Growth performance and reproductive efficiency of weaned NZW rabbits as affected by HCG injection

El Gaafary M.N., El Kelawy H.M.E., Marai I.F.M., Yamani K.A.O., Abd-Allah F.R., Amin R.S.

in

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

Zaragoza : CIHEAM
Cahiers Options Méditerranéennes; n. 8

1994
pages 321-331

Growth performance and reproductive efficiency of weaned NZW rabbits as affected by HCG injection

M.N. EL-GAAFARY[1], I.F.M. MARAI[2], k.A.O. YAMANI[2], F.R. ABD-ALLAH[3], R.S. AMIN[3], H.M.E. EL-KELAWY[1]

(1) ANIMAL WEALTH DEPARTMENT, INSTITUTE OF EFFICIENT PRODUCTIVITY, ZAGAZIG UNIVERSITY, ZAGAZIG, EGYPT.

(2) ANIMAL PRODUCTION DEPARTMENT, FACULTY OF AGRICULTURE, ZAGAZIG UNIVERSITY, ZAGAZIG, EGYPT.

(3) BIOCHEMISTRY DEPARTMENT, FACULTY OF PHARMACY, ZAGAZIG UNIVERSITY, ZAGAZIG, EGYPT

SUMMARY - Twenty-four females and eighteen males of 1.5 up to 4 months of age were used to study the effects of injection of 50 I.U. human chorionic gonadotrophin (HCG; Pregnyl) on growth performance, gonadal weight, hormonal activity and histological structure of the reproductive organs of growing male and female New Zealand White (NZW) rabbits during pre-sexual maturity. Semen characteristics of the bucks and doe post-maturity traits were also studied.

Following HCG injection, live body weight, weight gain and testes weight increased significantly ($P < 0.01$ or 0.05) and ovaries weight was not affected in the pre-pubertal rabbits. The concentration of testosterone in the males and progesterone in the females increased significantly ($P < 0.01$) by HCG injection. The histopathological studies showed that the tests were more developed and consisted of mature seminiferous tubules with mature spermatocytes in the injected males. The number of mature follicles in the female ovaries increased in the injected than in the control does. Mild degeneration of hepatic cells in both injected males and females were noticed, while kidneys were normal in their structure.

Semen quality was improved following injection of the bucks with HCG. Considerable improvement was also observed in the doe traits when mating was carried out between injected males and injected females. The parity showed no significant effect on most of the doe traits.

Key words: rabbit, growth performance, hormonal activity, semen, doe traits.

Introduction

The rabbit is not a spontaneous ovulating species. Ovulation in the rabbit occurs only after induction by an external or internal stimulus such as mating or hormone treatments. Interest in hormone treatment is increasing in all countries where intensive rabbit raising is practised. The studies showed that absence of a defined estrous cycle in rabbits gives rise to an imprecise reaction to superovulation induction with HCG (Berger *et al.*, 1981). At the same time, some studies have indicated that immune response varied from one individual to another and the intensity of the response was related to the total number of treatments and their frequency (Hulot *et al.*, 1988; Bonanno *et al.*, 1990; Canali *et al.*, 1991 and Bourdillon et al., 1992).

The present study aimed to investigate growth performance, gonadal weight, hormonal activity and histological structure of reproductive organs of growing NZW rabbits as affected by HCG injection.

Semen characteristics of the bucks and post-sexual maturity traits of the doe, 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 November 1991 to April 1992.

Twenty-four females and 18 males of 1.5 up to 4 months of age, were used. All animals were fed ad libitum on pelleted ration containing 17.3% crude protein, 13.5% crude fibre and 3.5% fat. Clean water was available at all times. The males and females were divided into two experimental groups just before 45 days of age. One group was injected intramuscularly once weekly with 50 I.U. HCG (Pregnyl, produced by Nile Company for Pharmaceuticals and Chemical Industries). The other group (control) was injected with saline solution (0.9% NaC1). Body weights were recorded at 45, 90 and 120 days of age and weight gain values between these ages were calculated. At four months of age, three rabbits from each sex in each group were sacrified and blood samples were collected into heparinized tube. Blood samples were immediately contrifuged at 3000 r.p.m. for 10 minutes and plasma were separated, freezed under -20 ^{o}C and kept for assaying of estrogen, progesterone and testosterone by radioimmunoassay technique coated-tube kits (Diagnostic Products Corporation, Los Angles, U.S.A.). The gonads (ovaries and testes) were removed, weighted and fixed in Bouin's solution. Representative samples were washed, dehydrated in ascending grades of ethyl-alcohol, cleared and embedded in paraffin wax. The samples were sectioned at 5 microns thickness, stained in hematoxylin/eosin and examined using x 20 objective of a phase contrast microscope.

At 6 months of age, 8 females and 4 males from each experimental group were kept to determine the reproductive efficiency during the first three parities. Semen was collected once weekly during 4 weeks at 6 months of age from 10 male rabbits (5 injected and 5 control) by using artificial vagina. Semen volume, sperm motility, sperm concentration, dead spermatozoa and abnormal spermatozoa were investigated according to El-Gaafary (1987).

The remaining rabbits were individually caged in universal wire cages to determine the doe and litter traits. Four types of matings (males x females) were conducted as follows: control x control, control x injected, injected x control and

injected x injected. 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 allotted in the rabbitry of the windowed house. Flat deck cages were provided to nests for does and automatic drinker nipples and feeding troughs were provided to all cages. Parity of litter, number of services per conception, conception rate, gestation length, litter size, litter weight, bunny weight, litter weight gain and pre-weaning mortality rate were recorded.

Data were statistically examined by Least Squares Maximum Likelihood method of analysis Harvey (1977). 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 rates 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. Data of semen characteristics were statistically examined by the analysis of variance and t-test according to Snedecor and Chocran (1982).

Results and Discussion

1. Growth performance:

Data in Table (1) showed that the body weight and weight gain were not affected by sex, in NZW rabbits. Similar results were obtained by Kosba and Abo-Elezz (1988).

The body weight and weight gain showed insignificant difference between the HCG treated group and the control one (Table 1). The present results agreed with those reported by El-Gaafary et al. (1991) in NZW rabbits. Sundby and Vella (1983) clarified that injection of bulls with HCG stimulate the amounts of testosterone produced and consequently increased weight. This may explain the slight increase in the average weight of the HCG treated group (Table 1).

2. Gonadal weight and hormonal activity:

Data presented in Table (2) showed that testicular weight and testes weight percentage were significantly ($P < 0.01$ or 0.05) heavier in the injected group (17.20 g and 0.64%, respectively) than in the control group (14.07 g and 0.54%, respectively). However, ovarian weight and ovaries weight percentage showed insignificant differences between the two experimental groups. The activities of the

Table 1. Least squares means and standard errors for live body weight and weight gain of prepubertal NZW doe rabbits as affected by sex and HCG injection, under Egyptian environmental conditions.

Classification	Live body weight (g)			Weight gain (g)	
	Age			Age interval	
	45	90	120	45-90	90-120
General mean	958.6±30.5	2200.0±182.3	2599.2±37.4	1099.6±25.9	1621.0±37.8
Sex:					
Male	976.2±32.2	2130.8±278.7	2586.6±59.2	1131.0±40.9	1605.4±59.7
Female	941.0±31.6	2269.3±223.2	2611.9±51.2	1068.3±35.4	1636.5±51.6
HCG injection:					
Control	956.0±31.8	1964.5±236.3	2554.5±55.3	1079.4±38.2	1604.3±55.8
50 I.U.	961.2±31.8	2435.6±236.3	2644.0±55.3	1119.8±38.2	1637.7±55.8

All differences were not significant.

Table 2. Gonadal weights and hormonal concentrations of NZW rabbits at 120 days of age as affected by HCG injection, under Egyptian environmental conditions.

Traits	Control	Injected
Males:		
Live weight (g)	2606.0±67.2	2715.7±72.8
Testes weight (g)	14.1^{b}±0.47	17.2^{a}±0.59
Testes weight (%)	0.54^{b}	0.64^{a}
Testosterone (ng/ml)	10.0^{b}±0.00	214.0^{a}±62.88
Females:		
Live weight (g)	2900.0±144.3	3055.0±54.8
Ovaries weight (g)	0.67±0.03	0.83±0.03
Ovaries weight (%)	0.02	0.03
Progesterone (ng/ml)	32.67^{b}±1.20	58.00^{a}±3.79
Estrogen (pg/ml)	110.3±12.8	149.9±22.4

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

testes in terms of testosterone concentration in the males was significantly ($P < 0.05$) higher in the HCG treated (214 ng/ml) than in the control (10 ng/ml) group. The activity of ovaries in terms of progesterone concentration in the female was significantly ($P < 0.01$) higher in HCG treated than in the control group. However, estrogen concentration was insignificantly higher in the HCG treated (149.9 pg/ml) than in the control (110.3 pg/ml) group. Gary and Kristen (1969) similarly found that injection of male rabbits with HCG produced a significant increase in plasma testosterone level.

3. Histopathological changes as affected by HCG injection:

The present study showed that the testes in the injected males consisted of mature seminiferous tubules with mature spermatocytes (Plate 1). The stage of spermatogonia (primary or secondary) and spermatocyte were presented in the structure, in addition to, the interstitial tissue. The epididymal section was normal in structure with mature sperm in its tube. Testicular artery was normal, as well.

The number of mature follicles (16 per ovary) increased in the injected females. The ovarian stroma are not completely damaged. The number of primary follicles was few (8 per ovary), while secondary follicles increased in number. One or more mature follicles were destructed without ova (3 per ovary). The other structure of the ovary appeared normal (Plate 2). Greenwald (1970) observed that ovaries of rabbits injected intramuscularly with 50 or 500 I.U. HCG were histologically identical with untreated females.

4. Physical semen characteristics:

Data presented in Table (3) showed that the ejaculate volume, wave motion, sperm motility percentages, sperm concentration per ml and total sperm output, were increased significantly ($P < 0.01$ or 0.05). However, percentages of dead spermatozoa and abnormal spermatozoa showed insignificant differences between the experimental groups. El-Gaafary et al. (1991) reported that a qualitative improvement was noticed in the sperm produced by bucks injected with 50 I.U. of HCG. The improvement in semen quality may denote association between secretory activity of both the accessory glands and spermatogenic cells in testes as a result of gonadotrophin injection (Scharbacher, 1978).

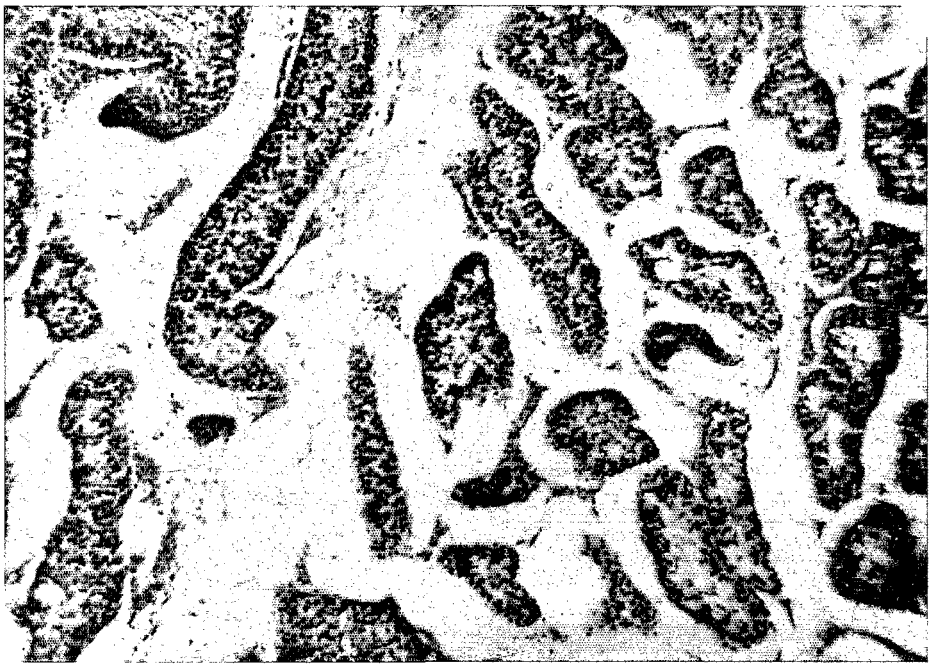

Plate 1. Cross section in the testicle of male rabbit injected with 50 I.U. HCG showing stages of spermatogenesis and interstitial cells (H & E x 150).

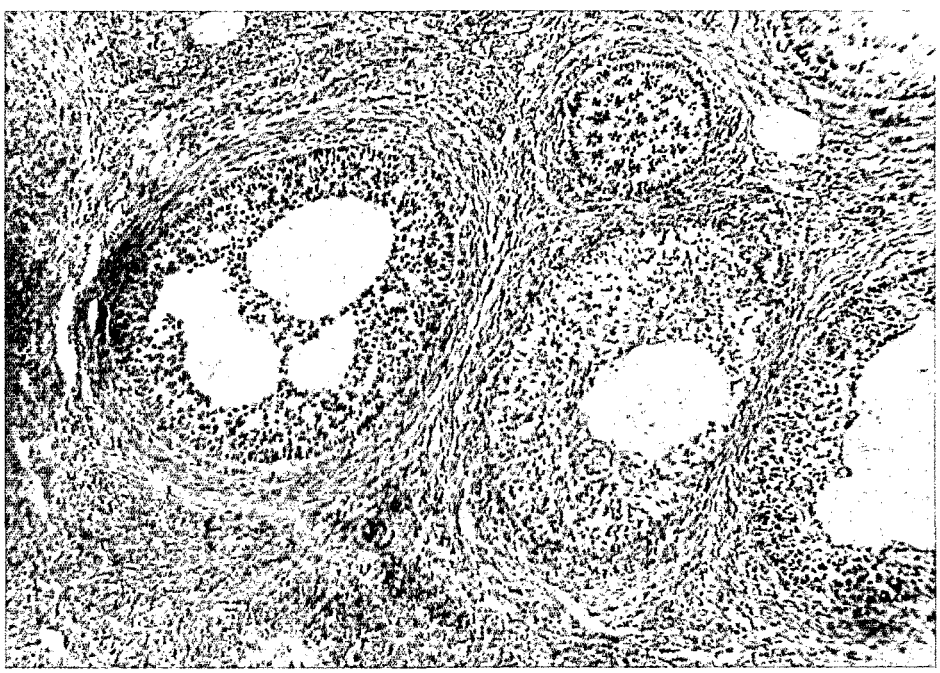

Plate 2. Cross section in the ovary of female rabbit injected with 50 I.U. HCG showing the increasing of number of mature follicles (H & E x 150).

Table 3. Physical semen characteristics of NZW rabbits as affected by HCG injection.

Traits	Treatments	
	Control Mean ± S.E.	50 I.U. Mean ± S.E.
Volume (ml)	0.74^{b} ± 0.06	0.99^{a} ± 0.07
Wave motion	3.00^{b} ± 0.15	3.70^{a} ± 0.15
Sperm motility (%)	55.50^{b} ± 2.46	64.00^{a} ± 1.97
Dead spermatozoa (%)	20.50 ± 1.19	15.15 ± 1.34
Abnormal spermatozoa (%)	14.15 ± 1.20	9.90 ± 0.82
Sperm concentration (x 10^6/ml)	168.25^{b} ± 3.99	189.25^{a} ± 4.66
Total sperm output (x 10^6)	120.63^{b} ± 10.00	185.63^{a} ± 14.33

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

5. Doe traits:

The differences in conception rate, number of services per conception, gestation length, litter size and litter weight among the experimental groups were not significant, being the highest in the group mated as male injected x female injected (Table 4). Similar trend was observed by Wilson and Dubley (1965) and Sandford and Woodgate (1979).

Differences due to parity effect were highly significant ($P < 0.01$) in gestation length and litter weight at birth and not significant in conception rate, number of services per conception, litter size at all ages studied and litter weight at 21 and 28 days (Table 4). Similar results were obtained by Tag El-Din and Mervat (1989).

Data in Table 5 revealed that the type of mating did not show any significant effect on bunny weight, litter weight gain and pre-weaning mortality percentages. The present results agreed with those obtained by El-Gaafary *et al.* (1991).

Parity showed insignificant effects on bunny weight litter weight gain and pre-weaning mortality percentage. Similar trends were reported by El-Maghawry *et al.* (1988) and Yassen (1992).

In conclusion, testes weight, testosterone levels in blood plasma in the males and progesterone in the females were

Table 4. Conception rate, number of services per conception, gestation length, litter size and litter weight of NZW rabbits as affected by type of mating and parity, under Egyptian environmental conditions.

Classification	Number of does			Number of services per conception	Gestation length	Litter size at			Litter weight (g) at		
	Mated	Pregnant (%)				Birth	21st day	28th day	Birth	21st day	28th day
General mean	57	38	(66.7)	1.38±0.13	31.2±0.21	6.7±0.40	5.7±0.39	5.6±0.61	384.0±19.7	2041.1±75.9	2532.9±102.9
Type of mating:											
Control x control	15	9	(60.0)	1.44±0.32	31.1±0.49	6.6±0.93	5.8±0.92	5.7±0.96	337.3±46.4	2096.9±179.5	2466.6±243.2
Injected x control	13	8	(61.5)	1.36±0.29	30.8±0.45	6.3±0.87	5.4±0.85	5.2±0.89	315.6±43.2	1995.9±166.8	2493.4±226.0
Control x injected	14	10	(71.4)	1.33±0.23	31.8±0.36	6.6±0.69	5.6±0.68	5.6±0.71	348.5±34.3	1957.3±132.5	2470.2±179.6
Injected x injected	15	11	(73.3)	1.38±0.21	31.3±0.33	7.4±0.63	6.0±0.62	5.8±0.65	390.8±31.3	2114.1±121.0	2701.4±164.0
Parties:											
1st	18	12	(66.7)	1.44±0.21	31.2^{ab}±0.32	7.1±0.62	6.4±0.61	6.1±0.63	413.6^{a}±30.6	2245.4±118.3	2785.6±160.3
2nd	20	13	(65.0)	1.65±0.20	30.6^{b}±0.31	6.9±0.60	6.0±0.59	5.9±0.61	353.8^{b}±29.7	1969.7±114.8	2494.5±155.5
3rd	19	13	(68.4)	1.06±0.28	32.2^{a}±0.43	6.1±0.80	6.6±0.81	4.6±0.84	276.0^{c}±19.7	1908.1±157.2	2318.5±213.0

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

Table 5. Bunny weight, litter weight gain and pre-wearning mortality percentages of NZW rabbits as affected by type of mating and parity, under Egyptian environmental conditions.

Classification	Bunny weight (g) at			Litter weight gain (g)			Pre-weaning mortality (%)		
	Birth	21st day	28th day	Birth-21 days	Birth-28 days	21-28 days	Stillbirth	Birth-21 days	Birth-28 days
General mean	50.9±1.1	375.6±14.4	476.4±18.8	1694.8±70.0	2186.9±95.5	492.5±43.5	0.62	8.98	10.73
Type of mating:									
Control x control	48.5±2.3	375.5±33.9	449.9±44.5	1759.6±165.5	2129.2±225.8	369.7±102.9	0.19	10.44	11.62
Injected x control	49.5±2.5	388.4±31.5	495.7±41.4	1680.4±153.8	2177.8±209.9	498.1±95.6	4.16	9.05	12.96
Control x injected	54.4±2.0	368.7±25.1	470.1±32.9	1598.3±122.2	2113.3±166.8	515.0±76.0	0.43	6.58	6.58
Injected x injected	51.5±1.8	369.9±22.9	489.8±30.0	1740.8±111.6	2327.3±152.3	587.3±69.4	0.00	10.14	12.39
Parities:									
1st	59.3±1.8	354.9±22.4	463.7±29.4	1831.8±109.1	2372.4±148.9	540.3±67.9	0.10	6.01	8.10
2nd	51.0±1.7	348.4±21.7	455.1±28.5	1622.7±105.8	2147.0±144.4	525.3±65.8	0.24	4.60	6.76
3rd	45.4±2.3	423.6±29.7	510.3±39.0	1629.8±144.9	2041.8±197.8	421.0±90.1	2.36	18.92	18.92

All differences were not significant.

significantly higher following HCG treatment. Injection of growing male NZW rabbits with 50 I.U. HCG improved, in general, the ejaculate volume, sperm motility, sperm concentration, live spermatozoa and normal spermatozoa. Mating between treated males and treated females previously injected with 50 I.U HCG at growing stage showed the best reproductive and productive performance. No immunological effects appeared as a result of repeated injection with HCG at level of 50 I.U.

References

BERGER, M., JEAN, F.C., TURCKHEIM, M.D.E., VEYSSIERE, G. and JEAN, C. (1981). Charge in the response of the testes to HCG in the maturing rabbit. IRCS Medical Science Library. Compendium, 9: 206-209.

BOURDILLON, A., CHMITELIN, F., JARRIN, D., PAREZ, Z. and ROUILLERE, H. (1992). Effect of a PMSG treatment on breeding results of artificially inseminated rabbits. Journal of Applied Rabbit Research, 15: 530-537.

BONANNO, A. BUDETTA, G., ALABISO, M. and ALICATA, M. (1990). Effect of PMSG and GnRH treatment on the ovulatory efficiency of rabbits. Acta Medical Veterinary, 36: 441-451.

CANALI, C., BOITI, C., ZAMPINI, D., CASTELLINI; C. and BATTAGLINI, M. (1991). Correlazions tra fertilita etitolo anticorpale anti-PMSG di Coniglie trattate ripetutamente con gonadotropine nel corso della loro carriera riproductiva. Atti IX Congress Nazionale ASPA, PP. 671-678.

EL-GAAFARY, M.N. (1987). The characteristics of semen from Welsh Mountain and Cambridge rams. Ph.D. Thesis University College of North Wales, Bangor, U.K.

EL-GAAFARY, M.N., TAWFEEK, M.I. and ABD EL-HAMID, M.W. (1991). Effect of human chorionic gonadotrophin injection on pre- and post- sexual maturity in rabbits. Egyptian Journal of Rabbit Sciences, 1: 35-46.

EL-MAGHAWRY, A.M., YAMANI, K.A. and MARAI; I.F.M. (1988). A preliminary study on performance of some productive traits in New Zealand White and Californian rabbits, under Egyptian environments. Proceedings of the 4th World Rabbit Congress, Budapest, Hungary, 19: 97-106.

EVERITT, B.S. (1977). The analysis of Contingency Tables. Monographs of Applied Probability and Statistics. PP. 38-66, London, Chopman Hall.

GARY, C.H. and KRISTEN, B.E. (1969). Plasma levels of testosterone in male rabbits following copulation. Journal of Reproduction and Fertility, 19: 273-277.

GREENWALD, C.S. (1970). Development of ovulatory refractoriness in the rabbit to cyclic injections of human chorionic gonadotrophin. Fertility and Sterility, 21: 163-168.

HARVEY, W.E. (1977). User's Guide for LSML 76, Model Least-Squares and Maximum Likelihood Computer Program. Mimeo, Ohio State University, U.S.A.

HULOT, F., MARIANA, J.C. and CATTIAU, G. (1988). HCG-induced ovulation in two rabbit breeds. Effects of dose, season and sexual behaviour. Livestock Production Sciences, 20: 257-267.

KOSBA, M.A. and ABO-ELEZZ, Z.R. (1988). Some factors affecting body weight and dressing out percentage in two breeds of rabbits. 4th World Rabbit Congress, Budapest, Hungary, 2: 177-186.

SANDFORD, J.C. and WOODGATE, F.G. (1979). The domoshic rabbit. 3rd Edition. Crosby Lockwood Staptes, Granada Publishing London.

SCHANBACHER, B.D. (1978). Fertility of ram chronically treated with gonadotropin releasing hormone during the non breeding season. Biology of Reproduction, 19: 661-665.

SNEDECOR, G.W. and COCHRAN, W.C. (1982). Statistical methods. 8th Edition, Iowa State University Press, Ames, Iowa, U.S.A.

SUNDBY, A. and VELLA, W. (1983). Relationship between growth rate in bulls and human chorionic gonadotrophin induced plasma testosterone concentration. Journal of Animal Sciences, 56: 52-57.

TAG EL-DIN, T.H. and MERVAT, A.A. (199). Some reproductive and meat yield traits in four rabbit breeds under small scale system of production. Journal of Agriculture Sciences, Mansoura University, Egypt, 14: 1981-1991.

WILSON, W.K. and DUBLEY F.J. (1965). The duration of gestation length in rabbit breeds and crosses. Acta Agriculture, 2: 135.

YASSEN, H.M. (1992). Studies on productive and reproductive efficiency of female rabbits, M.Sc. Thesis; Faculty of Agriculture, Zagazig University, Egypt.