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EFFECT OF LIGHTING DURATION ON REPRODUCTIVE PERFORMANCE OF RABBITS

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ABSTRACT

A total number of 36 females and 12 males of New Zealand White rabbits were used in this study to investigate the effect of different lighting period on reproductive performance of female rabbits. Rabbit dose weight ranged between 2.5o to 3.00 kg and aging 5-6 months old. Females were divided into three groups (12 doe each) according to the following lighting systems : long photoperiod (16L:8D) ; short photoperiod (8L:16D) and alternative photoperiod (8L:16D) followed by (16L:8D) for 6 days before mating .The results indicate that, right and left ovaries weight , right ovary length , ovulation rate , placental weight , and uterus weight were significantly different between the three groups. However, left ovarian length, right and left of oviduct weight and length , implantation rate , fetus weight, absorption rate and embryonic mortality were not significant. Litter size was increased under Alternative light and long light compare by the short photoperiod one. There were highly significant differences between the three groups in LH level with on increase for alternative photoperiod .It is concluded that alternative photoperiod is more efficient than long or short photoperiod to obtain a good reproductive performance of female rabbits .

Keyword: lighting system – reproductive performance- uterus weight – ovarian weight -Rabbits

INTRODUCTION

Photoperiod has a double role and acts, first as a stimulant of reproduction and secondly as a daily synchronizer of the endocrine events which result in ovulation. (Sauveur.,1996). Exposure for 14 to 16 hours light /day favors female sexual activity and fertilization (Lebas., 1997). Modifying the light program to be for 8 days before insemination 8 hours light/day and then to be 16 hours/day immediately after insemination, induced a significant improvement in sexual receptivity of the mated does (Theau- Clement *et al.*,1991). Moreover Increasing day length before mating (alternative light) could be effective in improving the receptivity and other reproductive traits of rabbit does (Ivan *et al.*,2003 and Szendero *et al.*,2004).

Litter size under long light was higher than short light (Gad .,2003 and Chiericato and Rizzi.,2004). ,Moreover, Photoperiod showed significant effects on litter weight at 14 days of age up to weaning at 35 day . Litter weight for does under 16 h. light /day decreased than those exposed to natural light at 14 , 21 and 28 days. While, does exposed to 8h light/day surpassed those of natural light at 28 and 35 days of natural age (Ahmed .,2002) .

Hafez and Hafez (2000) reported that ovaries weight depends on many factors such as age , breed , parity, reproductive status and number and type of ovarian structures .

Rabbits kept under short artificial light (8L: 16D) had significantly lowered mean weight of uterus and percentage of follicular development than those at natural light or long (16L:8D) artificial light (Schuddemage *et al.*,2000) .

Lighting programs are easy to apply and do not need large manpower costs. They will be all the more efficient as rabbit does will be in the same physiological condition. So, lighting programs are perfectly adapted to cycled production. (Theau- Clement *et al.*, 1998). Since, studies on the effect of lighting duration on ovarian activity and subsequent reproductive traits are scare, therefore, the present study was conducted to elucidate the possible effects of photoperiod regimes on ovarian activity and reproductive performance of NZW female rabbits.

MATERIALS AND METHODS

This study was carried out in a private Rabbit's Farm at Giza Governorate while the laboratory work was conducted in both the Faculty of Agriculture , Ain Shams University and Animal Production Research Institute, Agricultural Research Center, Ministry of Agriculture, Egypt. The field work was done during the period from February till April 2006 .

Experimental Animals:

A total number of 36 females and 12 males of New Zealand White rabbits (NZW) were used in this study. Their weight ranged between 2.5 – 3 kg and aging about 5-6 months old. Female rabbits were divided randomly into three groups (12 each) according to the following lighting systems:

G1 = Rabbits kept under long photoperiod (16h light : 8h darknees) (16L: 8D).

G2 = Rabbits kept under short photoperiod (8h.light :16h.darknees)(8 L: 16 D).

G3 = Alternative photoperiod (8h light: 16h. darknees) and change to (16h light : 8h.darknees) (16L: 8D) 6 days before mating .

Black curtains on the windows were used to control darknees while tungsten bulb lambs were used during the experimental period to provide the artificial light. Light intensity was approximately 40 Lux. The intensity of light was calculated according to the following equation, which was reported by the Ministry of Agriculture, London, 1970 (cited from Poultry Housing and Environment).

$$\text{Average Intensity} = \frac{\text{Power provided (watt)}}{\text{Area of surface (sq. Ft)}} \times K$$

Where: K is a constant (6.0 for white florescent lamb).

Lighting period was controlled by automatic time switches. All animals were kept individually in standard hutchs and they were fed on a commercially pelleted diet containing 16.o% crude protein, 3.4 % crude fat

and 14.o % crude fiber and 2700 K.cal/Kg DE of the diet . Feed and water were provided *ad.libtum*.

The minimum and maximum ambient air temperature were ranged between 16 C° and 28 C°. with relative humidity ranged between 27% and 65% .

Data collections:

At day 15 of pregnancy, after palpation, three pregnant does from each group were scarified to study the effect of lighting system on genitalia in both right and left sides, average weight and length of the right and left ovaries and oviducts, number of corpora lutea, implantation rate, number and weight of fetus, survival rate, absorption rate, embryonic mortality, uterus weight and placental weight,. Gestation period, litter size and weight at (birth, 21days and weaning (28days) and mortality at birth and weaning were recorded . Blood samples were collected before and after mating to determine LH.

Statistical Analysis:

Data were statistically analyzed according to SAS (1999) program according to the following model:

$Y_{ij} = \mu + T_i + e_{ij}$. Whereas: Y_{ij} = traits, μ= overall mean

T_i = effect of treatment (i=1,2,3) . e_{ij} = error.

RESULTS AND DISCUSSION

Effect of light regimes on :

Ovarian weight(g) and length(cm):

The results summarized in Table 1 show the weight and length of reproductive organs and corpora lutea in NZW rabbits kept under different lighting systems.

Ovarian weight as well as length was significantly influenced by different lighting systems. Regardless to the lighting system The overall means of total ovarian weight was (0.414 g), The heaviest ovarian weights were found in G_1 and G_3 (0.474 and 0.404g) ,respectively compared to the lowest mean recorded by the G_2 (0.365g) .So ,these results agree with the findings of Gad (2003) who reported that average weight of ovaries under long light was higher than short light , However, the present results are less than that found by Komwinja and Hauser (1983) under short light (6L:18D) and long light (18L:6D) , which may be due to different lighting system . The overall means of right and left ovaries length were (1.7cm) and (1.6 cm), respectively .The highest means of ovary length were recorded G_1 (1.9 cm and1.7 cm) of right and left ovaries length ,respectively while the lowest means were in G_2 (1.6 cm and1.6 cm)of right and left ovaries, respectively. The overall means total of ovarian length was (1.7cm) . Mean of ovarian length under G_1 was (1.8cm) followed by G_3 (1.7cm) and the lowest mean was recorded in G_2 (1.6cm).

It is likely that changes of the ovarian weight might be attributed to increase light stimulus which in turn the FSH and LH hormones concentration which affect ovarian follicles development and growth of ovary and increase the number of growing or mature ova (Hafez and Hafez .,2000) . This explanation can be supported by our results in LH hormones

concentration (Tables 4) ,where they increased in G_1 and G_3 compared to G_2 after mating which had been reflected in increase the ovarian weight .

Number of Corpora lutea :

The overall mean of corpora lutea numbering the right ovary was higher than in the left (4.9 vs 3.9) . Means of numbers of corpora lutea in both ovaries are higher than G3 were (7.0 and 4.5).

The results in Table 1 indicated that different lighting systems had significant effect on the number of corpora lutea. Means of corpora lutea in G_1 ,G_2 and G_3 were nearly 7.4, 7.7 and 11.5, respectively . This result agrees with the findings of Kamwnja and Hauser (1983) under short light and long light systems. Also, These results nearly similar to those a greeted by Gad (2003) .

The increased number of corpora lutea may be due to increase of ovulation rate this was supported by the higher LH hormone concentration after mating as happened in due result study to effect on ovulation rate . On the other hand , it may be due to melatonin hormone secretion which increase sexual activity as reported by Chemineau *et al.* (1992) in short light compared long light regimen. .

Oviducts weight (g) and length (cm) :

The overall mean of right and left oviducts weight were (0.307 g and 0.274 g), respectively . The highest mean of oviducts weight (R and L)(0.343 g and 0.283 g) were recorded in G_1 followed by G_3 (0.330 g and 0.293 g) . The lowest mean were observed in G_2 (0.247 g and 0.246 g) ,respectively (Table 1). The overall means of total oviducts weight were (0.291g) . Mean of oviducts weight under G_1, G_2 and G_3 was (0.313, 0.248 and 0.312g), respectively.Oviducts weight (R and L) did not differ significantly between three groups.

The higher oviducts weight could be attributed to the expected hyper secretion of oviduct cells as a response to the higher level of progesterone as reported by Gad (2003).

Different lighting system had a significant ($P<0.05$) effect on left oviducts length .The overall means of oviducts length (right and left) were (10.9 and 9.9 cm), respectively. The highest means of right oviducts length (11.4 cm) was in G_1 followed by G_3 (11.1 cm) . The lowest mean (8.5 cm) was recorded with G3 for left oviduct length. The overall means of total oviducts length were (10.4cm) . Mean of oviducts length under G_1, G_2 and G_3 were (11.1,10.4 and 9.8cm), respectively.

Implantation rate:-

Implantation rate did not differ significantly between the three groups. The overall mean was (80.10%). The highest mean was observed in G_2 followed by G_3 (76.45%) and G_1 (75.92%). This result is in close agreement with Ismail *et al* .(1992).

Fetus and livability (%):

The results summarized in Table 2 revealed that the effects of different lighting systems on implantation rate, survival rate %, absorption rate % , early embryonic mortality % and fetus weight (g) were not significant all the time .But Different lighting systems have a significant ($P<0.05$) effect of the number of fetus right and total , fetal survival and placental weight.

In Table 2, It could be seen that, the overall mean of No. of right ,left and total fetus were (3.8, 3.1 and 6.8), respectively. Number of fetus (right) under G_3 was high (5.0) and the lowest figure (2.5) was reported in G_1 of left uterine horn.The highest number was in G_3 (8.5) followed by G_2 (6.5). These results are agree with Gad 2003 who found that No. of fetus in short light higher than under long light .adversely, Kamwonja and Hauser (1983) who found that number of fetus under long light (18L:6D) was higher than that under short light (6L :18D) and it was 6.1 vs. 3.44 , respectively .

Fetal survival had differ significant ($P<0.05$) under different lighting systems (Table 2). The present results also showed that , mean of fetal survival under G_3 was high (7.5) and followed by G_2 .The lowest mean (4.7) was found under G_1.

The survival rate % under G_1 was high (88.3 %) followed by G_2 (85.7%). While, These results are nearly close (87%) to these reported by

Table 1: Effect of different lighting systems on ovarian weight (g) and length (cm), number of corpora lutea and oviduct weight (g) and length (cm) of NZW rabbits.

Items	G_1: Long light	G_2:Short light	G_3:Alternative light	Overall mean	Sig.
Right Ovarian weight (g)	0.492±0.03^{a}	0.377±0.03^{b}	0.445±0.03^{ab}	0.438±0.04	*
Left Ovarian weight (g)	0.457±0.03^{a}	0.353±0.03^{b}	0.363±0.03^{ab}	0.391±0.08	*
Total	0.474±0.03^{a}	0.365±0.03^{b}	0.404±0.03^{ab}	0.414±0.04	*
Right Ovarian length (cm)	1.9 ± 0.05^{a}	1.6±0.05^{b}	1.8±0.05^{a}	1.7±0.05	**
Left Ovarian length (cm)	1.7 ± 0.04	1.6 ±0.04	1.6±0.04	1.6±0.04	NS
Total	1.8±0.03^{a}	1.6±0.03^{b}	1.7±0.03^{ab}	1.7±0.04	**
Right No. of corpora lutea	4.2±0.43^{b}	3.5±0.43^{b}	7.0±0.43^{a}	4.9 ±0.52	***
Left No. of corpora lutea	3.2 ±0.51	4.2 ± 0.51	4.5 ± 0.51	3.9 ± 0.62	NS
Total	7.4±0.70^{b}	7.7± 0.70^{b}	11.5±0.70^{a}	8.9±0.86	***
Right Oviduct weight (g)	0.343±0.04	0.247±0.04	0.330±0.04	0.307±0.04	NS
Left Oviduct weight (g)	0.283±0.04	0.246±0.04	0.293±0.04	0.274±0.05	NS
Total	0.313±0.04	0.248±0.04	0.312±0.04	0.291±0.05	NS
Right Oviduct length (cm)	11.4 ± 0.59	10.1 ± 0.59	11.1 ± 0.59	10.9 ± 0.73	NS
Left Oviduct length (cm)	10.7 ±0.63^{a}	10.6±0.63^{a}	8.5 ± 0.63^{b}	9.9 ± 0.78	*
Total	11.1±0.50	10.4±0.50	9.8±0.50	10.4±0.62	NS

Means within each row having different letters differ significantly P≤0.05.
NS= not significant *P≤0.05 **P≤0.01 ***P≤0.001

Argente *et al.* (1992) .

The highest percentage of absorption rate was (8.1) under G_3 .While, the lowest percentage was (4.8) under G_1 (Table 2).

The percentage of early embryonic mortality under G_1 was low (6.9%) followed by G_2 (7.1%). While , the highest percentage was found with (8.0 %). The low percentage in embryonic mortality in G_1 so there is no competition between the fetus.

The survival rate, absorption rate and embryonic mortality did not differ significant under different lighting systems (Table 2).

Table 2: Effect of different lighting systems on implantation rate, terine weight(g),No.of fetus,fetus weight(g),Embryo survival, survival rate ,absorption rate, early embryonic mortality and placental weight(g),of NZW rabbits.

Items	G_1:Long light	G_2:Short light	G :Alternative light	Overall mean	Sig.
Implantation rate(%)	75.92±11.79	87.92±11.79	76.45±11.79	80.10±14.4	NS
No. of fetus (right)	3.0±0.68^{b}	3.3±0.68^{ab}	5.0±0.68^{a}	3.8±0.83	*
No. of fetus (left)	2.5±0.39	3.2±0.39	3.5±0.39	3.1±0.48	NS
Total	5.5±0.93^{b}	6.5±0.93^{ab}	8.5±0.93^{a}	6.8±1.14	*
Fetal survival	4.7±0.96^{b}	5.5±0.96^{ab}	7.5±0.96^{a}	5.9±1.17	*
Survival rate(%)	88.3±6.07	85.7±6.07	83.9±6.07	86.0±7.42	NS
Absorption rate(%)	4.8±3.43	7.2±3.43	8.1±3.43	6.7±4.20	NS
Early embryonic mortality(%)	6.9±3.45	7.1±3.45	8.0±3.45	7.3±4.22	NS
Fetus weight(g)	0.298±0.02	0.322±0.02	0.306±0.02	0.323±0.03	NS
Uterine weight(g)	31.283±3.5^{ab}	29.110±3.5^{b}	41.250±3.5^{a}	33.880±4.3	*
Placental weight(g)	0.591±0.59^{b}	0.805±0.59^{a}	0.704±0.59^{ab}	0.700±0.07	*

Means within each row having different letters differ significantly P≤0.05.
NS= not significant *P≤0.05

Fetus weight:

Mean of fetus weight under G_2 was the highest (0.322 g) followed by G_3 and G_1 0.306 and 0.298g , respectively . These results could be attributed to weight and size of placenta which effect on fetus growth and development (Hafez and Hafez., 2000) , or could be attributed to the number of fetus .

Uterine horns weight (g) :

Uterine horns weight were significantly (P<0.05) different as affected by different lighting systems (Table2).The overall mean of uterine horn weight was (33.880g). Mean of uterine horn weight in G_3 was the highest followed by G_1.While , the lowest one was in G_2 photoperiod . These results agree with the founding of Schuddemage *et al.* (2000) who studied the effect of artificial and natural lighting on the development of sex organs and fertility of female rabbits. They found that rabbits kept under artificial light (8L:16D) had significantly lower weight of uterus than natural light and artificial light (16L:8D). However ,Kamwnja and Hauser (1983) reported that uterine weight under long light (18L:6D) was lower than under short light (6L:18D).

Placental weight (g):

Different lighting systems had significant effect on the placental weight (Table2).The present results showed that , the overall mean of placental weight was (0.700 g). Means of placental weight under G_2 was high (0.805g) followed by G_3 which was 0.704.While , the lowest mean (0.591 g) was recorded in G_1. These results higher than founding by (Gad .,2003). These differences may be attributed to differences founded in litter size between three groups under different lighting systems .

Gestation period (day):

The results in Table (3) indicated that different lighting systems had significant effect on gestation period. The present results showed that, the overall mean of gestation period was 31.5 days. The highest gestation period
(32.0 days) was in G_1 long light. While, under G_2 short light) and G_3 Alternative light were 30.9 and 31.6, respectively.

Table 3: Means ± SE of gestation period, litter size and weight at (birth, 21 day and 28 day)and mortality (still birth and at weaning) of ZW Rabbits as affected by different lighting systems .

Items	G_1: Long light	G_2: Short light	G_3:Alternative light	Overall mean	Sig.
Gestation period(day)	32.0±0.21^{a}	30.9±0.20^{b}	31.6±0.20^{a}	31.5±0.59	***
Litter size at:					
Birth	6.8±0.38^{ab}	6.2±0.37^{b}	7.7±0.37^{a}	6.9±1.06	**
Alive	6.0±0.35^{ab}	5.6±0.34^{b}	6.8 ±0.34^{a}	6.2±1.00	*
21 day	4.9±0.37^{ab}	4.5±0.36^{b}	5.8±0.36^{a}	5.1±1.02	**
28 day	4.5±0.36^{b}	4.5±0.35^{b}	5.6±0.35^{a}	4.9±0.99	*
Litter weight at:					
birth	0.363±0.02^{ab}	0.353±0.02^{b}	0.412±0.02^{a}	0.376±0.06	*
21 day	1.407±0.07	1.425±0.07	1.521±0.07	1.452±0.19	NS
28 day	2.365±0.14^{b}	2.483±0.13^{ab}	2.748±0.13^{a}	2.535±0.40	*
Mortality					
still birth	1.8±0.33	1.7±0.39	2.1±0.33	1.9±0.61	NS
preweaning mortality	2.4±0.30	2.0±0.30	1.7±0.27	2.0±0.65	NS

Means within each row having different letters differ significantly P≤0.05.
NS= not significant *P≤0.05 **P≤0.01 ***P≤0.001

These results agrees with most previous studies reporting range of 30-35 days for gestation period in rabbits with an average of 30-32 days (Hassanein .,1980 ; Niedzwiadek *et al.,* 1983; El-Bogdady *et al.*,1992; Ahmed., 2000; Ahmed .,2002 and Gad.,2003) .

The shortest gestation period was obtained for G_2 may be attributed to the lower number of litter size and litter weight at birth . This agrees with the results of Askar (1989) and Gad (2003) On the other hand, this may be due to increase in feed intake as reporting by Ahmed (2002) .So, the kits reach to their optimal size early.

Litter size :

It could be seen from the table 3 that litter size at birth and at weaning (28 days) were statistically affected by different lighting systems(P≤0.01) and (P≤0.05).While , These results are in agreement with Uzcategui and Jensen .,1990 and 1992) and Depres *et al.* (1995),They reported that lighting system had significant affect on litter size in NZW rabbits at birth and at weaning .

The overall mean of litter size at birth was (6.9) . The highest means of litter size at birth (7.7)was under G_3 followed by G_1 (6.8) and the lowest mean (6.2) was under G_2. These results agree with Hassanien (1980) , Ramirez *et al.* (1983) , Rafay (1992) and El-Bogdady *et al.* (1992)

who reported litter size was higher for does rabbit which exposed to long light than short light . On the other hand,

The present results also showed that, litter size alive , at 21 and at 28 day were similar and high in G_3 followed by G_1 and the lowest means was obtained with short light

The high litter size during this study may be due to higher LH hormone concentration after mating as happened in due result study to effect on ovulation rate (Table 4) . These results in agree with those obtain by Ahmed (2002). Lighting systems affect the reproductive hormones and stimulate the activity of the sexual system.

Litter weight (g):

The present results showed that, The overall mean of litter weight at birth was (0.376). Mean of litter weight under G_3 was the heaviest, followed by G_1 and the lowest mean was under G_2. These differences in body weight may be due to that the litter size at birth and at different ages (21 and 28 days) under G_1, G_2 and G_3 were different. In addition to that , the litter weight was found to be affected by the lighting system .These results agrees with Hassanin (1980) as reporting that litter weight in the group exposed to 14 h (long light) was higher than in the control .

Different lighting systems had significant ($P<0.05$) effect on litter weight at birth and at weaning . Litter weight at birth were 0.363,0.353 and 0.412(g) in G_1,G_2,and G_3 , respectively. Litter weight at21 day was not affected by light program these result agreement with (Quintela *et al* .,2001) Litter weight at weaning (28 days) were 2.365,2.483 and 2.748 (g) in G_1,G_2 and G_3, respectively. These results agrees with the findings of Depres *et al.* (1995) . The previous results at weaning may be due to that the light program negatively These differences may be due to direct , indirect and joint effects of milk yield , litter size and to many factors which can affect growth. This trend is similar to results reported by (Mirabito *et al* ., 1994) .

Mortality:-

Results presented in Table 3 shows still birth as affected by lighting systems. It could be seen from the table that, The overall mean of still birth (1.9) . Still birth in G_1 and G_3 were high than G_3 1.8, 2.1 vs1.7., respectively . preweaning mortality in G_3 was lower than G_1 and G_2 1.7 vs. 2.4, 2.0 , respectively . These results agree with El-Bogdady *et al.* (1992) who shown that preweaning mortality under short light (6L:18D) was lower than long light (18L:6D) , and agrees with Ahmed (2002) which reported mortality rate was higher in the group exposed to long light (16L:8D) than in that exposed to natural light and short light.

These results may be due to the higher litter size in long light group which increase the competition among bunnies during suckling and increase mortality rate.

Hormones :-

LH levels (IU /ml):

Tables 4 presented LH concentration before mating and after mating (1.5-2) under different lighting systems. Results had no significant differences between means in LH level before mating, but after mating showed significant differences between three groups under different lighting

systems. It could be seen from this tables that ,mean LH concentration was high before mating in G_3 and increased rapidly after mating to reach their peak value (1.5-2)in the three groups but G_3 contain high level following by G_1 and lowest level in G_2. These results agrees with Orstead *et al.* (1988) and El-Ashry *et al.* (1989) who reported that LH concentration increased after mating .

Table 4: Effect of Different lighting systems on LH concentration (IU/ml) of NZW Rabbits.

Items	G_1: Long light	G_2: Short light	G_3:Alternative light	Overoll mean	Sig.
Before mating.	2.25 ± 0.25	2.04± 0.25	٢,٧٢± 0.25	2.34±43	NS
After mating.	2.89 ± 0.12^b	2.24 ± 0.12^b	$٣,٠٨ \pm 0.12^a$	2.7±0.44	**

Means within treatment having different letters differ significantly P ≤0.05.
NS= not significant **P ≤0.01

Increase of LH under long light (Tables 4) may be due to that light can affect through the nervous founded in hair follicles under the chin and ear and gave message to hypothalamus to secret GnRH which increase LH secretion from anterior pituitary (Lebas., 1997) .Results shows highly significant (P ≤0.01) differences between three groups in LH level after mating (1.5-2) .

تأثير فترة الإضاءة على الأداء التناسلي للأرانب

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اجريت هذه التجربه لمعرفة تأثير فترات الإضاءه على الأداء التناسلى لإناث الأرانب النيوزيلندى و استخدمت الدراسه ٣٦ أنثى ارنب نيوزيلندى و ١٢ ذكر بغرض التلقيح (إضاءه عاديه) عند عمر ٥-٦ شهور وعند وزن ٢,٥-٣ كجم تم تقسيم الأرانب الى ثلاث مجموعات متساويه على اساس فترة إضاءه طويله (١٦ ساعه ضوء- ٨ ساعات إظلام)- فترة إضاءه قصيره(٨ ساعات إضاءه- ١٦ ساعه إظلام) - فترة إضاءه متغيره(٨ ساعات إضاءه- ١٦ ساعه إظلام ثم ١٦ ساعه ضوء- ٨ ساعات إظلام قبل التلقيح بـ ٦ ايام) كل مجموعه بها ١٢ انثى ارنب.

اشارت اهم النتائج الى:

- توجدت اختلافات معنويه فى وزن وطول المبيض الأيمن وكذلك معدل التبويض للمبيض الأيمن ، طول قناة المبيض الأيسر ووزن المشيمه وزن الرحم .
- لا توجد اختلافات معنويه فى وزن قناة المبيض الأيمن والأيسر، وطول المبيض الأيسر ، معدل تبويض المبيض الأيسر ، معدلات إنغراس الأجنه ، عدد الأجنه الحيه والميته والممتصه.
- تأثرت طول فترة الحمل نتيجة التعرض لفترات الإضاءه فكانت اطول عند التعرض لفترة اضاءه طويله.كما تأثر عدد ووزن خلفات البطن عند الميلاد فكان هناك زياده عند التعرض لفتره الإضاءة المتغيره والطويله عن فترة الإضاءه القصيره كما وجدت إختلافات معنويه بين المجاميع لعدد ووزن خلفات البطن عند الميلاد- ٢١و ٢٨ يوم عدا وزن خلفه البطن عند ٢١ يوم.
- لا توجد اختلافات معنويه فى نسبة النفوق للخلفات عند الميلاد وعند الفطام .
- توجد اختلافات معنويه بين المجاميع فى مستوى هرمون التبويض LH بعد التلقيح بـ ١,٥-٢ ساعه .
- وقد خلصت الدراسه الى امكانية تعريض إناث الأرانب الى فتره اضاءه متغيره للحصول على اداء إنتاجى جيد دون زيادة فى التكلفه الأقتصاديه .