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in

Baselga M. (ed.), Marai I.F.M. (ed.).
Rabbit production in hot climates

Zaragoza : CIHEAM
Cahiers Options Méditerranéennes; n. 8

1994
pages 355-365

Effects of Human Chorionic Gonadotrophin on Reproductive and Productive Performance in Female New Zealand White Rabbits

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SUMMARY - One hundred thirty-eight New Zealand White (NZW) does of 5-6 months of age were used in the present study. The aim was to investigate the effects of human chorionic gonadotrophin (HCG; Pregnyl) injection at levels 0, 50 and 100 I.U on reproductive and productive performance of NZW does and their offspring after kindling up to weaning. The effects of time of mating following HCG injection, parity and month of kindling, were studied. Progesterone and estrogen levels in blood plasma during pregnancy period, were also determined.

Injection of rabbits with 50 I.U. of HCG gave the best values of most reproductive and productive traits. The effects of HCG treatments were highly significant ($P < 0.01$) on each of litter size at birth, litter weights at 21 and 28 days, bunny weight at birth and litter weight gain from birth to 28 days and the effects were not significant on conception rate, gestation length, number of services per conception, pre-weaning mortality rate, milk yield, milk conversion and progesterone and estrogen levels during pregnancy.

The time of mating following HCG injection showed insignificant effects on all doe traits.

The effects of parity following HCG injection were highly significant ($P < 0.01$) on each of the number of services per conception, gestation length, milk yield at week 2 of lactation and milk conversion at first week and were not significant on conception rate, litter size, litter weight, bunny weight, litter weight gain and pre-weaning mortality rate.

The effects of month of kindling were highly significant ($P < 0.01$) on each of conception rate, number of services per conception, gestation length and litter weight at birth and were not significant on each of litter size, bunny weight, litter weight gain and pre-weaning mortality rate.

Key words: rabbit, ovulation, conception rate, litter size and weight, milk yield, estrogen, progesterone.

Introduction

In rabbits, failure in ovulation after copulation is one of the major factors in rabbit infertility. Doe rabbit ovulates as a result of mating which takes place 10-13 h later. However, 20 to 25% of the does fail to ovulate even after copulation because of the deficiency of luteinizing hormone in the pituitary gland (Fox and Krinsky 1968).

The present study was designed to evaluate the effects of HCG (Pregnyl) injection at different levels on reproductive and productive traits of NZW rabbit does. The effects of time of mating following HCG injection, parity and month of kindling, were also studied.

Materials and Methods

The present study was conducted on a flock of NZW rabbits belonging to Saft Zoreek Co-operative Farm, Sharkia Governorate, Egypt, during the period from July 1991 to January, 1992.

One hundred thirty-eight does of 5-6 months of age were used during the first three parities. All animals were fed ad libitum a commercial pelleted ration containing 17.3% crude protein, 13.5% crude fibre and 3.2% fat. Clean tap water was available at all times. Does with nearly equal body weights were divided just after sexual maturity into three experimental groups with equal numbers (n=46). The first group was used as control and injected with saline solution (1 m of 0.9% NaCl). The second and third groups were injected intramuscularly with 50 and 100 I.U. of HCG (Pregnyl, produced by Nile Company for Pharmaceuticals and Chemical Industries). Each experimental group was divided into two subgroups according to time of Pregnyl administration (2h before mating in the first and just before mating in the second one). Twenty-one fertile bucks (6-7 months of age) were used for mating. Mating was carried out at random between does and bucks and each doe was transformed to the buck's cage to be mated and returned back to its cage after mating. All animals were kept under the same managerial, hygienic and environmental conditions. The experimental animals were alloted in a windowed house. Flat deck cages were provided with nests for does and automatic drinker nipples and feeding troughs. Pregnancy was diagnosed by abdominal palpation 10 days after service. All does were mated on day one after kindling. Does failed to conceive were immediately remated after pregnancy testing. All kindlings rabbits remained in the nests with their dams for suckling from birth up to weaning at 28 days after birth, then they were moved to the growing batteries. Month of kindling, parity of litter, number of services per conception, conception rate, gestation length, litter size, litter weight, bunny weight, litter weight gain, mortality rate, milk yield and milk conversion, were recorded. Estimation of milk yield was carried out according to Zarrow et al. (1965). Blood samples were collected from the marginal ear vein under vacuum in heparinized tube (5 does from each experimental group) after mating, 7, 18 and 28 days from mating. Blood samples were immediately centrifuged at 3000 r.p.m. for 10 minutes and plasma was seperated, freezed under -20 °C and kept for assaying estrogen and progesterone by radioimmunoassay technique coated-tube kits (Diagnostic Products Corporation, Los, Angles, USA).

Data were statistically examined by Least Squares Maximum Likelihood method of analysis (Harvey, 1977). Duncan's New Multiple Range Test was used for the multiple comparisons. Conception rate was analyzed using the contingency tables according to Everitt (1977). Pre-weaning mortality percentages were subjected to arc-sin transformation before being analyzed in order to approximate normal scale distribution. Least squares means were retransformed to the original scale before being illustrated.

Results and Discussion

1- Conception rate, number of services per conception, gestation length, litter size and litter weight:

Table 1 shows that does treated with 50 I.U. of HCG gave better conception rate, number of services per conception, litter size and litter weight than 100 I.U. and 0 doses. The improvement in reproductive performance of the does injected with 50 I.U. may be attributed to the effectiveness of that level which exerts mostly LH and slightly FSH-Like effects and gets in circulation quickly before the release of the endogenous LH, while the higher level (i.e. 100 I.U. HCG) may inhibit the release of LH and FSH hormones through the negative feedback mechanism. The effects of HCG treatment were highly significant ($P < 0.01$) on each of litter size at birth and litter weights at 21 and 28 days, and not significant on conception rate, number of services per conception and gestation length (Table 1).

Table 1. Effect of each of HCG injection, time of injection, parity and month of kindling on conception rate, number of services per conception, gestation length, litter size and litter weight of NZW rabbits, under Egyptian environmental conditions.

Classification	Number of does			Number of services per conception	Gestation length (days)	Litter size at			Litter weight (g) at		
	Mated (No.)	Pregnant (No.)	Pregnant (%)			Birth	21st day	28th day	Birth	21st day	28th day
General mean	535	359	(67.1)	1.81±0.04	31.3±0.11	6.0±0.16	5.3±0.15	5.2±0.15	334.8±8.5	1635.1±34.6	2231.3±52.1
HCG levels (I.U.):											
Zero	177	110	(62.2)	1.86±0.07	31.1±0.17	6.2±0.25[a]	5.3±0.23	5.2±0.23	338.3±13.0	1606.5±52.5[ab]	2165.6±79.1[b]
50	175	124	(70.9)	1.77±0.06	31.6±0.16	6.3±0.23[a]	5.5±0.21	5.5±0.21	351.2±12.3	1726.4±50.5[a]	2396.2±76.1[a]
100	183	125	(68.3)	1.82±0.07	31.2±0.17	5.5±0.25[b]	5.0±0.22	4.9±0.22	314.8±12.8	1572.4±51.8[b]	2132.2±78.0[b]
Time of injection:											
2h before mating	259	171	(66.0)	1.83±0.06	31.2±0.14	5.9±0.21	5.2±0.19	5.1±0.19	333.3±11.1	1549.0±44.8	2231.9±67.4
At mating	276	188	(68.1)	1.79±0.05	31.5±0.13	6.1±0.20	5.4±0.19	5.2±0.18	336.2±10.5	1676.2±42.9	2248.7±64.6
Parities:											
1	198	132	(66.7)	2.07±0.11[a]	31.8±0.28[a]	6.2±0.42	5.5±0.39	5.3±0.39	355.4±22.0	1624.4±90.7	2258.0±136.7
2	181	122	(67.4)	1.58±0.08[b]	31.5±0.19[a]	6.0±0.29	5.5±0.27	5.4±0.27	333.4±15.1	1719.4±62.1	2309.5± 92.6
3	156	105	(67.3)	1.78±0.09[b]	30.7±0.32[b]	5.7±0.33	4.9±0.31	4.8±0.30	315.6±17.2	1561.5±70.5	2126.4±109.2
Month of kindling:											
September	94	91	(96.8[a])	1.24±0.12[c]	30.8±0.30[b]	6.0±0.45	5.2±0.42	5.2±0.41	348.8±33.4[a]	1563.9±96.0	2206.3±144.5
October	144	85	(59.0[b])	1.35±0.08[c]	30.8±0.20[b]	5.3±0.30	4.8±0.28	4.7±0.28	291.1±15.8[b]	1482.6±65.5	2086.7± 94.7
November	145	91	(62.8[b])	2.02±0.08[b]	31.0±0.20[b]	6.4±0.29	5.3±0.26	5.2±0.26	355.2±15.2[a]	1598.4±60.6	2228.5± 91.3
December	124	76	(61.3[b])	2.50±0.10[a]	31.8±0.26[a]	6.2±0.39	5.8±0.37	5.6±0.37	346.9±20.3[a]	1798.6±85.5	2434.9±128.8
January	28	16	(57.1[b])	2.42±0.18[ab]	32.2±0.46[a]	5.9±0.69	5.4±0.62	5.2±0.62	331.9±35.4[a]	1732.1±143.5	2200.1±216.1

Means in the same column within the same classification with different letters, differ significantly ($P < 0.05$).

These results agreed with those obtained by Hulot and Poujardieu (1976) and Urbanski (1979).

The effects of time of mating on conception rate, number of services per conception, gestation length, litter size and litter weight were insignificantly higher in does injected at mating than in does injected 2 h before mating (Table 1). Similarly, Hattenhauer et al. (1985) found that conception rate was not significantly affected by time of injection of GnRH or PMSG. However, Xie and Lui (1983) found that the highest conception rate was obtained from does injected 4-5 h before mating with 20 I.U. HCG/kg body weight.

The differences among the first three parities in number of services per conception and gestation length were highly significant ($P < 0.01$). However, the differences in conception rate, litter size and litter weight were not significant (Table 1). Similar results were previously reported by Khalil (1980), Afifi et al. (1982), Afifi and Kadry (1985), El-Maghawry et al. (1988) and Yassen (1992).

Month of kindling showed highly significant ($P < 0.01$) effects on conception rate, number of services per conception and gestation length and insignificant effect on each of litter size, litter weight at 21 and 28 days (Table 1). Similar findings were obtained by Tag El-Din and Mervat (1989).

2- Bunny weight, litter weight gain and pre-weaning mortality rate:

The differences in bunny weight at birth among the experimental groups injected with 0, 50 and 100 I.U. HCG were significant ($P < 0.01$), being the highest in the group injected with 100 I.U. HCG. The litter weight gain from birth to 28 days of age was the highest ($P < 0.01$) in the group injected with 50 I.U. HCG. However, the differences in bunny weight at 21 and 28 days, litter weight gain from birth to 21 days and pre-weaning mortality rate were not significant (Table 2). Similar results were obtained by Afifi et al. (1973). El-Gaafary et al. (1991) reported that the differences in bunny weight at 21 day and at weaning were not significant.

The differences between the groups injected 2 h before mating and at mating in the bunny weight, litter weight gain and pre-weaning mortality rate were not significant (Table 2).

Parity and month of kindling showed no significant effect on bunny weight, litter weight gain and pre-weaning morlality rate (Table 2). These results

Table 2. Effect of each of HCG injection, time of injection, parity and month of kindling on each of bunny weight, litter weight gain and pre-weaning mortality percentages of NZW rabbits, under Egyptian environmental conditions.

Classification	Bunny weight (g)			Litter weight gain (g)		Pre-weaning mortality %		
	Birth	21st day	28th day	Birth-21 day	Birth-28 day	Stillbirths	Birth-21	Birth-28
General mean	58.2±0.84	330.4±6.23	457.9±7.45	1295.1±30.4	1885.3±36.8	1.50	12.70	15.07
HCG levels (I.U.):								
Zero	55.8[a] ±1.27	320.2±9.44	439.6±11.31	1262.2±46.1	1816.4[a]±70.9	0.92	15.83	18.34
50	58.5[ab]±1.21	328.4±9.09	462.1±10.89	1359.8±44.4	2026.9[b]±68.3	1.41	14.32	16.36
100	60.3[b] ±1.26	342.6±9.32	472.1±11.16	1263.4±45.5	1812.8[a]±70.0	2.34	8.51	10.91
Time of injection:								
2h before mating	58.4±1.09	328.9±8.05	458.6±9.64	1255.7±39.3	1874.0±60.5	1.56	11.86	13.62
At mating	57.9±1.03	331.9±7.72	457.3±9.24	1334.6±37.7	1896.7±57.9	1.44	18.56	16.58
Parities:								
1	58.9±2.16	327.1±16.32	457.9±19.54	1252.3±79.7	1902.7±122.5	1.52	16.54	19.59
2	58.8±1.48	330.1±11.18	452.8±13.38	1381.2±54.6	1947.2± 83.9	0.88	11.07	13.60
3	56.8±1.69	333.9±12.68	463.1±15.18	1252.0±61.9	1806.1± 95.2	2.26	10.82	12.45
Month of kindling:								
September	59.4±2.31	308.2±17.62	437.6±20.67	1219.9±84.2	1823.6±129.6	0.41	9.25	10.44
October	58.5±1.56	335.8±11.79	466.7±14.12	1189.7±57.5	1761.2± 88.5	2.58	14.63	15.68
November	57.0±1.49	330.8±10.91	460.0±13.06	1229.6±53.2	1877.0± 81.8	1.60	12.23	13.49
December	58.5±1.99	339.1±15.38	475.0±18.41	1432.9±75.1	2092.4±115.5	1.50	20.63	25.98
January	57.5±3.48	338.1±25.81	450.5±30.90	1403.6±126.0	1872.5±193.8	1.92	8.28	11.52

Means in the same column within the same classification with different letters, differ significantly ($P < 0.05$).

were in agreement with those obtained by Yassen (1992).

3- Milk yield and milk conversion:

Does injected with 50 I.U. HCG showed the best values of milk yield and milk conversion. However, the differences were not significant (Table 3). Milk yield reached the peak at third week after delivery, then declined during the fourth week in the different groups studied (Figure 1).

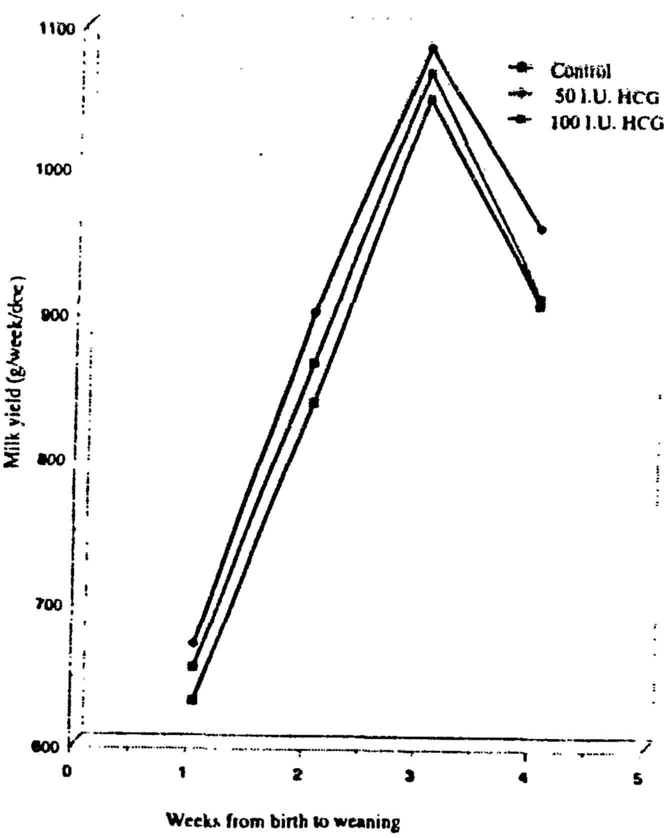

Figure 1. Effect of HCG injection on milk yield of NZW doe rabbit.

Time of mating following HCG administration did not show any significant effects on milk yield and milk conversion of NZW does at all stages of lactation (Table 3).

Milk yield at most stages of lactation increased insignificantly from the first up to the third parity, except at second parity of lactation at which the effect of parity on milk yield was significant ($P<0.05$) (Table 3). These results are in agreement with those obtained by Abo-Elezz et al. (1981) in Baladi rabbits. The second parity at all stages of lactation showed the best values of milk conversion. The differences were highly significant ($P<0.01$) at the first week (Table 3).

4- Plasma progesterone and estrogen levels:

Injection of the rabbit does with 50 I.U. HCG. showed, in general, higher progesterone concentration than in the other groups. Peripheral plasma progesterone levels in pregnant rabbits increased steadily at day of mating, peaked at day 18 and declined on day 28 of pregnancy (Figure 2). Similar trend was reported by Khalil and El-Sharabassy

Table 3. Least squares means and standard errors for some factors affecting milk yield (g) and milk conversion (milk yield (g)/litter weight gain (g)) of NZW does, under Egyptian environmental conditions.

Classification	Milk yield (g)				Milk conversion			
	1st week	2nd week	3rd week	4th week	1st week	2nd week	3rd week	4th week
General mean	650.42±14.9	867.1±17.5	1067.27±19.32	923.77±21.27	2.02±0.10	1.98±0.11	3.07±0.15	1.71±0.11
HCG levels (I.U.):								
Zero	629.30±25.83	836.73±30.31	1048.37±33.46	604.63±36.83	2.20±0.17	1.68±0.20	2.93±0.27	1.97±0.19
50	669.20±25.82	899.03±30.31	1084.77±33.46	957.37±36.83	2.03±0.17	2.08±0.20	3.03±0.27	1.71±0.19
100	652.77±25.82	865.63±30.31	1068.67±33.46	909.30±36.83	1.82±0.17	2.18±0.20	3.26±0.27	1.44±0.19
Time of injection:								
2h before mating	652.51±21.08	868.92±24.75	1100.09±27.32	941.73±30.07	1.07±0.14	2.14±0.16	2.98±0.22	1.79±0.15
At mating	648.33±21.08	865.84±24.75	1034.44±27.32	905.80±30.07	1.96±0.14	1.82±0.16	3.17±0.22	1.62±0.15
Parities:								
1	624.37±25.82	817.83^{b}±30.31	1017.33±33.46	888.53±36.83	2.37^{a}±0.17	2.28±0.20	2.75±0.27	1.66±0.19
2	655.60±25.82	861.0^{ab}±30.31	1080.33±33.46	936.37±36.83	1.89^{b}±0.17	1.70±0.20	3.23±0.27	1.84±0.19
3	671.30±25.82	922.60^{a}±30.31	1104.13±33.46	946.40±36.83	1.80^{b}±0.17	1.96±0.20	3.24±0.27	1.63±0.19

Means in the same column within the same classification with different letters, differ significantly ($P<0.05$).

(1987). Forcado and Abeica (1990) found that progesterone level in female rabbits injected with 50 I.U. HCG reached the peak on day 12 of pregnancy.

The mean level of estrogen was slightly higher at day of mating than at days 7, 18 and 28 after mating. However, there was no definite trend with insignificant difference in the estrogen level in the rabbit injected with 0, 50 and 100 I.U. HCG during pregnancy period (Figure 3). The present results agreed with those reported by El-Gaafary et al. (1991) in NZW rabbits.

In conclusion, injection of rabbits with 50 I.U. HCG improved the reproductive and productive performance, under Egyptian environmental conditions. No immunological effects appeared with those does repeatedly injected (3-4 times) with 50 I.U. HCG treatment showed considerably higher conception rate than the untreated does (control).

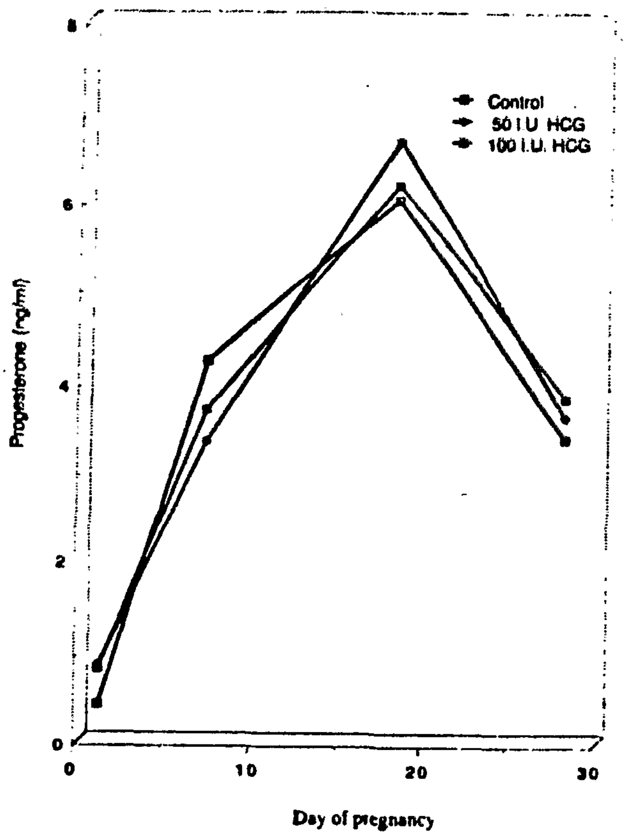

Figure 2. Patterns of circulating progesterone concentration in peripheral plasma of pregnant does.

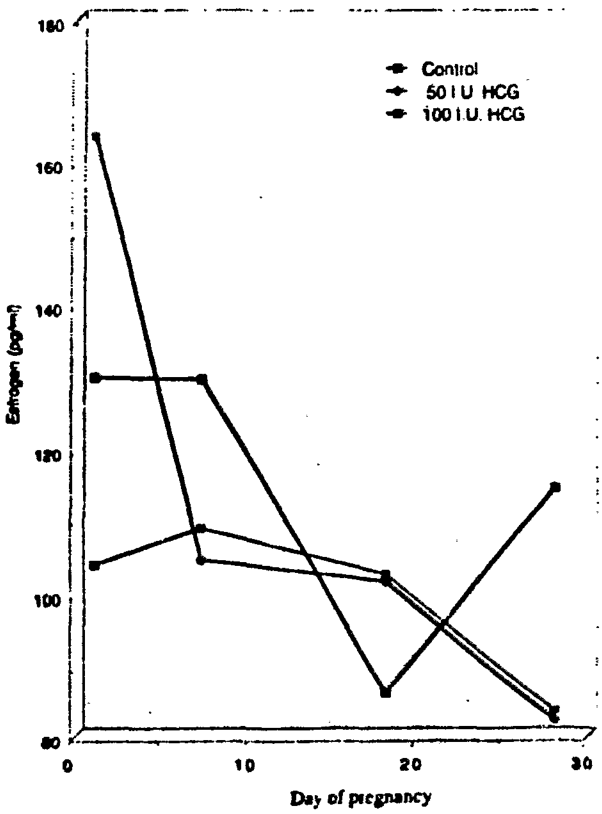

Figure 3. Patterns of circulating estrogen concentration in peripheral plasma of pregnant does.

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