

HORMONAL CHANGING DURING PREGNANCY AND LACTATION OF NEW ZEALAND WHITE FEMALE RABBITS.

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SUMMARY

A total number of 30 does and 6 bucks of mature New Zealand White (NZW) rabbits weighting 3.0 – 3.5 kg and aging 6-7 months were used in the present study. Does were divided according to post partum interval of mating (next to the first parity) into three groups, each of 10 does. Does in group1 (G1) were re-mated through the first day following parturition as an intensive production, does in group2 (G2) were re-mated on the day 14th post partum as a semi-intensive production and those in group3 (G3) were re-mated on the day 30th postpartum (after weaning) as an extensive production.

Blood samples were collected for hormones determination (progesterone, estradiol, prolactin and triiodothyronine) directly before mating and at 7, 14, 21 and 28 days through pregnancy. During lactation period, blood samples were withdrawn after parturition and at 7, 14, 21 and 28 days of lactation. Progesterone (P₄) concentration in serum of the NZW female rabbits significantly increased form parturition up to 7 days of pregnancy and maintained the high level up to 21 days, then a slight decrease was deserved at 28 days of pregnancy. The highest level of P₄ was found in females of (G3) during pregnancy and females of (G2) during lactation. The level of estradiol (E₂) in the serum of NZW female rabbits gradually increased from 14 to 21 days of pregnancy, then significant increase was found at 28 days of pregnancy. The highest level of (E₂) was determined in females of (G2) during pregnancy and lactation.

There were no significant differences in prolactin hormone (PRL) concentrations due to re-mating interval. Lower and higher levels of (PRL) were recorded in females of (G3) during pregnancy and lactation period, respectively. The highest level of triiodothyronine hormone (T₃) was determined in females of (G3) during pregnancy and lactation period.

It could be concluded that pregnant rabbits may regulate the hormonal pattern according to their physiological status requirements.

Keywords: Rabbit, hormones, pregnancy, lactation

INTRODUCTION

Remating interval is one of the most important items in the managerial regimes since it is a limiting factor of the success in the conception rate for each of parity, consequently the sequences of parities within a given period (Azoz, 1996; Khadr, *et al.*, 1996 and Azoz 2001). Commercial rabbit breeding aims at having more litters

per year. This intensive rabbit production requires more studies of their behavior and physiological function particularly in the field of reproduction.

The stress imposed upon the doe by pregnancy is less than that of lactation (Hafez, 1970). On the other hand, Partridge *et al.* (1984) reported that there was an adverse effect of suckling on implantation, which varied directly according to the number of suckling, strains and environmental conditions.

Steroid hormones are the major agents which control success of pregnancy, litter size and effective lactation (Ahmed Nagwa *et al.*, 1994; Azoz, 1996; Ahmed Nagwa *et al.*, 2000 and Azoz 2001). The profile of these hormones is expected to be affected by the rearing schemes.

The objective of this work was to study the effect of post partum remating intervals on hormonal profile of NZW does rabbits during pregnancy and lactation periods.

MATERIALS AND METHODS

This study was carried out in the Rabbit Unit, Center of Agricultural Production Technology, Faculty of Agriculture, Cairo University. The hormonal assay was executed in the laboratory of Animal Production Research Institute, Agriculture Research Center, Ministry of Agriculture.

Animal:

A total number of 30 does and 6 bucks of mature New Zealand White Rabbits (NZW) weighting 3.0 - 3.5 kg and aging 6 - 7 months were used in this experiment. The doe was transferred to the buck's cage at the time of service. Mating of the doe was executed twice to bucks of proven fertility. Pregnancy was diagnosed by abdominal palpation at 14 days post service. Before the beginning of the experimental does were mated almost at the same date to test the reproductive efficiency of the foundation stock in their first parity. All the does (30) were of good fertility thus treated as the experimental design for remating.

Does were divided according to post-partum interval of mating (next to the first parity) into three groups. Does in group 1 (G1) were remated through the day following parturition (intensive production), does in group 2 (G2) were remated on the 14th day post-partum (semi-intensive production) and does in group 3 (G3) were remated on the 30th day post-partum, after weaning (extensive production).

Blood samples and hormonal assay:

Blood samples were withdrawn from the marginal ear vein, directly before mating and at 7, 14, 21 and 28 days through pregnancy. During lactation period blood samples were withdrawn after parturition and at 7, 14, 21 and 28 days of lactation.

Serum samples were prepared by centrifugation (3000 rpm for 15 minutes) and stored at - 18° C until hormonal assay. Progesterone (P₄), estradiol (E₂), prolactin (PRL) and triiodothyronine (T₃) were determined using radioimmunoassay (RIA) technique.

Ready antibody coated tube kits (Orion Diagnostic, Finland) were used to determine P₄. According to the manufacturer information, antiserum at 50% displacement, has cross reaction values 100% with progesterone, while the reaction is less than 3.9% with pergnenolone and less than 1% with any of the other steroids.

The standard curve of progesterone ranged between 0.0 and 40.0 ng/ml. Sensitivity value when assaying 100 ml of plasmas is about 0.08 ng/ml.

Estradiol (E₂) antibody (at 50% binding) has 100% cross reaction with estradiol while it is 4.4%, 10.0% and 1.8% with d-equilenin, estrogen and estrone- β -glucuronide and ethinyl estradiol, respectively. It was less than 1.0% with any of the steroids.

Total triiodothyronine (T₃) antiserum is highly specific for triiodothyronine. The cross reactivity to total T₃ antiserum was 100% with T₃, while it was 19.8% and 1.1% with triiodothyroacetic acid and D-thyroxine, respectively. It was less than 1% with any of the other natural compounds that might be present in the samples.

Data were statistically analyzed using ANOVA procedure SAS (1988) as 2 factor-factorial arrangement of treatment with the model including effects of remating intervals (1, 14 and 30 days post-partum). And days through pregnancy or lactation (0, 7, 14, 21 and 28 days). Differences among means were tested using Duncan Multiple Range Test (Duncan, 1955).

RESULTS AND DISCUSSION

1. Progesterone hormone:

1.1. During pregnancy:

A clear trend of serum P₄ concentration was determined during pregnancy with different systems of remating interval (Table, 1 and Fig., 1). Sharp significant increase occurred in P₄ concentration after mating up to 7 days of pregnancy (Table 1) and this increase continued up to 21 days, then slight decrease occurred at 28 days (the end of gestation).

Table 1. Effect of remating interval on serum progesterone concentration (ng/ml) of NZW rabbits during pregnancy and lactation stages (SE=0.0302)

Remating intervals	Pregnancy stages				
	mating day	7 days	14 days	21 days	28 days
1 day	1.297 ^c	6.400 ^{ab}	8.040 ^a	7.843 ^{ab}	7.113 ^{ab}
14 days	1.020 ^c	6.057 ^b	7.303 ^{ab}	7.053 ^{ab}	6.853 ^{ab}
30 days	0.987 ^c	6.373 ^{ab}	8.520 ^a	8.137 ^{ab}	7.413 ^{ab}
Lactation stages					
1 day	7.771 ^a	1.700 ^{de}	1.029 ^{de}	2.038 ^d	1.403 ^{de}
14 days	6.549 ^b	0.773 ^e	1.144 ^{de}	5.307 ^c	6.541 ^b
30 days	7.184 ^{ab}	1.325 ^{de}	1.140 ^{de}	0.740 ^e	0.721 ^e

^{abcde} Means within the same row having different superscripts differ significantly (P<0.05).

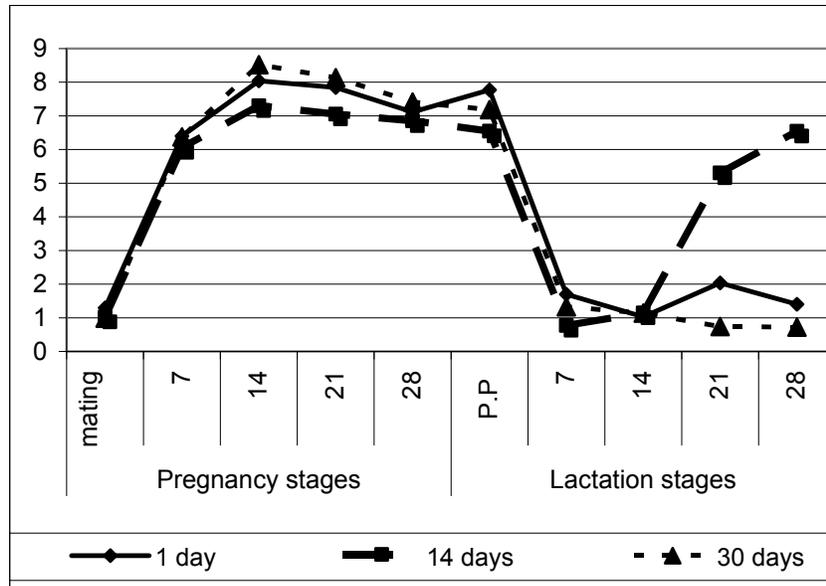


Figure 1. Effect of remating interval on serum progesterone concentration (ng/ml) of NZW rabbits during pregnancy and lactation stages.

The present mean peripheral serum P_4 concentration is similar to those previously reported for pregnant rabbits by (Challis *et al.*, 1973; Stoufflet and Caillol, 1988; Ahmed Nagwa *et al.*, 1994; Azoz, 1996; Khadr *et al.*, 1996 and Azoz, 2001). The highest mean concentration of circulating P_4 was observed around days 12-14 followed by a gradual decline between mid pregnancy and parturition. Also, in the present study, the changes in peripheral serum P_4 levels in pregnant NZW rabbits are in harmony with the results of Khadr *et al.* (1996). They reported that the P_4 curve of pregnancy could be divided into three phases: (a) increasing phase, from coitus up to day 7-14 or 11 of pregnancy, (b) phase of maintenance from day 14 to day 21 of pregnancy and (c) phase of regression where values of the hormone decreased to become minimal on days 30, 31 and 33 of gestation (depending upon gestation length). The findings of McNitt (1992) support our results. He reported that plasma P_4 levels rose rapidly during the first trimester of pregnancy, remained relatively constant during the second trimester and declined through the final trimester.

The high level of P_4 during the 1st half of pregnancy plays a role in the preparation of the uterus for implantation of the fertilized ovum and the inhibition of uterine contractions during the first few days of pregnancy (Habeeb and El-Masry, 1991 and Ahmed *et al.*, 1994). In addition, high P_4 concentration and particular estrogen titer shut off Lutinizing hormone release from the pituitary gland and prevent induced ovulation during pregnancy in rabbits (Hafez, 1970 and Sharma, 1979). Moreover, progesterone suppresses the immunological rejection of the fetuses (Daniel *et al.*, 1984). The fall in P_4 titer in late pregnancy is the first step in the

initiation of parturition, where prostaglandin participate in later stages of parturition by expelling fetuses through their oxytocin property (Enbergs, 1979).

In the present study P_4 concentration was higher in cases of does mated at 30 days after parturition since there were no interference of milking. The 1st day post-partum mated group had a confound effect of pregnancy and lactation than in case of does mated on 14 day post-partum which had halfway interloping effect of pregnancy and lactation.

However these differences in P_4 levels were not statistically significant (Table 1). The insignificant differences in the level of P_4 when females were mated at different periods post-partum may be related to the level of prolactin hormone during lactation which stimulate P_4 secretion from corpora lutea. Daniel *et al.* (1984) and Younglai (1986) reported that prolactin was essential for P_4 secretion and acted as an essential hormone in rabbit uterine response to P_4 by modulation of P_4 receptor activity for maintenance of pregnancy period.

It could be concluded that remating interval post-partum had no significant effect on the level of progesterone hormone throughout pregnancy.

1.2. During lactation:

Table (1) shows different patterns of P_4 hormone concentration after parturition (throughout lactation) in the three systems of remating intervals. In the first system, when does were introduced to the buck on the 1st day after parturition, the concentration of P_4 hormone in serum was high just after parturition, a significant low level was found at 7 days from the beginning of lactation and continued up to 14 days (Figure 1). The level of hormone increased slightly at 21 days and decreased again when it was determined at 28 days from lactation.

In the second system, of does remated on the 14th day after parturition, the level of P_4 significantly ($P < 0.05$) decreased drastically at 7 days followed by a negligible increase till the 14th days (at the next mating). Then it continued to increase up to 28 days (the first half period of the following pregnancy). At the third system of mating (when does were remated at 30 day after parturition, after weaning) the level of P_4 significantly continued to decrease after parturition up to 28 days after that.

The significant fall in the level of serum P_4 after parturition up to 14 days post-partum in the three cases of remating interval indicates that the regression in P_4 level in the first group may be attributed to induction of the next litter which leads to an increased secretion of GnRH, thus FSH and LH, and resulted in a larger crop of follicles that could develop for the next cycle (McNitt 1992). However, the second reason of falling P_4 level in the serum of does which observed in the three groups may be attributed to the depression effect of lactation.

After 14 days of lactation, it could be observed that the highest level of P_4 hormone was detected in serum of does remated at 14 days post-partum (G2, Figure 1). This result indicates that P_4 level increased significantly after mating for maintaining the following pregnancy. The level of the hormone in the serum of does in the first group (after 14 days during lactation) was lower than those of group 2, this result may be related to the inhibition of P_4 in the second stage of pregnancy.

2. Estradiol (E_2) :

2.1. During pregnancy:

The effect of remating interval on estradiol (E_2) concentration in serum of NZW female rabbits through pregnancy is shown in Table (2) and Figure (2). Fluctuating trend was determined for the concentration of E_2 hormone from mating to 21 days of pregnancy, then, significant increase was observed at 28 days of pregnancy. The differences in serum estradiol hormone level due to remating interval were not significant from after mating to 21 days of pregnancy, however, these differences were significant at 28 days of pregnancy (Table 2). At that stage, the level of E_2 was significantly higher in the serum of females mated at 14 days post-partum than females mated within the 1st day after parturition and females mated at 30 days post-partum (after weaning), respectively (Figure 2). These results are in agreement with those obtained by Stouffelt and Coillol (1988). Also, these results are consistent with the results of Ubilla and Rebollar (1994), they found that E_2 levels was high from 5 to 7 and 23 to 30 days post-partum. These authors attributed the failure of receptive mating on day 14 post-partum to low estradiol levels.

Table 2. Effect of remating interval on serum estradiol concentration (pg/ml) of NZW rabbits during pregnancy and lactation stages (SE=1.792)

Remating interval	Pregnancy stages				
	mating day	7 days	14 days	21 days	28 days
1 day	4.507 ^c	8.130 ^c	4.057 ^c	9.267 ^c	38.010 ^b
14 days	2.657 ^c	9.173 ^c	6.557 ^c	11.450 ^c	57.690 ^a
30 days	4.307 ^c	8.563 ^c	5.630 ^c	14.070 ^c	31.790 ^b
	Lactation stages				
	7 days	14 days	21 days	28 days	30 days
1 day	7.459 ^{bc}	6.543 ^c	6.122 ^{cd}	7.491 ^{bc}	7.900 ^{abc}
14 days	7.038 ^c	4.652 ^{de}	6.446 ^c	9.174 ^{ab}	9.516 ^a
30 days	7.526 ^{bc}	6.847 ^c	2.619 ^f	2.872 ^f	4.228 ^{ef}

^{abcdef} Means within the same row having different superscripts differ significantly ($P < 0.05$).

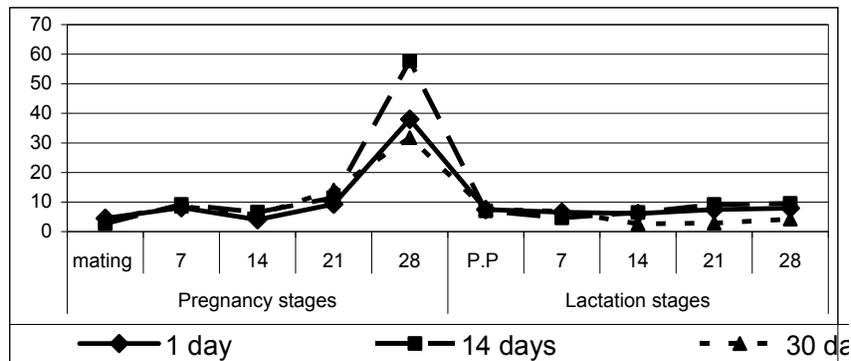


Figure 2. Effect of remating interval on serum estradiol concentration (pg/ml) of NZW rabbits during pregnancy and lactation stages

The increased serum estradiol concentration in pregnant rabbits at day 7 post-partum is, probably, related to the follicular growth and increase of the follicle steroidogenic activity that occurred between the last days of pregnancy and between 5-9 days post-partum (Diaz *et al.*, 1988) as well as, to the high plasma FSH levels observed around 5-7 days after parturition in lactating rabbits (Ubilla *et al.*, 1992).

It is interesting to point out that the level of E₂ hormone was high on the 1st day after parturition in serum of does mated within that day as well as that left milking to be mated after 30 days, being about two folds of that remated after 14 days post-partum (Table 2 and Figure 2). This drop in the concentration at mating on the 14th day seems to be brought about by the halfway of lactation as present in case of lactation proper (will no pregnancy) in G3 (Table 2). This high concentration in G1 and G3 coincides with the rise of sexual receptivity (high natural conception rate) which was observed in females remated at 1 and 30 days post-partum, in the present study. As mentioned above, Ubilla and Rebollar (1994) stated that the failure of receptively on day 14 post-partum is due to low estradiol concentration.

2.2. During lactation:

The results of changes in peripheral blood of E₂ hormone throughout lactation stage are shown in Table (2) and Figure (2). It can be observed that similar trends of E₂ concentration was obtained in serum of does remated at first day and 14 days post-partum during lactation period, however, the level of E₂ hormone was higher in the first group than in those of the second group through the 7 days of lactation followed by opposite trend. This result may be attributed to the immediately remating after parturition in the first group leading to follicular growth and increasing the level of E₂ hormone, while the ovulation and follicular growth were occurred at 14 days post-partum in the second group leading to more increase of E₂ level in serum of does in group two than those of group one (Figure 2). Due to remating at 30 days after parturition the level of E₂ hormone in this group significantly (P < 0.05) decreased after 7 days post-partum and contended to the end of lactation (Table 2 and Figure 2). The differences in E₂ level due to remating interval were significant throughout the lactation period.

3. Prolactin hormone:

3.1. During pregnancy:

The effect of remating intervals on PRL hormone concentration of NZW does serum during pregnancy is shown in Table (3) and Figure (3).

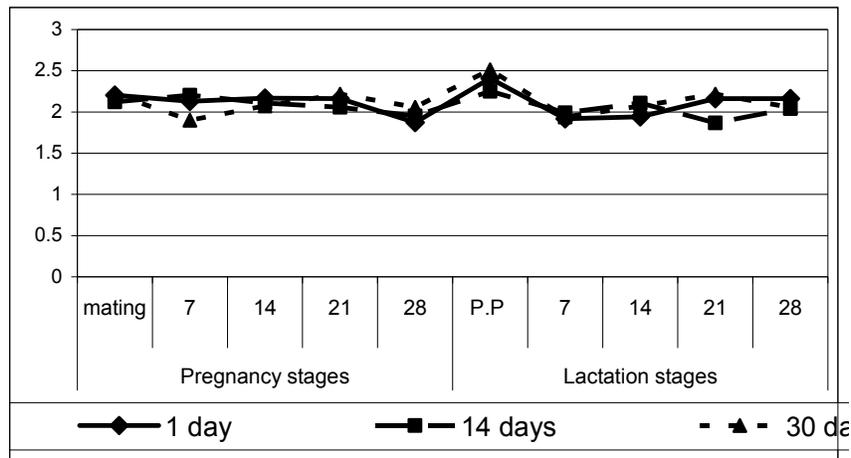
Remating intervals had no significant effect on the concentration of PRL hormone (Table 3). The overall average of concentration was almost similar being 2.107, 2.089 and 2.093 ng/ml in serum of does remated at 1, 14 and 30 days post-partum, respectively.

Similar trend was determined for PRL hormone concentration during pregnancy in does remated on 1 day and 30 days post-partum (Figure 3). The level of PRL hormone decreased after mating at 7 days of pregnancy, sharply in group 3, followed by increase up to 21 day of pregnancy, then remarkable decrease was observed at 28 days of pregnancy. However, in group 2, does mated at 14 days post-partum, the level of prolactin hormone increased from mating to 7 days, then it decreased gradually up to 28 days of pregnancy (Figure 3).

Table 3. Effect of remating interval on serum prolactin concentration (ng/ml) of NZW rabbits during pregnancy and lactation stages (SE=0.2252)

Remating interval	Pregnancy stages				
	mating day	7 days	14 days	21 days	28 days
1 day	2.203	2.130	2.167	2.163	1.873
14 days	2.123	2.203	2.110	2.057	1.953
30 days	2.217	1.900	2.073	2.217	2.057
Remating interval	Lactation stages				
	mating day	7 days	14 days	21 days	28 days
1 day	2.408 ^{ab}	1.918 ^b	1.941 ^b	2.163 ^{ab}	2.163 ^{ab}
14 days	2.251 ^{ab}	1.991 ^{ab}	2.108 ^{ab}	1.868 ^b	2.041 ^{ab}
30 days	2.512 ^a	1.939 ^b	2.072 ^{ab}	2.217 ^{ab}	2.056 ^{ab}

^{ab} Means within the same row having different superscripts differ significantly ($P < 0.05$).

**Fig. 3. Effect of remating interval on serum prolactin concentration (ng/ml) of NZW rabbits during pregnancy and lactation stages**

The slight decrease in serum PRL concentration observed from 21 days to 28 days of pregnancy, may be responsible for the high magnitude of LH and FSH associated with high sexual receptivity. Forcada and Abecia (1990) reported that in early pregnancy female receptivity decreased but was higher a few days before parturition. McNitt (1992) reported that at the time of mating, there was a fall in plasma PRL levels which rose to precopulatory levels in about 30 minutes. Plasma levels were again increased significantly three to four days post-coitus and remain elevated for the first half or two thirds of gestation after which the levels declined. Lamb *et al.* (1991) reported that does which failed to ovulate when served at 14 days post-partum had reduced plasma concentration of estradiol 17- β and prolactin.

The changes in levels of prolactin in the present study with different mating systems were related to doe physiological status, the number of bunnies suckling and the stage of lactation. Daniel (1984) reported that the principle function of PRL

during pregnancy was to conserve the amount of P₄ available for maintenance of pregnancy.

3.2. during lactation:

The effect of remating interval on serum PRL hormone concentration of NZW rabbits throughout lactation is shown in Table (3) and Figure (3).

There were no significant changes observed in the levels of PRL hormone during the different stages studied through lactation. The mean value of the hormone level was 2.390, 1.949, 2.040, 2.083 and 2.087 ng/ml after parturition and at 7, 14, 21 and 28 days of lactation, respectively.

Generally, the level of PRL hormone decreased after parturition to 7 days. In G1, remated 1 day post-partum slight decrease was terminated at 14 days of lactation and the level of the hormone gradually and slightly increased up to 28 days of pregnancy (Table 3 and Figure 3). The level of PRL throughout lactation was higher in G3 (2.160 ng/ml) than that in females of G1 (2.132 ng/ml) or those in G2 (2.032 ng/ml). This result explains the important role of PRL in certain aspects of maternal behavior.

4. Triiodothyronine hormone:

4.1. During pregnancy:

The effect of remating interval after parturition on T₃ concentration (ng/ml) during pregnancy is shown in Table (4) and Figure (4).

Table 4. Effect of remating interval on serum triiodothyronene concentration (ng/ml) of NZW rabbits during pregnancy and lactation stages (SE=0.085)

Remating interval	Pregnancy stages				
	Mating day	7 days	14 days	21 days	28 days
1 day	0.850 ⁱ	1.927 ^{bcd}	2.187 ^{abc}	1.587 ^{cde}	1.523 ^{de}
14 days	1.193 ^{ef}	1.760 ^{bcd}	1.633 ^{cde}	2.593 ^a	1.497 ^{de}
30 days	1.920 ^{bcd}	2.273 ^{ab}	1.903 ^{bcd}	2.197 ^{abc}	1.420 ^{def}
Lactation stages					
1 day	1.8846 ^b	1.1309 ⁱ	1.5139 ^f	1.4172 ^g	1.7327 ^c
14 days	1.0981 ⁱ	1.1931 ^h	1.4470 ^g	1.7217 ^c	1.5784 ^{de}
30 days	1.5190 ^{ef}	1.8810 ^b	2.0358 ^a	1.5350 ^{ef}	1.6041 ^d

^{abcdefghi} Means within the same row having different superscripts differ significantly (P < 0.05).

Fluctuated trend of T₃ was detected during pregnancy. The overall mean of T₃ concentration in serum of G3 was higher than that of those G2 or G1. It was 1.943, 1.735 and 1.615 ng/ml, respectively.

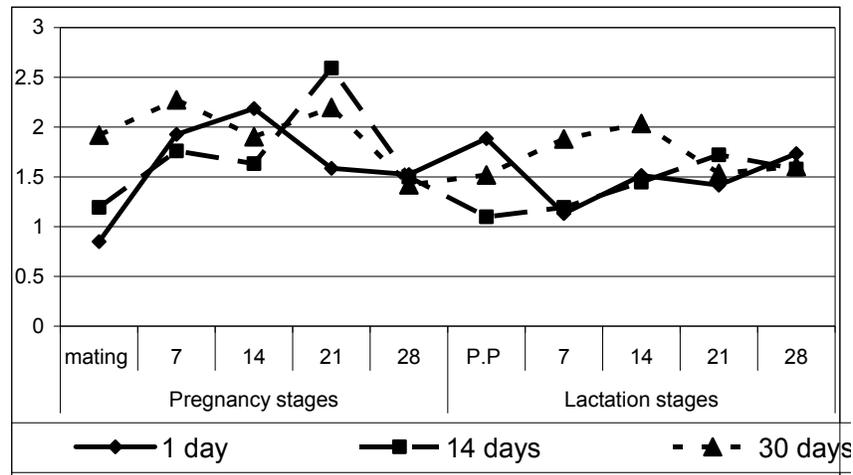


Figure 4. Effect of remating interval on serum triiodothyronine concentration (ng/ml) of NZW rabbits during pregnancy and lactation stages

Similar fluctuating trend was observed in T_3 hormone concentration of group 2 and group 3 (Figure 4), that the level of the hormone increased significantly after mating up to 7 days of pregnancy (Table 4), then it significantly decreased at 14 days and significant increase was determined at 21 days of pregnancy followed by a sharp significant drop at 28 days (the end of pregnancy). However, the level of T_3 hormone in serum of G1 significantly increased from mating to 7 days after parturition and continued up to 14 days (Table 4 and figure 4), then significant decrease was detected in the second half of pregnancy (from 14 to 28 days). Bober *et al.* (1980) reported that thyroid hormones are considered necessary for cellular metabolism of the mammary gland and energy utilization which may be an important factor in fetal development during pregnancy and milk biosynthesis.

The increase in T_3 level in pregnant rabbits may be due to its role in tissue synthesis, especially, in the first half of pregnancy (Habeeb and El-Massry, 1991) and development of fetuses. The increase in T_3 concentration in the second half of pregnancy indicates its vital role in energy metabolism to face milk synthesis.

4.2. During lactation:

Significant changes in the level of T_3 hormone were determined (Table 4) throughout lactation. Due to remating interval post-partum, females of G3 had the highest level of T_3 hormone along 21 days throughout lactation. However, the level of T_3 decreased sharply after parturition in the group G1 and increased gradually from 7 up to 28 days of lactation (Figure 4). In group 2, the level of T_3 increased after parturition until 21 days of lactation, then a decrease was detected 28 days of lactation.

The results belong to the effect of remating intervals on T_3 concentration in serum indicate that rabbits try to regulate the concentration of hormone according to

physiological status to face the requirements of pregnancy only or lactation only or pregnancy and lactation at the same time.

It could be concluded that pregnant rabbits may regulate the hormonal pattern according to their physiological status requirements.

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التغيرات الهرمونية أثناء الحمل والرضاعة في إناث الأرناب

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أستخدم في هذه الدراسة عدد ٣٠ أنثى من نوع النيوزلندي الأبيض التي يتراوح وزنها من ٣ - ٣.٥ كجم ويبلغ عمرها من ٦-٧ شهور. وقسمت الأمهات بعد البطن الأولى طبقا لفاصل التلقيح بعد الولادة إلى ثلاثة مجاميع كالتالى:

المجموعة الأولى: تم التلقيح فيها خلال يوم بعد الولادة (نظام الإنتاج المكثف)، **المجموعة الثانية:** تم التلقيح فيها عند ١٤ يوم من الولادة (نظام الإنتاج شبه المكثف) و**المجموعة الثالثة:** تم التلقيح فيها بعد ٣٠ يوم من الولادة أى بعد الفطام (نظام الإنتاج الغير مكثف).

* وتم دراسة التغير فى التوازن الهرمونى خلال ٣ بطون متتالية بعد البطن الأولى.

وكانت أهم النتائج المتحصل عليها هي:

- ١- أعلى مستوى من تركيز هرمون البروجستيرون وجد في إناث المجموعة الثالثة أثناء الحمل و إناث المجموعة الثانية أثناء الرضاعة.
 - ٢- أعلى مستوى من هرمون الاستراديول وجد في الإناث التى لقت عند ١٤ يوم من الولادة أثناء الحمل والرضاعة.
 - ٣- انخفض تركيز هرمون البرولاكتن في سيرم الإناث الملقحة بعد ٣٠ يوم من الولادة (بعد الفطام) أثناء فترة الحمل بينما ارتفع تركيزه أثناء الرضاعة.
 - ٤- حدث ارتفاع في تركيز هرمون التراى أيبودو ثيرونين في سيرم إناث المجموعة الثالثة أثناء الحمل والرضاعة.
- من نتائج هذه الدراسة يمكن استنتاج ان الشكل الهرموني لإناث الأرناب الحوامل يتحدد طبقا للحالة الفسيولوجية للأنتى أثناء الحمل .