rhode Island Red), semen characteristics were examined. Two ejaculates within one week were collected from each cockerel by massage method without milking the copulatory organs (Kamar, 1958). Characteristics measured for each ejaculate were volume to nearest 0.01 ml, motility rating following Kamar (1960 a) scheme of classification; concentration measured according to Smith and Moyer (1955), live percentage and types of abnormalities as described by Kamar (1959 a), pH and sperm to plasma percent were also measured according to the method of Kamar and Badreldin (1959).

A total of 136 Fayoumi females at one year old were artificially inseminated with the examined males (Fayoumi, Plymouth Rock and Rhode Island Red). Each Fayoumi hen was inseminated biweekly with 0.05 cc for 14 weeks. The eggs were collected and weighted. Ten consecutive weekly hatches were obtained which continued from January 31, to April 5, (1981). A total of 2191 eggs were incubated. At the end of the 21th day of incubation, the chickens which hatched were weighted. While the eggs which did not hatch were considered to be dead embryos and were broken and classified as one of the following types of malpositions: 1. The head is buried between thighs, 2. Head in the narrow end of the egg, 3. Head is bent to the left side, 4. Beak is not directed toward the air cell, 5. Feet are over the head and 6. Beak is over the right wing.

Analysis of variance were made according to Snedecor and Cochran (1968).

Results and Discussion

1. Semen characteristics

The mean values of semen characteristics are presented in Table 1. It is clear that the mean of semen volume is higher in Plymouth (0.62) followed by Rhode Island (0.48) then Fayoumi (0.26). The same trend is also true with respect to the mean of total sperms, normal sperms, live sperms per ejaculate and motility rate. Plymouth Rock gave also superiority for the overall means of concentration, live sperms % and sperm/plasma %.

Egypt. J. Anim. Prod. 24, No. 1-2 (1984)

where Rhodes showed lower means compared to the Fayoumi. The results of semen volume are in agreement with that reported by Williams and McGibbon (1956), they found that the heavy breeds produce higher volumes than that collected from light breeds. Kamar *et al.* (1979) found also that Fayoumi breeds had the lowest volumes of semen than Baladi, W. Leghorn and Rhode Island.

The pH value for Plymouth Rock and Rhode Island were closer than Fayoumi to the optimum pH value for semen reported in the literature. Lardy and Phillips (1943) reported a pH of 7.25 to the best value of cock semen.

The total abnormalities in Fayoumi was significantly higher than that of Plymouth Rock and/or Rhode Island. Kamar (1959 b) reported that Fayoumi males produce a high percentage of total abnormalities with respect to other breeds (White Leghorn and White Baladi). Most of sperm abnormalities for the two breeds Plymouth Rock and Fayoumi were those of tailless, while it was of coiled head in Rhode Island breed. Total tail abnormalities in this study showed higher values in Fayoumi breeds than Rhode Island breed, while head abnormalities showed higher values in Rhodes than Fayoumi. Plymouth Rock males showed lowest tail and head abnormalities compared with Rhode Island and Fayoumi. Kamar (1960 a) reported that the most of sperm abnormalities in Fayoumi.

2. Phenotypic correlation between semen characteristics

The phenotypic correlation between the semen characteristics are presented in Table 2. In general, phenotypic correlation between all semen quantitative traits were positive and significant. The same trend is also true with respect to motility with live sperms or pH and live sperms with sperm/plasma. The total abnormalities were correlated negatively with all quantitative traits. In general, phenotypic correlation between the types of abnormalities were low and insignificant.

In general, the phenotypic correlation in the present study were of higher magnitude than those reported in literature. Kamar *et al.* (1979) observed positive correlation between volume with total sperms, volume with normal sperms, motility with pH and live sperms with sperm/plasma with the corresponding figures 0.70, 0.71, 0.30 and 0.13, respectively. Marini and Goodman (1969) reported negative significant phenotypic correlation between motility and total abnormality percentage ranging from 0.2 to 0.3.

The high positive correlation observed between most of semen characteristics, would suggest a positive response to selection not only for traits directly selected for, but also to other correlated ones. These results would indicate that selection for some easily measured traits such as volume and total sperms, *etc.* would indirectly improve other semen characteristics.

TABLE 1. Mean values for all semen characteristics in Fayoumi, Plymouth Rock and Rhode Island Red cocks.

Trait	Fayoumi	Plymouth	Rhode Island
Semen Quantitative Traits			
Volume	B 0.26 a	A 0.62 a	AB 0.48 a
Concentration	1.49 a	1.58 a	1.45 a
Total sperms / ejaculate	403.60 b	1056.20 a	668.80 ab
Normal sperms / ejaculate	334.20 b	980.10 a	600.50 ab
Live sperms / ejaculate	360.30	992.10	576.80
Semen Qualitative Traits			
Motility rating	a 6.60	a 7.60	a 6.10
Live sperms %	ab 88.90	a 92.20	b 86.00
Sperm / plasma %	B 22.00	A 38.90	B 18.30
Total abnormalities %	A 19.10	B 8.30	B 10.40
pH	b 6.70	a 7.46	ab 7.16
Types of Abnormalities			
Coiled head %	a 2.43	a 1.00	a 2.50
Hooked head %	a 1.28	a 0.90	a 1.50
Ruptured head %	a 1.00	a 0.50	a 0.88
Other heads %	a 1.57	a 1.00	e 1.50
Coiled tail %	a 1.79	a 1.30	a 1.63
Broken tail %	a 0.64	a 0.30	a 0.38
Tailless %	a 10.60	b 3.30	b 2.25

a b and A B values followed by different letter in the same row are significantly different ($P \geq 0.05$) and ($P \geq 0.01$), respectively.

TABLE 2. Phenotypic correlation between semen characteristics.
a) r between the semen quantitative traits.

Trait	Volume	Concentration	Total sperms	Normal sperms
Concentration	0.36	—	—	—
Total sperm / ejaculate	0.89**	0.70**	—	—
Normal sperms / ejaculate	0.90**	0.70**	0.99**	—
Live sperms / ejaculate	0.50*	0.40	0.80**	0.56*

b) r between the semen qualitative traits.

Trait	Motility rating	Live sperms	Sperm/plasma	pH
Live sperms%	0.59**	—	—	—
Sperm / plasma%	0.35	0.47*	—	—
pH	0.60**	0.43	0.41	—
Total abnormalities%	-0.53*	-0.22	-0.37	-0.75**

c) r between the types of Abnormalities.

Trait	Coiled head %	Hooked head %	Ruptured head %	Other heads %	Coiled tail %	Broken tail%
Hooked head	0.37	—	—	—	—	—
Ruptured head	0.10	-0.12	—	—	—	—
Other heads	0.09	-0.22	0.62*	—	—	—
Coiled tail	-0.16	0.06	0.31	0.21	—	—
Broken tail	-0.21	0.03	0.55	0.66*	0.70*	—
Tailless	-0.12	-0.12	0.03	0.03	0.41	0.09

** Significant at the 1% level of probability.

* Significant at the 5% level of probability.

3. *Hatching traits*

The mean values of some hatching traits are presented in Table 3. It is clear that the mating of Plymouth males to Fayoumi females seem to be more effective for significant improving hatchability and hatching weight. This mating is due also to decrease the embryonic mortality in all periods and the malposition percentage at 21th day of incubation compared with its corresponding mating of Fayoumi and Rhode males with Fayoumi females. Khalil and El-Ibiary (1963) concluded that when the Fayoumi was crossed with

TABLE 3. Mean values of some hatching traits.

Trait	Fayoumi x Fayoumi	Plymouth x Fayoumi	Rhode x Fayoumi
Egg weight (gm)	40.9- ^a	40.4 ^a	41.6- ^a
Fertility (%)	74.0- ^a B	73.6- ^a A	71.6- ^a B
Hatchability (%)	66.9- ^B	75.0- ^A	65.3- ^A
Chick hatching weight (gm)	28.8-	29.7-	29.9-
Total embryonic mortality (%) classified as :			
at 7 th day.	33.1	25.0	34.7
at 14 th day.	7.5	5.8	6.0
at 21 th day.	9.1	6.6	11.3
Total malpositions at 21 th day (%) classified at the types	16.5	12.6	17.4
Head between thighs	4.5	1.5	3.7
Head in narrow end of eggs	2.7	4.3	2.0
Head bent to left side.	0.3	0.4	1.7
Beak not directed air cell.	4.5	3.0	5.0
Feets over head.	2.4	2.6	3.7
Beak above right wing	2.1	0.8	1.3

a b and A B values followed by different letter in the same row are significantly different ($P \geq 0.05$) and ($P = 0.01$), respectively.

foreign breeds, the highest hatchability and hatching weight were secured from Plymouth Rock cocks and Fayoumi females. Kicka *et al.* (1977) showed that Fayoumi exceeded the Rhode in fertility and hatchability.

The results in the embryonic mortality are in agreement with that reported by Hartman and Steinke (1975), they found that 30% of embryonic mortality occurred in the first 4 days of the incubation period, then slightly no change up to 2 weeks and again increased significantly during the last 4 days.

The most frequent type malposition (Table 3) was the head in the narrow end of the eggs in Plymouth X Fayoumi mating, while it was the head burried between thighs and the beak is not directed toward the air cell in the other

TABLE 4. Phenotypic correlations between semen characteristics and fertility or hatchability in Fayoumi.

Character	Correlation
	correlated with Fertility
Volume	0.47**
Concentration	0.48**
Motility rating	0.45**
Live sperms %	0.37**
pH	0.27*
Total abnormalities %	-0.25*
	correlated with Hatchability
Volume	0.41**
Concentration	0.29**
Motility rating	0.45**
Live sperms %	0.10
pH	0.36**
Total abnormalities %	-0.43**

** Significant at the 1% level of probability.

* Significant at the 5% level of probability.

two matings. El-Ayadi and El-Ibiary (1957) and Omar (1959) stated that the types malposition of head in the narrow of the eggs was the most frequent, while Helmy (1958) reported that the most frequent malposition was the head is burried between thighs.

4. Phenotypic correlation between semen characteristics with fertility and hatchability.

The phenotypic correlation between semen characteristics (Table 4) were significant positively correlated with fertility and hatchability (except for live sperms %). Negative significant correlation were shown between percentage of abnormal sperms and fertility or hatchability. These results are in agrcement with Kamar (1960 a), Pilipei (1970) and Carvallo and Megal (1978), they found significant positive correlations between volume, concentration and motility with fertility. Kamar(1960 a) ; Zabolotshil and Vovonima (1970) and Kamar and Razik (1972) found significant positive correlations between motility, concentration and number of live sperms % with hatchability. Kamar (1960 a and b) and Kamar and Razik (1972) reported significant negative correlations between the percentage of abnormalities with fertility or hatchability.

References

- Carvalho, M.R.D. and Megall, F. (1978). Relationship of three semen characters with fertility in White Leghorn cocks. *EMBRAPA, Itaguaia*, Riode Janeiro Brazil, 30 (1), 29.
- El-Ayadi, M.N. and El-Ibiary, H.M. (1957). Variation in fertility and hatchability of Baladi and Leghorn eggs. *Alex. J. Agr.* 5, 69.
- Hartman, W. and Steinka, L. (1975). Relationship between egg fertility and embryonic mortality and their effects on viability of White Leghorn hens. *Kleintier Zucht forschung* 23, 8.
- Helmy, S.H. (1958) Fertility, Embryonic mortality and Hatchability in poultry as affected by genetical environmental and physical factors. *Ph. D. Thesis*, Cairo University.
- Kamar, G.A.R. (1958) The collection of cock's semen without milking the copulatory organ. *Poultry Sci.* 37, 1382.
- Kamar, G.A.R. (1959 a) The differentiation of live from dead sperms in chicken semen. *Stain tech.* 34, 5.
- Kamar, G.A.R. (1959b). Semen characteristics of foreign and native fowls under Egyptian conditions. *Ind. J. Vet. Sci.* 29, 19.
- Kamar, G.A.R. (1960a) The influence of semen characteristics on hatching results of chickens eggs. *Poultry Sci.*, 39, 188.
- Kamar, G.A.R. (1960b) The semen of Fayoumi cockereles. *Ind. J. Vet. Sci.* 30, 52.
- Kamar, G.A.R. and Baireldin, A.L. (1959) Sperm morphology and viability. *Acad. Anat.*, 39, 81.
- Kamar, G.A.R., Obiedah, A., Goher, N.E. and Khalifa, M.A. (1979) Genetical studies on semen characteristics of cocks. *Egypt. J. Anim. Prod.* 19 1, 101
- Egypt. J. Anim. Prod.* 24, No. 1-2 (1984)

- Kamar, G.A.R. and Razik, M.A. (1972). The relationship between semen characteristics and hatching results of Turkeys. *Atti. Del. VII Simposio international DI Zoo Tecnia Milano* 874.
- Khalil, A. and El-Ibiary, H.M. (1963) Fertility and Hatchability of crossbreed Fayoumi egg proc. 1st Arab Meet. on Poultry. Alexandria, 5.
- Kieka, M.A.M., Stino, F.K.R. and Kamar, G.A.R. (1977) Genetical studies on some economical traits of chickens in the subtropics. *Egypt. J. Anim. Prod.* 17, 41.
- Lardy, H.A. and Phillips, P.H. (1943) Effect of pH and certain electrolytes on the metabolism of ejaculated spermatozoa. *Am. J. Physiol.* 138, 741.
- Martini, J.P. and Goodman, B.L. (1969) Semen characteristics as influenced by selection for divergent growth rate in chickens. *Poultry Sci.* 48, 859.
- Omar, H.B. (1959) A comparative study of hatchability, Embryonic mortality and Malposition in Fayoumi and three standard breed chickens. *M. Sc. Thesis.* Alex. Univer.
- Pilipei, T.P. (1970) Relation between reproduction capacity and semen quality in cocks. *Pitstvo*, 29, 32.
- Smith, J.T. and Meyer, D.T. (1955) Evaluation of sperm concentration by haemocytometer method. *Fertil. and Steril.* 9, 271.
- Snedecor, G.W. and Cochran, W.G. (1968) "*Statistical Methods*", 6th Ed., 2nd. Printing. The Iowa State University Press, Iowa.
- Williams, C. and McGibbon, (1956) The yields of semen among inbred lines and crosses of single comb White Leghorns. *Poultry Sci.* 35, 617.
- Zabolotshil, V.M. and Vovonima, M.S. (1970) The relationship between egg fertility and hatchability and some semen characters of cocks. 56 *nauch. Trud. vses-rvychoro-issled. Inst. Razy-Genet-Sel., Khoz-zhivot.* (16) 36

دراسات على صفات السائل المنوي ونسبة الخصب والفقس في الفيومي البليموث روك والرودايلاند الأحمر

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درست صفات السائل المنوي لعدد ١٥ ذكر من كلا من الأنواع الفيومي والبليموث روك والرودايلاند الأحمر . لوحظ تفوق ذكور البليموث روك عن ذكور الفيومي والرودايلاند في الصفات التالية . حجم وتركيز السائل المنوي وعدد الاسبرمات الكلية والاسبرمات الطبيعية والاسبرمات الحية في كل قذفة وكذلك في معدل الحركة والنسبة المثوية للاسبرمات الحية والنسبة المثوية للاسبرمات في البلازما ذكور الفيومي أعطت أكبر نسبة من الاسبرمات الشاذة وخاصة التي بدون ذيل .

وجد ارتباط موجب بين صفات السائل المنوي بعضها وبعض بينما الارتباط كان سالباً بينها وبين نسبة الاسبرمات الشاذة .

لقحت ١٣٦ أنثى من الفيومي صناعياً بسائل منوي مختبر من ذكور الفيومي والرودايلاند والبليموث روك وجمع البيض وتم تفريخه . لوحظ أن التزاوج بين ذكور البليموث روك مع اناث الفيومي أعطت أحسن النتائج من حيث نسبة الفقس ووزن الفرخ عند الفقس كما انخفض نسبة النفوق الجنيني ونسبة الأجنة الشاذة حتى عمر ٢١ يوم من التفريخ .

وجد ارتباط موجب وعالي بين صفات السائل المنوي مع نسبة الخصوبة والتفريخ بينما كان الارتباط سالباً مع الاسبرمات الشاذة .