

Dept. of Biochemistry,
Animal Health Research Institute, New-Valley Branch.

**LEVELS OF THYROID HORMONES AND SOME
HAEMATOLOGICAL INDICES IN DESERT GOATS
AT AL-WADI AL-GADEED GOVERNORATE**
(With 7 Tables and 2 Figures)

By

**A. ABOU EL-ELA; IBTISAM M.H. EL-MILEEGY*
and TH. S. ABDEL-ALL****

*Dept. of Physiology, Faculty of Medicine Assiut University, Egypt.

**Dept. of internal medicine, Faculty of Vet. Med., Assiut University, Egypt.

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**مستويات هرمونات الغدة الدرقية وبعض المؤشرات الدموية في الماعز
الصحراوية في محافظة الوادي الجديد**

علي ابو العلا محمد ، ابتسام محمد المليجي ، ثروت سعيد عبد العال

استهدفت هذه الدراسة وضع قيم اوليه لمعدلات هرمونات الغده الدرقيه في بلازما دم الماعز الصحراوي وعلاقتها بالصوره الدمويه ولتنفيذ هذا الهدف تم اختيار عدد خمسين من الماعز السليمه فى اعمار واجناس وحالات تناسليه وانتاجيه مختلفه وتعيش هذه الحيوانات فى ضواحي محافظه الوادي الجديد. اوضحت النتائج ان متوسط التراى ايوودو ثيرونين (T_3) والثيروكسين (T_4) فى بلازما دم الماعز الصحراوي كانت $109.650 \pm 6.167 \text{ ng/dl}$ ($49-210$) and $4.703 \pm 0.197 \text{ ug/dl}$ ($2.1-7$) على التوالي وكانت الصوره الدمويه شامله كريات الدم الحمراء (RBC) والهيموجلوبين (Hb) ونسبه الخلايا المسطه (PCV) كانت 6.610 ± 0.183 ($4-8.4$) $\times 10^6/\text{ul}$, 7.473 ± 0.158 ($5-9.4$) g/dl and 24.255 ± 0.436 ($19-30$)% على التوالي. اما بالنسبه لمتوسطات (T_3) و (RBC) و (Hb) و (PCV) زادت بزيادة عمر الحيوانات. وبالنسبه لتأثير الجنس على هذه الحيوانات فكانت الاختلافات غير معنويه فى الماعز اقل من عمر 6 شهور بينما كانت قيم الذكور اعلى من الاناث فى الاعمار الكبيره. وحدثت اختلافات معنويه فى متوسطات القيم المدروسه فى الماعز العشار عند مقارنتها بالماعز الحلابه والغير عشار بينما كانت الفروق غير معنويه فى الماعز الغير عشار والغير حلابه عند مقارنتها بالماعز الحلابه. وخلصت الدراسه الى وجود درجات من التغيرات فى تركيزات هرمونات الغده الدرقيه وبعض المؤشرات الدمويه فى الماعز الصحراوي التى ترعى فى منطقه الوادي الجديد تحت تأثير العمر والجنس والحاله التناسليه والانتاجيه.

SUMMARY

The present investigation aimed to set up a preliminary data for plasma thyroid hormones in desert goats and the corresponding haematological parameters. For this purpose, a total of 50 apparently healthy goats at different ages, sexes, reproductive and productive status were selected from their natural habitat in the peri-urban areas at Al-Wadi Al-Gadeed governorate. The obtained results revealed that the all-mean values of plasma triiodothyronine (T_3) and thyroxin (T_4) were 109.650 ± 6.167 ng/dl (49-210) and 4.703 ± 0.197 ug/dl (2.1-7) respectively. The haematological investigations revealed that the mean values of red blood cells (RBC) $\times 10^6$ /ul, haemoglobin (Hb) g/dl and packed cell volume (PCV%) in desert goats were 6.610 ± 0.183 (4-8.4) $\times 10^6$ /ul, 7.473 ± 0.158 (5-9.4) g/dl and 24.255 ± 0.436 (19-30)% respectively. The mean values of T_3 , RBC, Hb and PCV were increased by increasing age of animals. Sex had non-significant effect on all studied parameters in young animals < 6 months, while the values in males were significantly higher than females in older individuals. The mean values of the studied parameters were significantly varied in pregnant individuals if compared with lactating and stagnant goats. The mean values of both non-pregnant non-lactating and lactating individuals were non-significantly varied. The present investigation demonstrated different degrees of variations in the plasma thyroid hormone concentrations and haematological parameters in goats raised at Al-Wadi Al-Gadeed area under the effect of age, sex, reproductive and productive status.

Key words: *Triiodo thyroninec (T_3), thyroxin (T_4), haematology, desert goats.*

INTRODUCTION

Goats constitute the main animal species, which play an important role in the rural economy. Thyroid hormones 3, 5, 3' triiodothyronine (T_3) and 3, 5, 3', 5' tetraiodothyronine (thyroxine, T_4) are iodine containing aminoacids synthesized in the thyroid gland and perform many functions in the body (Felig, *et al*, 1981).

In fact, every cell of the body is a target of thyroxine (T_4), but in general thyroid hormones regulate growth, cell differentiation and oxidative metabolism (McDonald, 1980). They are also responsible for increase utilization of carbohydrates, fats and protein catabolism in addition to the normal function of central nervous system (Kaneko, 1997).

Under field practice the judgement of the thyroid gland state and its abnormalities is depending mainly on the values of thyroid hormones in serum or plasma of farm animals (Gupta, *et al.* 1998 and Sokkar, *et al.* 2000).

Al-Wadi Al-Gadeed is an arid inland tropical area. There are no rivers, rainfall or surface water. Soil nature is sandy limestone with low humus and low annual precipitation. Such areas are said to be iodine deficient as it is far from importable air born iodine from seas and oceans and this element is readily leached from these soils by irrigation (McDowell, 1992). Saleh (2000) denoted that the dietary iodine that admitted for animals in this area is so low to overcome the real needs for normal health. The obtained values by the author for the actual iodine contents in the soil, water and feeding resources were lower than the international recommended levels.

To date, studies on thyroid hormones in desert goats are very scarce. The present investigation aimed to set up a preliminary data for plasma thyroid hormones in desert goats and the corresponding haematological parameters under the effect of age, sex, reproductive and productive conditions.

MATERIALS and METHODS

Animals: A total of 50 apparently healthy goats at different ages, sexes, reproductive and productive status were selected from their natural habitat in the peri-urban areas at El-Kharga City, Al-Wadi Al-Gadeed governorate. Of these animals, 10 female goats (1-2 years) were classified according to their reproductive and productive state into pregnant and lactating individuals (5 each). The remainders (40 goats) were classified according to sex into two equal groups (20 non-pregnant non-lactating females and 20 males). Each group was subdivided according to age into 4 subgroups, 5 each (<6Month, 6-12Month, 1-2 Years and >2 Years). The non-pregnant non-lactating females subgroup which aged 1-2 years (5 animals) was used as a control group for the pregnant and lactating individuals.

Blood sampling and haematobiochemical analysis: Whole blood sample from each animal was collected by jugular vein puncture in EDTA vacuumed 2 test tubes of 10-ml capacity. The first sample was used for separation of plasma which freezed at -20°C until the radio-immune assay (RIA) of thyroid hormones, Triiodothyronine (T_3) and Thyroxine (T_4) according to Abraham (1977) using commercial test kits. The second sample was used for haematological investigations (RBC,

Hb and PCV) according to the standard methods described by Feldman *et al.* (2000).

Statistical analysis: Obtained raw data were subjected to a software program (SPSS, Ver. 10) according to Borenstein *et al.* (1997). Values were evaluated dependently in all samples by use of linear general model ANOVA to assess the all mean values and the effect of age, sex, reproductive and productive factors on the measured variables. ANOVA was followed by paired "t" test and pair-wise multiple comparison procedures (Duncan's new multiple range test) to compare between the mean values of both sexes, different age groups and to differentiate between the reproductive, productive and stagnant females.

RESULTS

The statistical linear model ANOVA of blood plasma thyroid hormones and haematological values in desert goats is presented in table 1. Under the effect of age and sex, the registered F value in this table was highly significant ($P < 0.001$) for T_3 , RBC, Hb and PCV, while it was non-significant ($P < 0.05$) for the estimated T_4 .

Source of this variation is clear in tables 2, 3, 4, 5 and 6. In these tables it can be noticed that the mean values of T_3 , RBC, Hb and PCV were increased by increasing age of animals. Sex had non-significant effect on all studied parameters in young animals < 6 months. In those of 6-12 months, sex had non-significant effect on the mean values of T_3 , T_4 and RBC, while males were significantly higher than females in Hb and PCV. In older individuals (1-2 and > 2 years) the mean values of all parameters were significantly higher in males than females.

Table 7 showed the reproductive and productive effects on the studied parameters. The estimated F and P-values were significant for all parameters. The mean values of the studied parameters were significantly varied in pregnant individuals if compared with lactating and stagnant goats. The mean values of both non-pregnant non-lactating and lactating individuals were non-significantly varied.

DISCUSSION

Thyroid activity exerts an important influence on general and energetic metabolism in mammals. Measurements of thyroid hormones in the plasma of desert goats in the present investigation revealed that the total mean values of triiodothyronine (T_3) and thyroxin (T_4) were

109.650±6.167ng/dl (49-210) and 4.703±0.197ug/dl (2.1-7) respectively. Reap, *et al.* (1978), McDonald (1980), Anderson, *et al.* (1988) and Eswari, *et al.* (1999) obtained similar values. Contrary to our results higher values were obtained by Abou-Zeina, *et al.* (2002) for Egyptian goats and Blaszczyk, *et al.* (2004) for poland goats.

Although the examined goats in this study raised at known iodine deficient area (Saleh, 2000), their plasma thyroid hormones concentrations lies within the normal ranges and no clinical signs of goiter was observed. Saleh (2000) noticed also absence of goiter in sheep at Al-Wadi Al Gadeed area and explained this phenomena by the adaptability of the native breeds at this area to iodine deficiency. Markou, *et al.* (2001) reported that the thyroid gland has the capacity and holds the machinery to handle the iodine efficiently when the availability of iodine becomes scarce.

Regarding haematological parameters estimated in the present study, the mean values of red blood cells (RBC) $\times 10^6/\text{ul}$, haemoglobin (Hb) g/dl and packed cell volume (PCV%) in desert goats were 6.610±0.183 (4-8.4) $\times 10^6/\text{ul}$, 7.473±0.158 (5-9.4) g/dl and 24.255±0.436 (19-30)% respectively. Similar values were previously obtained by McDougal, *et al.* (1991), Jain (1993); Khalaf (2002) and Biswas and samanta (2002). In contrast Rastogi and Singh (1990) and Shumaher-Henrique, *et al.* (1987) recorded higher values. Such variations in all over mean values of T_3 , T_4 , and estimated haematological parameters might be due to differences in geographical locations, nutritional status, soil nature and plant, water iodine content. (Schmidt-Nielsen, 1997).

There were inverse relationship between age and plasma T_3 concentration in desert goats in the present investigation as T_3 decreased by increasing age while T_4 unchanged. Such decrease in the concentration of T_3 by increasing age may be explained by decrease iodothyronin deiodinase (D1& D2) which convert T_4 into T_3 (Wilson, *et al.*, 1998). Also my be explained as sensitivity of the thyroid gland to TSH decreases with aging ,as weight of thyroid gland decreased with age despite increasing amount of TSH impinging on thyroid follicular cells.(Reimers, *et al.*, 1990).

In the present investigation sex seemed to have non significant effects on the mean values of T_3 and T_4 in goats less than one year, while males had higher values of thyroid hormones than females in older goats. Such higher concentrations of thyroid hormones in males than females could be explained as the androgens in male are anabolic in action leading to increasing levels of thyroid hormones in males than

females. (Ganong, 1999). Many authors, Gupta *et al.* (1998) and Eswari *et al.* (1999) obtained the same results for the effect of age and sex on the levels of thyroid hormones in goats.

In the present study the effect of age and sex was clear on the estimated haematological parameters which showed lower levels in young goats than older ones. Such increase in these parameters in growing and adult goats than young ones may be due to consumption of roughage which are very rich sources of iron (McDowell, 1992).

Sex had non significant effect on the estimated haematological parameters in the young goats less than one year, while male had significant higher values than females in adult goats. The higher levels of the estimated haematological parameters in male goats than female could be owing to increased metabolic rate and direct effect of testosterone on red cell production (Guyton and Hall, 2000). The estimated haematological parameters in the present investigation under effect of age and sex come in agreement with those previously reported by Feldman, *et al.*, (2000) and Khalaf, (2002).

Thyroid hormones and haematological parameters in pregnant goats in the present investigation were significantly higher than those of non pregnant and lactating goats. Such variations owing to the fact that, pregnancy is considered euthyroid state, the hormonal change and metabolic demands of pregnancy result in significant increase in thyroid function. (Glinoe, *et al.*, 1990, Lockitch, 1993 and Smyth, 1999). Also such increase in thyroid hormones during pregnancy may be due to increased production of thyroxin-binding globulin. (Feely, 1979 and Lockitch, 1993). Moreover, Berghout and Weirsinga (1998) reported that during pregnancy thyroid function and thyroid gland volume adapt in a physiological way to meet increased demands for iodine and energy.

On the other hand, decreasing levels of thyroid hormones in lactating goats when comparing with pregnant goats might be due to high demands of thyroid hormones needed for milk production (Kaneko, 1997).

Pregnant goats had significantly lower levels of the estimated haematological parameters when comparing with than those of non-pregnant and lactating individuals. Such decrease could be due to haemodilution effects resulting from an increase in plasma volume, this haemodilution may have a physiological importance as it reduce the blood viscosity and greatly increase the blood flow in small blood vessels (Koller, 1982; lockitch, 1993 and Guyton and Hall, 1996).

On the other hand, decreasing levels of the estimated haematological parameters in lactating goats when comparing with pregnant goats may be explained as lactation seemed to induce stress on life span of the red blood cell and haemoglobin formation or haemodilution due to increasing water mobilization to mammary glands through the vascular system (El-Sherif and Asaad, 2001). Biagi, *et al.* (1988), Mbassa and Poulsen, (1991) and Azab and Abdel-Maksoud, (1999) obtained the same results for the effect of pregnancy and lactation on the haematological parameters.

In contrast Popsil, *et al.* (1987) recorded no statistical differences in haematological parameters between pregnant and non pregnant goats.

Although pregnant goats having higher levels of thyroid hormones, the haematological parameters showed lower levels. This can be owing to the effect of haemodilution which may mask the effect of thyroid hormones on the haematological parameters.

In conclusion, the present investigation demonstrated different degrees of variations in the plasma thyroid hormone concentrations and haematological parameters in desert goats raised at Al-Wadi Al-Gadeed area under the effect of age, sex, reproductive and productive status.

Table 1: Linear model ANOVA of blood plasma thyroid hormones and haematological values in desert goats.

	T3 ng/dl	T4 µg/dl	RBC x10 ⁶ /µl	Hb g/dl	PCV %
Mean	109.650	4.703	6.610	7.473	24.525
SE	6.167	0.197	0.183	0.158	0.436
F value*	6.51***	1.51 ^{NS}	7.79***	10.9***	9.35***
Variance	1521.156	1.557	1.343	0.993	7.589
Min	49.000	2.100	4.000	5.000	19.000
Max	210.00	7.000	8.400	9.400	30.000

*F critical at total 39 *df* is 2.313, 3.258 and 4.718 at P<0.05, 0.01 and 0.001 respectively.

NS: Non-significant, *** Highly significant (0.001)

Table 2: The effect of sex (P-value) and Duncan's new multiple range test (Mean ±SE) showing the effect of age on plasma T₃ (ng/dl) in desert goats.

T3	<6Month	6-12Month	1-2Year	>2Year
Male	158.00 ^a ±16.75	120.80 ^a ±7.33	97.60 ^b ±6.10	94.20 ^b ±4.62
Female	144.20 ^a ±21.53	118.60 ^a ±15.50	72.40 ^b ±8.42	71.40 ^b ±7.49
P-value	0.627 ^{NS}	0.902 ^{NS}	0.046 *	0.036 *

Values in the same row with unlike superscripts letters a,b are significantly differing at P<0.05.

Table 3: The effect of sex (P-value) and Duncan's new multiple range test (Mean \pm SE) showing the effect of age on plasma T₄ (μ g/dl) in desert goats.

T4	<6Month	6-12Month	1-2Year	>2Year
Male	5.220 ^a \pm 0.573	4.600 ^a \pm 0.678	5.660 ^a \pm 0.394	5.260 ^a \pm 0.357
Female	4.820 ^a \pm 0.665	4.240 ^a \pm 0.564	4.020 ^a \pm 0.557	3.800 ^a \pm 0.374
P-value	0.661 ^{NS}	0.694 ^{NS}	0.043 *	0.022 *

Values are not differing significantly according to age category.

Table 4: The effect of sex (P-value) and Duncan's new multiple range test (Mean \pm SE) showing the effect of age on RBC count ($\times 10^6$ / μ l) in desert goats.

RBC	<6Month	6-12Month	1-2Year	>2Year
Male	5.520 ^a \pm 0.203	6.320 ^{ab} \pm 0.252	7.940 ^b \pm 0.068	7.800 ^b \pm 0.259
Female	5.320 ^a \pm 0.235	6.100 ^b \pm 0.714	6.900 ^c \pm 0.445	6.980 ^c \pm 0.169
P-value	0.538 ^{NS}	0.779 ^{NS}	0.049 *	0.029 *

Values in the same row with unlike superscripts letters a,b,c are significantly differing at P<0.05.

Table 5: The effect of sex (P-value) and Duncan's new multiple range test (Mean \pm SE) showing the effect of age on haemoglobin (g/dl) in desert goats.

Hb	<6Month	6-12Month	1-2Year	>2Year
Male	6.54 ^a \pm 0.250	7.64 ^b \pm 0.209	8.44 ^c \pm 0.201	8.68 ^c \pm 0.260
Female	6.32 ^a \pm 0.545	6.66 ^a \pm 0.121	7.66 ^b \pm 0.150	7.84 ^b \pm 0.157
P-value	0.723 ^{NS}	0.004 **	0.015 *	0.024 *

Values in the same row with unlike superscripts letters a,b,c are significantly differing at P<0.05.

Table 6: The effect of sex (P-value) and Duncan's new multiple range test (Mean \pm SE) showing the effect of age on PCV (%) in desert goats.

PCV	<6Month	6-12Month	1-2Year	>2Year
Male	21.800 ^a \pm 0.800	26.000 ^b \pm 0.447	26.800 ^{bc} \pm 0.583	28.000 ^c \pm 0.707
Female	21.200 ^a \pm 0.860	23.200 ^{ab} \pm 1.068	24.400 ^b \pm 0.748	24.800 ^b \pm 0.860
P-value	0.623 ^{NS}	0.042 *	0.035 *	0.021 *

Values in the same row with unlike superscripts letters a,b,c are significantly differing at P<0.05.

Table 7: Linear model ANOVA and Duncan's new multiple range test (Mean \pm SE) showing the effects of reproductive and productive status on blood plasma thyroid hormones and haematological values in desert goats.

	Non-pregnant	Pregnant	Lactating	F	P-value
T ₃ Ng/dl	72.400 ^a ± 8.424	99.200 ^b ± 7.172	77.200 ^a ± 6.094	3.910*	0.049
T ₄ Mg/dl	4.020 ^a ± 0.557	6.600 ^b ± 0.510	3.820 ^a ± 0.577	7.989**	0.006
RBC $\times 10^{-6}/\mu\text{l}$	6.900 ^a ± 0.445	5.400 ^b ± 0.311	6.440 ^a ± 0.271	4.806*	0.029
Hb g/dl	7.660 ^a ± 0.150	6.900 ^b ± 0.274	7.740 ^a ± 0.144	5.455*	0.021
PCV %	24.400 ^a ± 0.748	21.600 ^b ± 0.510	23.800 ^a ± 0.583	5.620*	0.019

F critical at 14 *df* = 3.885, 6.926 and 12.973 at *P* < 0.05 and 0.01 and 0.001 respectively

*Significant at *P* < 0.05, ** significant at *P* < 0.01.

Values in the same row with unlike superscripts letters a,b are significantly differing at *P* < 0.05.

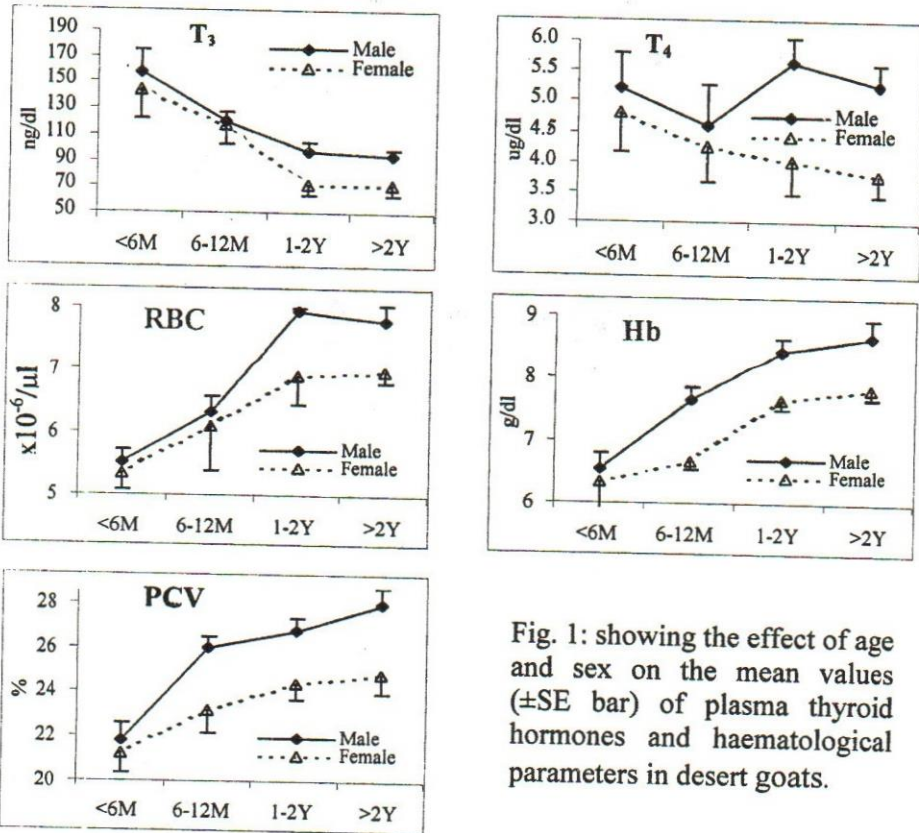


Fig. 1: showing the effect of age and sex on the mean values (\pm SE bar) of plasma thyroid hormones and haematological parameters in desert goats.

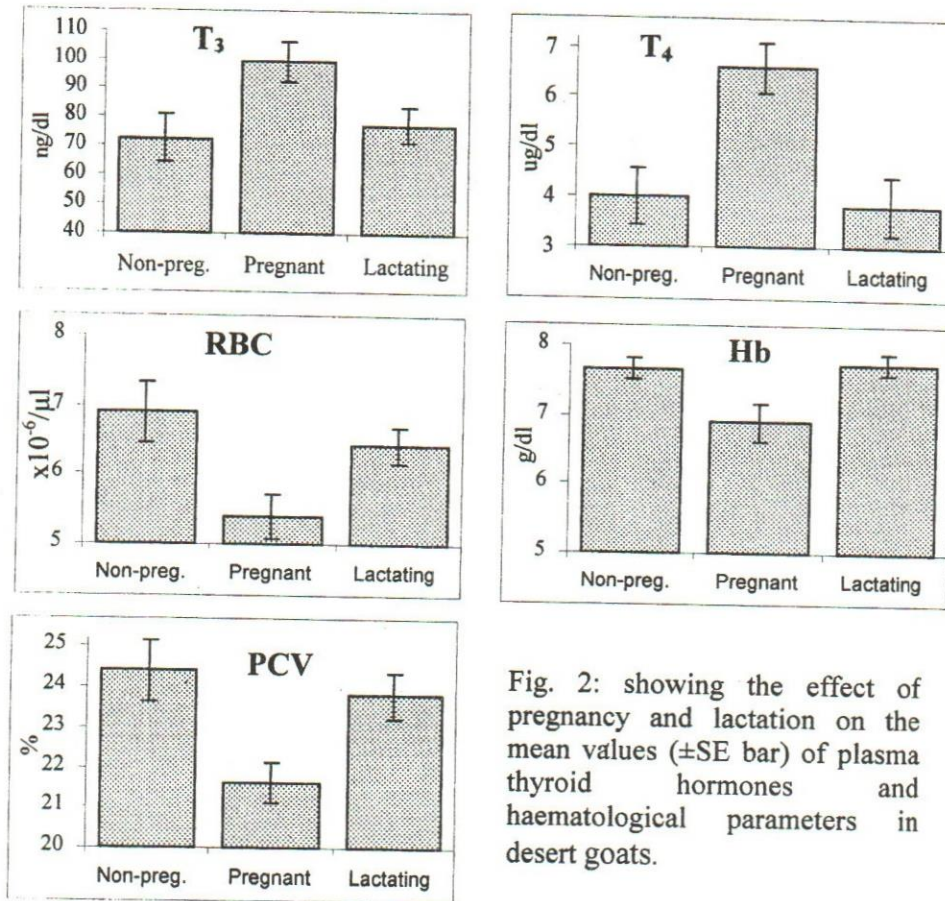


Fig. 2: showing the effect of pregnancy and lactation on the mean values (\pm SE bar) of plasma thyroid hormones and haematological parameters in desert goats.

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