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ENHANCING SEMEN QUALITY OF HUBBARD PARENT COCKERELS DURING THE SECOND YEAR OF PRODUCTION

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SUMMARY

This study was conducted to improve the semen quality of Hubbard parent cockerels during the second year of production. Twenty four cockerels at 68 weeks of age were divided into three groups. All birds were caged individually in metal batteries. Five cockerels of 5.82 Kg. average body weight served as control, nine cockerels of 6.05 Kg. average body weight were subcutaneously injected daily with 50 IU of human chorionic gonadotrophin (HCG) in 1ml of saline solution for sequence of seven days; and ten cockerels of 5.86 Kg. average body weight were force molted by feed deprivation for 10 days and received only darkness. Water was available all time. The experiment was extended for seven weeks of post-treatment.

It was found that each of force molting or HCG treatment improved significantly ($P<0.05$) the semen quality of Hubbard parent cockerels in the second year of production. However, force molting required four weeks of recovering period to prove the improvement, while the HCG injection induced the improvement much faster.

The congeniality of correlation coefficient between seminal characteristics [ejaculate volume (ml), sperm concentration (10^8 /mm^3), % sperm cell motility and semen pH] and blood constituents (total protein, albumin, globulin, total lipids, glucose, cholesterol, calcium, total phosphorous, inorganic phosphorous, glutamic oxaloacetic, glutamic pyruvic transaminase in plasma and concentrations of triiodothyronine, thyroxine and testosterone in serum) are apparently agreeable with the dependence of semen formation and metabolic activities.

Keyword: Semen quality, force molting, HCG, blood constituents

INTRODUCTION

Induced molting in laying hens is commonly used to restore high laying rates after the gradual decrease in egg production that takes place at the end of the first year of lay (Gildersleeve *et al.*, 1983).

Molting process usually consists of a reduction in lighting period and a period of food withdrawal, which cause major changes within the hypothalamo-hypophyseal-gonadal axis and results in the temporary cessation of laying (Zimmerman and Andrews, 1990). A similar decrease in gamete production occurs in the males, especially in meat-type strains, whose semen quality can be decreased by 50% at 45-50 weeks of age (Jacquet *et. al.*, 1993b).

Human chorionic gonadotrophin (HCG) is synthesized by the syncytiotrophoplastic cells of the placenta of the pregnant primate and is found in the blood and urine. It has been detected in the urine as soon as eight days after conception by sensitive radioimmunoassay (Jaffe, 1978). HCG has both LH and FSH like biologic actions, but has predominately LH like action. Not enough information is available on the effect of HCG administration on the performance of male reproduction during the second cycle. Thus, the question which needs more research, is could HCG improve the testicular activity during the second cycle of production?

In the present study, the ability of each of induced molting procedure or HCG injection to improve semen quality in Hubbard parent cockerels was examined.

MATERIALS AND METHODS

A total number of 24 cockerels (68 weeks of age) of Hubbard parent were randomly assigned to three groups. The cockerels were caged individually in cages of metal batteries. Five cockerels of 5.82 Kg average body weight served as control; nine cockerels of 6.05 Kg average body weight were daily injected subcutaneously with 50IU of HCG in 1 ml of saline solution for seven days. Ten cockerels of 5.86 Kg average body weight were force molted by food deprivation for 10 days with darkness. Water was available all time. The experiment was extended for seven weeks post-treatment.

All cockerels were reared under the same conventional system of management during the experimental period. A commercial diet of 16.25% crude protein and 2749 kcal ME/Kg was offered. The daily amount of 120 gm/bird was offered. Force molted cockerels were offered crushed yellow corn for one week after molting.

Individual body weight was recorded at the start of the treatment, at the middle, at the end and weekly thereafter for seven weeks.

Semen was collected daily from all the 24 cockerels, using the abdominal massage method, before starting of the treatment for a period of 10 days and weekly thereafter for seven weeks. Ejaculate volume was recorded to the nearest 0.1 ml using a graduated collecting tube. Normal sperm number/1mm^3 was counted using hemocytometer and percentage of progressive motility was determined by using a microscope with warm stage immediately after collection. Semen pH was recorded by using Whatman pH indicator paper. All semen collections were taken at 1:30 p.m.

Two blood samples with and without heparin, were collected from the wing vein of each cockerels at the start, the middle, the end of the treatment protocol and weekly thereafter for seven weeks. All blood samples were taken before semen collections. Plasma and serum were obtained by centrifuging the whole blood at 3000 rpm for 20 min. Serum and plasma were kept at -20°C until analysis. Plasma total protein,

albumin, total lipids, glucose and cholesterol were estimated by colorimetric methods according to Armstrong and Carr (1964), Doumas (1971), Frings *et al.*, (1972), Trinder (1969) and Watson (1960), respectively. Plasma globulin was obtained by subtracting the values of the albumin from the corresponding values of the total protein.

Plasma calcium (Hawk *et al.*, 1947), total phosphorous and inorganic phosphorous (Zilversmit, 1950), were determined.

Plasma glutamic oxaloacetic (GOT) and pyruvic transaminase (GPT) were determined according to Reitman and Frankel (1957). While plasma alkaline phosphatase was determined according to Bell (1971).

Serum triiodothyronine (T_3) and thyroxine (T_4) were determined (Peebles and Marks, 1991). Serum testosterone concentration was determined according to Jaffe and Behrman (1974). Hormones determinations were done by using coat-A-count I^{125} radioimmionoassay kits from Diagnostic Products Corporation, Los Angeles, California, 90045, USA. All these measurements were done to get as much as possible information about the physiological changes related to either force molting or applied treatments in cockerels.

One way ANOVA was applied using the general linear models (GLM) procedure of SAS software (SAS, 1985). If probability (P values) <0.5 were obtained, the differences were tested by Duncan's new multiple range test (Duncan, 1955). Percentage data were transformed to arcsine % for the analyses of variance. Correlations among semen quality characters and each of blood plasma and serum parameters were computed.

RESULTS AND DISCUSSION

1- Changes in body weight

Data obtained on body weight are presented in tables 1 and 2. Results show that force molted cockerels had higher ($P<0.05$) percentage of body weight loss from the initial body weight at five and ten days of fasting period than other groups. These percentages of losses were of 20.15 and 33.10 at five and ten days of fasting, respectively. The magnitude of body weight loss reveals that the force molting applied caused a quite reproductive activity by tanaring the allow energy for maintenance. This may give a chance for the cock to rejuvenate its reproductive activities after molting. At six week of recovering period, force molted cockerels approached coming back to their initial body weight and the percentage loss decreased ($P<0.05$). This relief somehow is needed to the resumption of sperm production. However, the percentage changes in body weight of HCG injected cockerels may suggest that HCG inhibited the growth in order to improve the reproductive activity (Bahl, 1977). Moreover, the small positive change in body weight of control cockerels seemed logic.

2 -Semen quality

Data on the effects of force molting and HCG treatment on some seminal characters are shown in table 3. Force molting caused depression ($P<0.05$) in semen

Table 1. Least squares means (± SE) of body weight (kg) of the experimental cockerels as affected by force molting (FM) and HCG treatment.

Time	Treated Cockerels		
	Control	FM	HCG
At start of treatment	5.820 ± 0.022^{C}	5.860 ± 0.026^{A}	6.050 ± 0.024^{A}
At mid. of treatment	5.860 ± 0.026^{bC}	4.680 ± 0.032^{cC}	6.060 ± 0.028^{aA}
At end of treatment	6.050 ± 0.024^{aB}	3.920 ± 0.034^{bD}	6.080 ± 0.032^{aA}
1st week post treatment	6.100 ± 0.088^{aB}	3.980 ± 0.022^{cD}	6.000 ± 0.034^{bA}
2nd ,, ,, ,,	6.105 ± 0.027^{aB}	4.135 ± 0.027^{cD}	6.000 ± 0.032^{bA}
3rd ,, ,, ,,	6.130 ± 0.027^{aA}	4.450 ± 0.029^{cC}	6.040 ± 0.035^{bA}
4th ,, ,, ,,	6.170 ± 0.022^{aA}	4.640 ± 0.021^{cB}	6.040 ± 0.034^{bA}
5th ,, ,, ,,	6.170 ± 0.028^{aA}	4.830 ± 0.028^{cB}	6.090 ± 0.032^{bA}
6th ,, ,, ,,	6.175 ± 0.025^{aA}	5.360 ± 0.028^{cA}	6.090 ± 0.028^{bA}
7th ,, ,, ,,	6.189 ± 0.024^{aA}	5.590 ± 0.028^{cA}	6.100 ± 0.028^{bA}

^{abc} Least squares means within each row with different superscripts are ($P<0.05$) different.
^{ABC} Least squares means within each column with different superscripts are ($P<0.05$) different.

quality. The daily semen output was significantly diminished. Cockerels of this group recorded lower ($P<0.05$) values of ejaculate volume, sperm concentration and percentage of sperm-cell motility when compared with control or HCG injected cockerels. The marked body weight loss, recorded in force molted group, might have caused depression in energy budget therefore pituitary-testicular axis did not lead to semen production (Jacquet *et al.*, 1993b). The efficiency of induced molting is rebound in the activity of semen production after about three weeks of recovering period. The possibility remains that a more severe molting treatment with a more pronounced or longer period of food restriction, might lead to greater amelioration of semen production. Similar suggestions have been made by Hocking (1991) and Jacquet *et. al.*, (1993 a and b). The retrievesion happened for the force molted cockerels at fourth week of recovering period is indicating that force molting could improve semen quality at the second year of production. However, HCG treatment seemed to have an analeptic effect on semen production. It has been reported that HCG treatment showed enlargement of the semniferous tubules and precocious spermatogenesis (Cole, 1978). HCG which contains both of FSH and LH, must be the suitable convertion of the present obtained results. As it is well known, both of FSH and LH are the main impulsive of the reproductive characters.

Table 2. Percentages (±SE) differences between initial and subsequence body weight (loss or gain) as affected by force molting (FM) and HCG treatment.

Time	Treated Cockerels		
	Control	FM	HCG
At start of treatment	—	—	—
At middle of treatment	6.87 ± 0.8^{aA}	-20.15 ± 1.4^{cB}	0.17 ± 0.8^{bB}
At end of treatment	3.95 ± 0.7^{aC}	-33.10 ± 2.1^{cD}	0.50 ± 0.8^{bB}
1st week post treatment	4.80 ± 0.8^{aB}	-32.09 ± 1.9^{cD}	-0.82 ± 0.8^{bD}
2nd ,, ,, ,,	4.90 ± 1.1^{aB}	-29.44 ± 1.8^{cC}	-0.82 ± 0.8^{bD}
3rd ,, ,, ,,	5.32 ± 1.2^{aB}	-24.40 ± 1.8^{cC}	-0.17 ± 0.9^{bC}
4th ,, ,, ,,	6.00 ± 1.2^{aA}	-20.82 ± 2.7^{cB}	-0.16 ± 1.2^{bC}
5th ,, ,, ,,	6.00 ± 2.2^{aA}	-17.58 ± 2.6^{cB}	0.66 ± 1.4^{bA}
6th ,, ,, ,,	6.10 ± 2.1^{aA}	-8.53 ± 2.5^{cA}	0.66 ± 1.8^{bA}
7th ,, ,, ,,	6.34 ± 2.3^{aA}	-4.60 ± 2.4^{cA}	0.82 ± 1.9^{bA}

^{abc} Least squares means within each row with different superscripts are ($P<0.05$) different.
^{ABC} Least squares means within each column with different superscripts are ($P<0.05$) different.

The results of the present study are consistent with the early abrupt decline and agument in serum testosterone for force molted and HCG injection, respectively (Table 8). Logically, reproductive performance decline by age (for control group) after first year of production. A similar observation was reported by Siegel *et al.*, (1969). The decrease or increase in semen quality observed herein is related to higher or lower semen pH, respectively. Moreover, HCG treatment depict the negative correlation between each of sperm concentration or sperm cell motility and semen pH. Sturkie (1986) stated that pH of cock's semen ranged from 7.0 to 7.6 depending on the amount of transparent fluid present in semen. It has been reported that testosterone reverses the effects on sexual behavior, and increasing levels of testosterone produce a greater level of copulatory behavior (Henney *et al.*, 1990).

3 - Blood constituents

3-1- Metabolic responses in plasma

Data on plasma total protein, albumin and globulin are presented in table 4. Data on plasma total lipids, glucose and cholesterol are illustrated in table 5. Table 6 is showing the obtained data in plasma calcium, total and inorganic phosphorous. Obtained results indicate that force molting caused a great depression ($P<0.05$) in metabolic rate as well as body tissue. Similar results were reported by Jacquet *et al.*,

Table 3. Least squares means (±SE) of some seminal characteristics of cockerels as affected by force molting (FM) and HCG treatment.

Time	Ejaculate volume (ml)			Sperm concentration (x 10^8 mm^3)		
	Control	FM	HCG	Control	FM	HCG
Before treatment	0.41±0.1	0.40 ± 0.1^{B}	0.41 ± 0.1^{B}	2.89 ± 0.4^{A}	2.92 ± 0.5^{A}	2.89 ± 0.5^{B}
After 1 day	0.38 ± 0.1^{b}	0.30 ± 0.1^{cB}	0.56 ± 0.1^{aA}	2.75 ± 0.3^{bA}	1.51 ± 0.5^{cB}	3.81 ± 0.6^{aA}
After 2 day	0.39 ± 0.1^{b}	0.12 ± 0.1^{cC}	0.72 ± 0.2^{aA}	2.80 ± 0.3^{bA}	1.30 ± 0.4^{cB}	3.81 ± 0.5^{aA}
After 3 day	0.40 ± 0.1^{b}	0.10 ± 0.1^{cC}	0.68 ± 0.2^{aA}	2.81 ± 0.2^{bA}	1.13 ± 0.5^{cB}	3.85 ± 0.5^{aA}
After 4 day	0.40 ± 0.1^{b}	0.10 ± 0.1^{cC}	0.68 ± 0.2^{aA}	2.82 ± 0.3^{bA}	0.81 ± 0.5^{cC}	3.81 ± 0.4^{aA}
After 5 day	0.41 ± 0.1^{b}	0.10 ± 0.1^{cC}	0.69 ± 0.2^{aA}	2.88 ± 0.4^{bA}	0.84 ± 0.6^{cC}	3.81 ± 0.4^{aA}
After 6 day	0.43 ± 0.1^{b}	0.09 ± 0.1^{cC}	0.68 ± 0.2^{aA}	2.79 ± 0.4^{bA}	0.80 ± 0.6^{cC}	3.79 ± 0.4^{aA}
After 7 day	0.44 ± 0.1^{b}	0.04 ± 0.1^{cC}	0.70 ± 0.2^{aA}	2.78 ± 0.4^{bA}	0.82 ± 0.4^{cC}	3.79 ± 0.5^{aA}
After 8 day	0.42 ± 0.1^{b}	0.04 ± 0.1^{cC}	0.66 ± 0.2^{aA}	2.79 ± 0.5^{bA}	0.64 ± 0.3^{cC}	3.79 ± 0.5^{aA}
After 9 day	0.43 ± 0.1^{b}	0.06 ± 0.1^{cC}	0.63 ± 0.2^{aA}	2.81 ± 0.4^{bA}	0.58 ± 0.4^{cC}	3.80 ± 0.5^{aA}
After 10 day	0.42 ± 0.1^{b}	0.05 ± 0.1^{cC}	0.65 ± 0.2^{aA}	2.75 ± 0.6^{bA}	0.52 ± 0.4^{cC}	3.74 ± 0.5^{aA}

Table 3. Continued.

Time	Sperm cell motility (%)			Semen pH		
	Control	FM	HCG	Control	FM	HCG
Before treatment	82.5±5.1 ^{A}	83.8±4.8 ^{A}	83.2±5.0 ^{B}	7.40±0.07 ^{B}	7.42±0.06 ^{B}	7.40±0.06 ^{A}
After 1 day	82.2±4.5 ^{aA}	41.2±4.9 ^{bc}	85.9±4.8 ^{aA}	7.40±0.03 ^{aB}	7.55±0.06 ^{aA}	7.33±0.05 ^{bA}
After 2 day	82.5±4.3 ^{aA}	35.6±5.0 ^{bD}	89.8±4.8 ^{aA}	7.41±0.05 ^{bB}	7.61±0.05 ^{aA}	7.32±0.06 ^{bA}
After 3 day	82.7±4.8 ^{bA}	36.2±5.1 ^{cD}	90.6±4.8 ^{aA}	7.41±0.07 ^{bB}	7.61±0.06 ^{aA}	7.34±0.06 ^{bA}
After 4 day	81.3±4.2 ^{bA}	35.4±5.0 ^{cD}	90.6±3.0 ^{aA}	7.39±0.04 ^{bB}	7.59±0.05 ^{aA}	7.38±0.06 ^{bA}
After 5 day	81.2±4.3 ^{bA}	34.8±4.9 ^{cD}	90.8±5.0 ^{aA}	7.40±0.05 ^{bB}	7.58±0.04 ^{aA}	7.37±0.04 ^{bA}
After 6 day	80.8±5.0 ^{bA}	30.2±4.8 ^{cD}	90.7±5.0 ^{aA}	7.42±0.03 ^{bB}	7.61±0.04 ^{aA}	7.38±0.04 ^{bA}
After 7 day	81.7±5.2 ^{bA}	21.9±4.8 ^{cD}	91.3±5.0 ^{aA}	7.42±0.04 ^{bB}	7.60±0.04 ^{aA}	7.35±0.04 ^{bA}
After 8 day	81.4±5.2 ^{bA}	23.0±4.9 ^{cD}	91.3±5.0 ^{aA}	7.43±0.05 ^{bB}	7.65±0.05 ^{aA}	7.37±0.03 ^{bA}
After 9 day	81.3±5.0 ^{bA}	23.2±4.8 ^{cD}	90.4±4.9 ^{aA}	7.43±0.06 ^{bB}	7.70±0.05 ^{aA}	7.39±0.06 ^{bA}
After 10 day	77.4±4.9 ^{bA}	23.7±4.9 ^{cD}	90.2±4.9 ^{aA}	7.43±0.06 ^{bB}	7.62±0.07 ^{aA}	7.38±0.05 ^{bA}

Table 3. Continued.

Time	Ejaculate volume (ml)			Sperm concentration (x 10^6 /mm^3)		
	Control	FM	HCG	Control	FM	HCG
1 week post treatment	0.40±0.1 ^{b}	0.12±0.1 ^{cC}	0.60±0.2 ^{aA}	2.74±0.4 $^{b A}$	1.81±0.4 ^{cB}	3.68±0.5 ^{aA}
2 weeks post treatment	0.42±0.1 ^{b}	0.32±0.1 ^{cB}	0.58±0.2 ^{aA}	2.53±0.4 ^{bB}	2.75±0.5 ^{bA}	3.66±0.6 ^{aA}
3 weeks post treatment	0.40±0.1 ^{b}	0.42±0.1 ^{bA}	0.58±0.2 ^{aA}	2.55±0.4 ^{cB}	2.85±0.5 ^{bA}	3.69±0.6 ^{aA}
4 weeks post treatment	0.38±0.1 ^{c}	0.45±0.1 ^{bA}	0.62±0.2 ^{aA}	2.53±0.5 ^{cB}	3.11±0.5 ^{bA}	3.68±0.5 ^{aA}
5 weeks post treatment	0.39±0.1 ^{b}	0.50±0.1 ^{aA}	0.55±0.1 ^{aA}	2.52±0.5 ^{cB}	3.23±0.6 ^{bA}	3.69±0.5 ^{aA}
6 weeks post treatment	0.38±0.1 ^{b}	0.55±0.1 ^{aA}	0.57±0.1 ^{aA}	2.40±0.5 ^{cB}	3.20±0.6 ^{bA}	3.69±0.5 ^{aA}
7 weeks post treatment	0.37±0.1 ^{b}	0.54±0.1 ^{aA}	0.58±0.1 ^{aA}	2.31±0.4 ^{cB}	3.21±0.6 ^{bA}	3.72±0.6 ^{aA}

Table 3. Continued.

Time	Sperm cell motility (%)			Sperm pH		
	Control	FM	HCG	Control	FM	HCG
1 week post treat.	78.2±4.8 ^{bA}	48.2±5.0 ^{cC}	91.2±4.9 ^{aA}	7.44±0.07 ^{bA}	7.50±0.07 ^{aA}	7.34±0.05 ^{bA}
2 weeks post treat.	71.3±5.1 ^{bB}	72.7±5.1 ^{bB}	90.8±5.1 ^{aA}	7.46±0.05 ^{aA}	7.38±0.06 ^{aB}	7.35±0.06 ^{bA}
3 weeks post treat.	72.2±5.1 ^{bB}	82.2±5.0 ^{aA}	91.7±5.1 ^{aA}	7.50±0.06 ^{aA}	7.37±0.06 ^{bB}	7.38±0.06 ^{bA}
4 weeks post treat.	68.2±5.0 ^{bB}	85.8±5.0 ^{aA}	91.8±5.1 ^{aA}	7.52±0.05 ^{aA}	7.40±0.05 ^{bB}	7.30±0.06 ^{bA}
5 weeks post treat.	66.7±5.1 ^{bB}	86.7±4.9 ^{aA}	91.5±5.0 ^{aA}	7.50±0.07 ^{aA}	7.38±0.04 ^{bB}	7.38±0.05 ^{bA}
6 weeks post treat.	67.0±5.0 ^{bB}	86.4±4.9 ^{aA}	91.2±5.0 ^{aA}	7.55±0.07 ^{aA}	7.38±0.04 ^{bB}	7.30±0.06 ^{cA}
7 weeks post treat.	67.2±5.0 ^{bB}	86.8±4.8 ^{aA}	91.4±5.1 ^{aA}	7.58±0.06 ^{aA}	7.36±0.05 ^{bB}	7.35±0.05 ^{bA}

abc : Least squares means within each raw under the same semen characteristic with different superscripts are ($P<0.05$) different.
ABC: Least squares means within each column with different superscripts are ($P<0.05$) different.

(1993b). The inanition was observed in this group. This result assert the venomous effect of the force molting on body organs as its reflection on the metabolic mechanisms. However, HCG treatment elevated ($P<0.05$) plasma total protein, that may be due to the increase of testosterone level. A specific role for gonadal hormones to major aspects of protein metabolism has been demonstrated (Jacquet *et al.*, 1993a and b). Plasma glucose and total lipids had similar direction like total protein as affected by force molting and HCG treatment.

Moreover, plasma cholesterol increased ($P<0.05$) in force molting group, especially during the fasting. It is possible that feed deprivation leads to elevation of plasma catecholamine and corticosteroid level which lead to increase the level of cholesterol in force molted group. Siegel (1971) came to similar observation. Since cholesterol is the precursor of steroid hormones (Gilbert, 1971), this probable attributed to cholesterol utilization and an increased steroid hormones synthesis. This vindication may be an overt results obtained in HCG injected cockerels. These cockerels recorded lower ($P<0.05$) values in plasma cholesterol.

Force molting caused depression ($P<0.05$) in plasma Ca while HCG treatment did not show a remarkable change. It is plausible that intestinal Ca secretion and possibly parathyroid hormone (PTH) are responsible for the cycle appearance of circulating Ca may be due to calcium utilization, followed by bone and kidney clearance (Sykes, 1971), Perhaps, in force molted group the same temporal scheme of intestinal and PTH secretion, while Ca apperance and clearance persisted, but at much reduced Ca level similar results obtained by Gildersleeve *et al.* (1983).

Plasma total and inorganic phosphorous were similarly affected as plasma total lipids. Which total lipids circulating in the blood contain 31.8% phospholipids (Sturki, 1986).

3-2- Plasma Enzymes

It is clear from table (7) that the force molting caused ($P<0.05$) increase in glutamic oxaloacetic transaminase (GOT) and decrease ($P<0.05$) in glutamic pyruvic transaminase (GPT) and alkaline phosphatase (Alk. P). While HCG injection caused decrease ($P<0.05$) in GOT, increase ($P<0.05$) in GPT and no signigicant ($P>0.05$) changes in Alk.P. These findings confirm the present results on plasma glucose. However, if plasma transaminase activity in part from corticosteroid stimulation in the liver, it seems that higher GPT activity may be associated with higher adrenal corticosterone output, whereas lower adrenal output may be associated with lower GPT but higher GOT activity. Possibly, then during time of increased liver lipogenesis, such as during semen production, the production of pyruvic from alanine is higher than non-producing cockerels. Khalil and Abd El Hakim (1990) came to similar explanation in force molted cockerels.

Plasma Alk. P is apparently of a somatic cell origin and is thought to arise from active anabolic tissue (Bell, 1971). The depression ($P<0.05$) of Alk. P in force molted cockerels may be due to the metabolic activity (catabolic or anabolic). In the present study, HCG injection showed no significant changes in Alk-P which may be sequel and dependent on the time of semen collection and blood sampling, which is first. In this study blood sampling was followed by semen collection.

Table 4. Least squares means (± SE) of plasma total protein, albumin and globulin as affected by force molting (FM) and HCG treatment.

Time	Total protein (gm/dl)			Albumen (gm/dl)			Globulin (gm/dl)		
	Control	FM	HCG	Control	FM	HCG	Control	FM	HCG
Before treatment	5.25± 0.20	5.27± 0.17^{A}	5.21± 0.19^{B}	2.16± 0.21	2.18± 0.17^{A}	2.15± 0.19^{C}	3.09± 0.11	3.09± 0.10^{B}	3.06± 0.12^{B}
At middle of treatment	5.20± 0.23^{a}	3.12± 0.21^{bC}	5.90± 0.22^{aB}	2.14± 0.19^{b}	1.14± 0.18^{cC}	2.39± 0.22^{aB}	3.08± 0.09^{a}	1.98± 0.11^{bB}	3.51± 0.13^{aA}
At end of treatment	5.12± 0.25^{a}	2.20± 0.18^{bD}	6.21± 0.27^{aA}	2.12± 0.18^{b}	0.75± 0.19^{cB}	2.55± 0.20^{aB}	3.00± 0.10^{b}	1.45± 0.11^{cC}	3.66± 0.13^{aA}
1 week post treatment	4.81± 0.26^{b}	3.12± 0.25^{cC}	6.22± 0.27^{aA}	2.05± 0.18^{b}	1.10± 0.21^{cC}	2.50± 0.24^{aB}	2.76± 0.10^{b}	2.02± 0.11^{bB}	3.72± 0.11^{aA}
2 week post treatment	4.86± 0.34^{b}	4.15± 0.25^{bB}	6.18± 0.23^{aA}	2.11± 0.21^{b}	1.59± 0.18^{cB}	2.70± 0.24^{aA}	2.75± 0.10^{b}	2.56± 0.10^{bB}	3.48± 0.11^{aA}
3 week post treatment	4.81± 0.32^{b}	4.81± 0.23^{bB}	6.15± 0.28^{aA}	1.98± 0.21^{b}	1.83± 0.18^{bA}	2.75± 0.23^{aA}	2.42± 0.11^{c}	2.98± 0.10^{bA}	3.42± 0.11^{aA}
4 week post treatment	4.75± 0.31^{c}	5.20± 0.33^{bA}	6.12± 0.31^{aA}	2.13± 0.22^{b}	2.05± 0.28^{bA}	2.68± 0.21^{aA}	2.62± 0.12^{c}	3.15± 0.11^{bA}	3.44± 0.11^{aA}
5 week post treatment	4.80± 0.27^{c}	5.65± 0.32^{bA}	6.11± 0.32^{aA}	1.99± 0.21^{b}	2.11± 0.23^{bA}	2.65± 0.23^{aA}	2.81± 0.11^{b}	3.54± 0.08^{aA}	3.26± 0.10^{aA}
6 week post treatment	4.71± 0.28^{c}	5.82± 0.30^{bA}	6.06± 0.31^{aA}	2.00± 0.21^{b}	2.10± 0.28^{bA}	2.62± 0.23^{aA}	2.71± 0.11^{b}	3.72± 0.09^{aA}	3.24± 0.10^{aA}
7 week post treatment	4.72± 0.32^{b}	6.12± 0.29^{aA}	6.19± 0.31^{aA}	2.12± 0.20^{b}	2.25± 0.28^{bA}	2.68± 0.24^{aA}	2.60± 0.11^{b}	3.87± 0.09^{aA}	3.31± 0.12^{aA}

abc : Least squares means within each raw under the same blood constituent followed by different superscripts are ($P<0.05$) different.
ABC: Least squares means within each column with different superscripts are ($P<0.05$) different.

Table 5. Least squares means (± SE) of plasma total lipids, glucose and cholesterol as affected by force molting (FM) and HCG treatment.

Time	Total lipids (gm/dl)			Glucose (mg/dl)			Cholesterol (mg/dl)		
	Control	FM	HCG	Control	FM	HCG	Control	FM	HCG
Before treatment	3.71± 0.06	3.73± 0.06^{A}	3.70± 0.03^{C}	236.2± 3.8	239.6± 3.6^{A}	238.5± 3.4^{A}	117.8± 1.4	119.6± 1.3^{D}	120.4± 1.3^{A}
At middle of treatment	3.69± 0.05^{b}	1.21± 0.06^{cC}	5.31± 0.04^{aB}	233.7± 3.2^{a}	81.2± 3.4^{bD}	236.7± 3.4^{aA}	115.2± 1.3^{b}	185.4± 1.8^{aA}	102.2± 1.8^{cB}
At end of treatment	3.73± 0.03^{b}	0.94± 0.07^{cD}	5.30± 0.04^{aB}	232.7± 3.4^{a}	66.4± 3.3^{bD}	242.5± 3.6^{aA}	119.4± 1.4^{b}	239.3± 1.8^{aA}	110.3± 1.7^{cA}
1 week post treatment	3.65± 0.07^{b}	1.49± 0.08^{cC}	5.71± 0.04^{aB}	240.8± 3.2^{a}	122.2± 3.5^{bC}	245.5± 3.5^{aA}	112.4± 1.4^{b}	210.7± 1.5^{aA}	108.5± 1.5^{cA}
2 week post treatment	3.74± 0.08^{b}	2.52± 0.08^{cB}	5.80± 0.05^{aB}	241.6± 3.5^{a}	200.7± 3.7^{bB}	245.5± 3.5^{aA}	118.3± 1.5^{b}	198.2± 1.5^{aA}	110.7± 2.1^{cA}
3 week post treatment	3.81± 0.08^{b}	3.12± 0.07^{bA}	6.10± 0.06^{aA}	238.7± 3.1^{a}	230.8± 3.6^{aA}	244.6± 3.6^{aA}	121.7± 1.7^{b}	170.4± 1.4^{aB}	105.8± 2.1^{cA}
4 week post treatment	3.72± 0.09^{b}	3.60± 0.05^{bA}	6.17± 0.05^{aA}	235.9± 3.2^{a}	228.6± 3.2^{aA}	246.8± 3.8^{aA}	118.2± 1.8^{b}	170.5± 1.8^{aB}	102.4± 2.1^{cA}
5 week post treatment.	3.70± 0.05^{b}	3.76± 0.05^{bA}	6.21± 0.07^{aA}	233.1± 3.4^{a}	235.5± 3.6^{aA}	243.9± 3.6^{aA}	117.5± 1.8^{b}	165.6± 1.8^{aB}	111.3± 2.1^{bA}
6 week post treatment	3.67± 0.06^{b}	3.89± 0.07^{bA}	6.21± 0.07^{aA}	231.3± 3.2^{a}	234.3± 3.5^{aA}	242.9± 3.7^{aA}	113.7± 2.1^{b}	145.5± 1.8^{aC}	108.2± 1.8^{bA}
7 week post treatment	3.65± 0.07^{b}	4.15± 0.08^{bA}	6.33± 0.07^{aA}	234.2± 3.3^{a}	238.9± 3.4^{aA}	243.2± 3.6^{aA}	126.6± 2.0^{b}	138.8± 1.7^{aC}	110.6± 1.8^{bA}

abc : Least squares means within each raw under the same variable followed by different superscripts are ($P<0.05$) different.
ABC: Least squares means within each column with different superscripts are ($P<0.05$) different.

Table 6. Least squares means (±SE) of plasma calcium, total phosphorus and inorganic phosphorus as affected by force molting (FM) and HCG treatment

Time	Calcium (mg/dl)			Total phosphorus (mg/dl)			Inorganic phosphorus (mg/dl)		
	Control	FM	HCG	Control	FM	HCG	Control	FM	HCG
Before treatment	11.07± 0.17	11.08± 0.16^{A}	11.08± 0.18^{A}	35.04± 2.8	35.14± 2.5^{A}	35.40± 2.7^{B}	7.39± 0.90	7.40± 0.85^{A}	7.37± 0.93^{A}
At middle of treatment	11.20± 0.12^{a}	5.36± 0.16^{bD}	11.11± 0.18^{aA}	34.02± 2.7^{a}	18.95± 2.3^{bB}	39.75± 2.6^{aA}	7.41± 0.85^{a}	4.42± 0.24^{bC}	7.35± 0.98^{aA}
At end of treatment	11.22± 0.13^{a}	3.41± 0.16^{bD}	11.16± 0.21^{aA}	34.10± 2.6^{a}	13.84± 2.4^{bC}	38.20± 2.7^{aA}	7.52± 0.86^{a}	4.10± 0.22^{bC}	7.36± 0.94^{aA}
1 week post treatment	11.21± 0.15^{a}	8.36± 0.14^{bC}	11.21± 0.21^{aA}	34.70± 2.7^{a}	10.85± 2.6^{bD}	39.28± 2.8^{aA}	7.41± 0.87^{a}	4.50± 0.21^{bC}	7.35± 0.92^{aA}
2 week post treatment	11.29± 0.15^{a}	9.05± 0.13^{bB}	11.27± 0.20^{aA}	32.81± 2.8^{a}	18.72± 2.3^{bB}	39.27± 2.7^{aA}	7.36± 0.92^{a}	5.73± 0.20^{bB}	7.37± 0.93^{aA}
3 week post treatment	10.94± 0.12^{a}	10.07± 0.13^{bA}	10.89± 0.22^{aA}	32.92± 2.5^{a}	20.74± 2.5^{bB}	38.52± 2.6^{aA}	7.42± 0.93^{a}	5.98± 0.34^{bB}	7.23± 0.98^{aA}
4 week post treatment	11.36± 0.12^{a}	10.06± 0.14^{bA}	11.41± 0.21^{aA}	33.13± 2.6^{a}	29.82± 2.6^{bA}	38.45± 2.6^{aA}	7.33± 0.90^{a}	6.82± 0.41^{bB}	7.29± 0.95^{aA}
5 week post treatment	11.40± 0.16^{a}	10.09± 0.15^{bA}	11.40± 0.21^{aA}	33.12± 2.7^{a}	31.72± 2.4^{bA}	37.38± 2.5^{aA}	7.38± 0.91^{b}	7.52± 0.73^{aA}	7.38± 0.96^{bA}
6 week post treatment	11.10± 0.16^{a}	10.04± 0.15^{bA}	11.59± 0.19^{aA}	33.02± 2.8^{a}	32.88± 2.3^{bA}	37.47± 2.7^{aA}	7.34± 0.93^{b}	7.44± 0.80^{aA}	7.39± 0.92^{aA}
7 week post treatment	11.09± 0.16^{a}	10.52± 0.13^{aA}	11.46± 0.18^{aA}	32.75± 2.7^{a}	32.86± 2.4^{bA}	38.56± 2.8^{aA}	7.36± 0.95^{a}	7.30± 0.82^{aA}	7.40± 0.94^{aA}

^{abc} Least squares means within each raw under the same plasma constituent followed by different superscripts are (P<0.05) different.

^{ABC} Least squares means within each column with different superscripts are (P<0.05) different.

Table 7. Least squares means (±SE) of plasma enzymes (glutamic, oxalsacetate pyruvic transaminase) and alkaline phosphatase as affected by force molting (FM) and HCG treatment

Time	GOT (U/l)			GPT (U/l)			Alkaline phosphatase (U/l)		
	Control	FM	HCG	Control	FM	HCG	Control	FM	HCG
Before treatment	126.5± 2.6	127.2± 2.5 ^{B}	126.4± 2.3 ^{A}	28.6± 1.8	29.4± 2.1 ^{A}	28.7± 1.9 ^{B}	773.3± 40.5	779.3± 40.8 ^{A}	785.4± 41.6 ^{A}
At middle of treatment	126.6± 2.4 ^{b}	154.6± 2.6 ^{aA}	115.8± 2.4 ^{cC}	28.5± 1.6 ^{a}	10.5± 1.9 ^{bD}	31.6± 1.8 ^{aA}	763.2± 40.8 ^{a}	234.2± 40.9 ^{bC}	780.2± 40.8 ^{aA}
At end of treatment	126.7± 2.3 ^{b}	167.4± 2.6 ^{aA}	117.5± 2.5 ^{cC}	28.6± 1.5 ^{a}	8.2± 1.9 ^{bD}	32.4± 1.6 ^{aA}	783.8± 41.2 ^{a}	211.3± 42.8 ^{bC}	759.9± 40.8 ^{aA}
1 week post treatment	126.4± 2.5 ^{b}	143.5± 2.5 ^{aA}	123.5± 2.6 ^{bB}	27.9± 1.8 ^{a}	11.4± 1.8 ^{bD}	29.8± 1.8 ^{aA}	756.6± 41.2 ^{a}	312.4± 44.2 ^{bC}	775.8± 42.1 ^{aA}
2 week post treatment	125.2± 2.6 ^{b}	132.4± 2.4 ^{aA}	122.4± 2.4 ^{bB}	27.7± 1.8 ^{a}	19.8± 1.4 ^{bC}	29.5± 1.8 ^{aA}	770.6± 41.8 ^{a}	568.6± 40.5 ^{bB}	778.6± 42.8 ^{aA}
3 week post treatment	125.2± 2.6 ^{a}	127.2± 2.4 ^{aB}	127.2± 2.5 ^{aA}	28.4± 1.7 ^{a}	25.5± 1.7 ^{bB}	29.6± 1.7 ^{aA}	785.5± 42.5 ^{a}	780.4± 40.8 ^{aA}	774.4± 41.3 ^{aA}
4 week post treatment	127.4± 2.7 ^{a}	127.4± 2.5 ^{aB}	127.4± 2.6 ^{aA}	28.8± 1.7 ^{a}	30.4± 1.9 ^{aA}	29.8± 2.0 ^{aA}	782.4± 44.8 ^{a}	785.6± 40.2 ^{aA}	782.8± 41.9 ^{aA}
5 week post treatment	127.2± 2.5 ^{a}	126.5± 2.5 ^{aB}	126.5± 2.4 ^{aA}	28.7± 1.6 ^{a}	29.2± 1.8 ^{aA}	29.8± 2.1 ^{aA}	768.2± 42.7 ^{a}	790.2± 44.8 ^{aA}	792.2± 42.3 ^{aA}
6 week post treatment	126.3± 2.4 ^{a}	126.2± 2.7 ^{aB}	126.2± 2.5 ^{aA}	28.2± 1.8 ^{a}	28.8± 1.8 ^{aA}	29.6± 1.9 ^{aA}	770.2± 44.5 ^{a}	783.3± 45.3 ^{aA}	783.4± 42.8 ^{aA}
7 week post treatment	125.7± 2.4 ^{a}	126.8± 2.7 ^{aB}	126.8± 2.4 ^{aA}	27.9± 1.8 ^{a}	29.6± 2.0 ^{aA}	29.7± 1.9 ^{aA}	780.3± 44.5 ^{a}	780.8± 45.2 ^{aA}	780.6± 42.9 ^{aA}

^{abc} Least squares means within each raw under the same plasma enzyme followed by different superscripts are (P<0.05) different.

^{ABC} Least squares means within each column with different superscripts are (P<0.05) different.

3-3- Serum hormones

Data on thyroxine (T_4), triiodothyronine (T_3) and testosterone are presented in table 8. Data indicate that both T_3 and T_4 were increased ($P<0.05$) as affected by force molting or HCG treatment. The increasing in T_4 in force molted group may be due to induction of feather loss. Hoshino *et al.*, (1988) speculated similar vindication. Moreover, the elevation of thyroid hormones related to HCG injection may be due to a rise of the hypothalamo pituitary-testes axis coincided with an increased activity of the hypothalamo-pituitary-thyroid axis (Jacquet *et al.*, 1993b). An increase in thyroid hormones which mean elevating the metabolic rate, is probably of crucial importance of improving the semen production of injected HCG cockerels.

The serum testosterone was dramatically and statistically decreased ($P<0.05$) during the fasting period. Charles *et al.*, (1992) concluded that plasma testosterone level is correlated with body weight changes. In the present results, the lower testosterone level in force molted cockerels may be due to there was no surplus metabolisable energy (energy insufficiency) toward the reproduction, after maintenance of force molted cockerels. These cockerels showed not only return to initial testosterone level but also increase ($P<0.05$) in serum testosterone level after three weeks of recovering period. Similar results were reported by Jacquet *et al.* (1993b).

It is likely that, however, HCG contains LH and FSH then its action could be reflect, the physiological basis of these hormones. In discussing, the physiological action of FSH, it is pertinent to consider the effect of this hormones on metabolism and steroidogensis. LH stimulates the interstitial tissue of the male to secrete androgen. Similar findings were obtained by Jacquet *et al.* (1993a).

In general, all blood constituents studied herein seemed to return to their initial values and improved ($P<0.05$) after about three weeks of recovering period for force molted cockerels.

4- Correlations among seminal characteristics and serum hormones and plasma metabolites

Table 9 lists the correlation coefficients calculated within each treatment among seminal characteristics and serum hormones and plasma metabolites. In general, obtained correlation values were closely linked to each other. However, it might be noticed that the correlations between seminal characteristics and serum hormones are indeed related to the metabolic activities especially for force molting group. The positive correlations of all blood (plasma or serum) constituents and seminal characteristics might be due to that during fasting the metabolic activities are decreased and the efficiency to produce semen is decreased as well. Only one exception of T_4 showed negative ($P<0.05$) correlation with seminal characteristics, while serum testosterone recorded highly ($P<0.01$) correlation with the seminal characteristics.

The congeniality of correlation coefficients among seminal characteristics and total protein, total lipids and glucose in blood plasma reported herein are apparently agreeable with that dependence of semen formation and metabolic products. Hocking (1991) came to similar observations. The same direction was observed in the

Table 8. Least squares means (±SE) of serum triiodothyronine, thyroxine and testosterone as affected by force molting (FM) and HCG treatment

Time	T3 (ng/ml)			T4 (ng/ml)			Testosterone (ng/dl)		
	Control	FM	HCG	Control	FM	HCG	Control	FM	HCG
Before treatment	1.8± 0.03	1.7± 0.04 ^{C}	1.8± 0.04 ^{B}	12.6± 0.9	12.5± 0.9^{C}	12.6± 0.8^{B}	216.3± 4.8	221.7± 5.3 ^{B}	219.2± 4.8 ^{C}
At middle of treatment	1.7± 0.02 ^{b}	3.2± 0.04 ^{aA}	1.9± 0.04 ^{bB}	12.6± 1.1 ^{c}	18.8± 1.1^{aB}	16.2± 0.8^{bA}	220.9± 4.3^{b}	105.4± 4.9 ^{cC}	285.2± 4.7 ^{aA}
At end of treatment	1.7± 0.02 ^{b}	2.0± 0.05 ^{aB}	2.4± 0.04 ^{aA}	12.4± 1.1 ^{c}	22.7± 1.2^{aA}	15.8± 0.8^{bA}	221.1± 3.8^{b}	47.8± 5.3 ^{cD}	286.7± 4.9 ^{aA}
1 week post treatment	1.8± 0.03 ^{b}	2.1± 0.05 ^{aB}	2.2± 0.04 ^{aA}	11.9± 0.9 ^{c}	22.2± 1.2^{aA}	16.1± 1.1^{bA}	215.7± 3.4^{b}	98.7± 5.2 ^{cC}	275.6± 4.8 ^{aA}
2 week post treatment	1.8± 0.02 ^{b}	1.8± 0.04 ^{bC}	2.3± 0.03 ^{aA}	11.8± 0.8 ^{c}	21.3± 1.3^{aA}	15.5± 1.1^{bA}	212.2± 3.7^{b}	112.4± 5.6 ^{cB}	277.2± 4.6 ^{aA}
3 week post treatment.	1.8± 0.03 ^{b}	1.8± 0.03 ^{bC}	2.3± 0.05 ^{aA}	13.4± 0.9^{b}	15.7± 1.2^{aB}	15.7± 1.2^{aA}	218.7± 4.5^{c}	245.6± 4.8 ^{bA}	268.4± 4.6 ^{aA}
4 week post treatment	1.8± 0.03 ^{b}	1.7± 0.04 ^{bC}	2.4± 0.06 ^{aA}	12.2± 0.8^{b}	15.2± 0.9^{aB}	15.8± 1.1^{aA}	219.2± 4.4^{c}	241.4± 4.9 ^{bA}	269.7± 4.6 ^{aA}
5 week post treatment	1.8± 0.02 ^{b}	1.8± 0.03 ^{bC}	2.4± 0.06 ^{aA}	13.8± 0.8^{b}	12.5± 1.0^{aC}	15.6± 0.8^{aA}	210.8± 4.2^{c}	240.8± 5.2 ^{bA}	259.8± 4.6 ^{aB}
6 week post treatment	1.8± 0.02 ^{b}	1.7± 0.03 ^{bC}	2.3± 0.05 ^{aA}	11.6± 0.9^{b}	12.3± 1.0^{bC}	15.8± 0.9^{aA}	215.5± 3.9^{c}	243.7± 5.2 ^{bA}	257.4± 4.7 ^{aB}
7 week post treatment.	1.8± 0.03 ^{b}	1.8± 0.04 ^{bC}	2.2± 0.05 ^{aA}	12.4± 0.9^{b}	12.2± 1.1^{bC}	16.2± 1.1^{aA}	218.7± 3.8^{c}	235.6± 5.1 ^{bA}	258.6± 4.8 ^{aB}

^{abc} Least squares means within each raw under the same assay followed by different superscripts are (P<0.05) different.

^{ABC} Least squares means within each column with different superscripts are (P<0.05) different.

Table 9. Coefficient of correlation between seminal characteristics and serum hormones and plasma metabolites. The correlations were calculated within treatment.

Treatment	Semenal characters	Serum hormones			Plasma metabolites							
		T3	T4	Testos-terone	TP	TL	Glu	Ca	P	GOT	GPT	Alk-P
Control	Ejaculate volume	0.724**	0.669**	0.818**	0.611**	0.618**	0.669**	0.623**	0.718**	0.721**	0.723**	0.733**
	Sperm x 10^8/mm^3	0.639**	0.628**	0.796**	0.540**	0.512**	0.560**	0.617**	0.672**	0.621**	0.619**	0.669**
	Motility %	0.769**	0.618**	0.781*	0.515**	0.451*	0.550**	0.512*	0.496*	0.522*	0.512*	0.518**
	Semen pH	0.433	0.414**	0.381*	0.321*	0.318*	0.332*	0.381*	0.381*	0.381*	0.312*	0.312*
Force molting	Ejaculate volume	0.714**	-0.432*	0.854**	0.723**	0.745**	0.749**	0.632**	0.630**	0.721**	0.720**	0.671**
	Sperm x 10^8/mm^3	0.614**	-0.521*	0.890**	0.727**	0.765**	0.723**	0.623**	0.627**	0.720**	0.718**	0.681**
	Motility %	0.718**	-0.341*	0.812**	0.513**	0.524**	0.518**	0.518**	0.524**	0.525**	0.527**	0.518**
	Semen pH	0.451*	-0.562*	0.413*	0.331*	0.321*	0.336*	0.337*	0.384*	0.382*	0.343*	0.335*
HCG injection	Ejaculate volume	0.812**	0.713**	0.951**	0.751**	0.734**	0.821**	0.714**	0.712**	0.810**	0.812**	0.831**
	Sperm x 10^8/mm^3	0.816**	0.712**	0.911**	0.753**	0.769**	0.820**	0.715**	0.718**	0.822**	0.815**	0.821**
	Motility %	0.719**	0.815**	0.918*	0.523**	0.533**	0.527**	0.528**	0.518**	0.618**	0.628**	0.517**
	Semen pH	0.315*	0.395*	0.412*	0.333*	0.289*	0.285*	0.234*	0.342*	0.352*	0.363*	0.374*

Where T3: Triiodothyronine, T4: Thyroxine, TP: Total protein, TL: Total lipids, Glu: Glucose, Ca: Calcium, P: Total phosphorus, GOT: glutamic oxaloacetic transaminase, GPT: glutamic pyruvic transaminase, and Alk-P: Alkaline phosphatase

* P<0.05 ** P<0.01

correlations among seminal characteristics and plasma enzymes. In this point of view it is not surprising that seminal characteristics are strongly correlated with liver function. The low values of the correlation coefficients in semen pH with all metabolic parameters may be because it depends largely on ionic balance and /or water cycling (metabolic body water).

From these results, it could be concluded that each of force molting or HCG treatment improve the reproductive performance of Hubbard parent cockerels in second year of production. Prolongation of production period and semen quality should be aimed. Also, economic status of the production unit must be considered.

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تحسين صفات السائل المنوى لديوك اباء الهابرد أثناء السنة الإنتاجية الثانية

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صممت هذه التجربة بغرض رفع جودة السائل المنوى لديوك اباء الهابرد أثناء السنة الإنتاجية الثانية: استخدم ٢٤ ديك عمر ٦٨ أسبوع. قسمت الديوك إلى ثلاثة مجاميع:

المجموعة الأولى : خمسة ديوك بمتوسط وزن ٥,٨٢ كجم (كونترول) ، المجموعة الثانية تسعة ديوك بمتوسط وزن ٦,٠٥ كجم حقنت تحت الجلد ب ١ ملل محلول فسيولوجى يحتوى على ٥٠ وحدة دولية من HCG يوميا لمدة ٧ أيام ، المجموعة الثالثة: عشرة ديوك بمتوسط وزن ٥,٨٦ كجم عرضت للقلش الاجبارى عن طريق التصويم التام لمدة عشرة أيام متصلة مع الاظلام التام وتوافر ماء الشرب.

ومن النتائج يتضح الأتى : أن كلا من الحقن بـ HCG والقلش الاجبارى حسن من جودة السائل المنوى. بينما أعطى الحقن تحسناً مباشراً ولكن مع القلش الاجبارى احتاجت الديوك لحوالى أربع اسابيع لوضوح التحسن.

معامل الارتباط بين صفات السائل المنوى (حجم القذفة، تركيز الحيوانات المنوية ، حيوية الحيوانات المنوية ، التركيز السالب ايون الايدروجين للسائل المنوى ، ومكونات الدم البروتين الكلى ، الالبومين ، الجلوبيولين ،الليبيدات، الجلوكوز ، الكوليسترول ، الكالسيوم ، الفوسفور ، T_3 ، T_4 ، التستستيرون ، Alk. P, GPT, GOT) اوضحت أن تخليق السائل المنوى يعتمد كليا على كفاءة التمثيل الغذائى.