

CIRCULATING CONCENTRATIONS OF THYROID HORMONES IN
PREGNANT CAMELS (Camelus dromedarius)

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Received for publication: *September 19, 1988*
Accepted: *April 4, 1989*

ABSTRACT

Blood samples from 16 female camels were collected at monthly intervals commencing from 60 d post breeding until the last month of gestation. Two camels failed to conceive and two had unnoticed abortions. The average gestation period was 398 ± 13 and 372 ± 11 in camels bearing male and female fetus, respectively, with an overall mean of 383 ± 9 d. Sera were analyzed for thyroxine (T_4) and triiodothyronine (T_3) by radioimmunoassay. Mean T_4 and T_3 concentrations varied from 76 to 116 ng/ml and 0.73 to 1.32 ng/ml, respectively, during various stages of gestation. In general, the T_4 and T_3 levels were higher during early pregnancy, with lowest values in the tenth month. $T_4:T_3$ ratio showed minor, nonsignificant fluctuations. Age of dam or sex of fetus had no effect on hormone levels. Similarly, hormone levels were not affected by failure of conception or by abortion.

Key words: camel, thyroxine, triiodothyronine, pregnancy

Acknowledgments: The authors gratefully acknowledge the Indian Council of Agricultural Research, New Delhi, for its financial support of this work. They are thankful to Sri P.C. Gupta, Technician, for his assistance.

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INTRODUCTION

Pregnancy in the adult female is a physiological phenomenon supported by the interaction of various hormones. Of these, progesterone is of prime significance, and thyroid hormones play an important role in modulating metabolic adjustments and cell division for the optimum growth and differentiation of vital organs. A deficiency of these hormones may lead to serious complications. Studies on thyroid hormones have been carried out in pregnant cows and buffalo (1,2), mares (3), goats (4,5) and sheep (6,7), but such investigations in camels are rare (8). This study reports the serum thyroid hormone levels of pregnant camels as affected by age of dam and sex of fetus.

MATERIALS AND METHODS

Single-humped camels (*Camelus dromedarius*) belonging to the National Research Center on Camels in Bikaner were used for this study. The animals at the farm were maintained under standard management conditions. In addition to stall feeding, they were allowed to go out from 0900 to 1600 h and were watered twice daily. All the experimental animals were clinically healthy and free from diseases. Female camels exhibiting estrus were mated to a fertile camel bull during its rutting season (November to February). Sixteen female camels suspected of being pregnant, as judged by the "cocking tail" response (raising of tail when approached), were selected randomly. Blood samples were collected at monthly intervals starting from 2 mo post mating until the last month of gestation. Serum was separated and stored at -15°C until analyzed for thyroxine (T_4) and triiodothyronine (T_3) using radioimmunoassay kits supplied by Bhabha Atomic Research Centre, Bombay. The protocol and critical evaluation of assays has been reported elsewhere (9). The data were classified according to stage of pregnancy, age of dams and sex of fetus, and they were then statistically analyzed by the method of analysis of variance according to Senedecor and Cochran (10).

RESULTS

Of the sixteen camels, two failed to conceive and two others had unnoticed abortions as confirmed by the levels of estrogens and progesterone (11) as well as by their failure to deliver a calf. Twelve camels carried pregnancy to term and each delivered a calf. Twelve camels carried pregnancy to term and each delivered a calf. Five camels gave birth to a male calf and seven to a female calf. No twinning was observed. The gestation period for the camels bearing male and female fetuses was 398 ± 13 and 372 ± 11 d, respectively, with an overall mean of 383 ± 9 d.

Table 1. Concentration of thyroid hormones in pregnant camels bearing male or female fetuses

Name of the hormones	Sex of fetus	No. of camels	Length of pregnancy (months)												Overall
			2-3	3-4	4-5	5-6	6-7	7-8	8-9	9-10	10-11	11-12	12-13		
T ₄ (ng/ml)	Male	5	112.9 ±8.7	111.3 ±10.8	100.5 ±7.2	104.3 ±1.8	96.8 ±2.6	88.0 ±5.8	75.2 ±6.2	79.8 ±6.8	81.6 ±1.9	78.0 ±4.2	64.0	92.9 ±2.6	
	Female	7	118.6 ±7.7	99.9 ±3.8	108.1 ±7.6	103.3 ±9.4	100.3 ±6.7	88.3 ±4.9	85.7 ±5.6	73.1 ±6.2	82.9 ±4.4	89.7 ±8.5	89.0 ±11.0	94.9 ±2.5	
	Overall	12	116.2 ^a ±5.6	104.6 ^a ±5.0	105.0 ^a ±5.3	103.7 ^a ±3.6	98.8 ^{ab} ±3.6	88.2 ^b ±4.2	81.3 ^b ±4.5	75.9 ^b ±4.5	82.3 ^b ±2.6	85.8 ^b ±5.9	80.7 ^b ±10.4	94.1 ±1.8	
T ₃ (ng/ml)	Male	5	1.10 ±0.10	1.12 ±0.08	1.09 ±0.10	1.42 ±0.17	1.22 ±0.14	1.07 ±0.12	0.78 ±0.10	0.78 ±0.08	1.04 ±0.05	1.20 ±0.15	0.90	1.07 ±0.04	
	Female	7	1.48 ±0.11	1.22 ±0.08	1.18 ±0.11	1.14 ±0.20	1.12 ±0.10	1.02 ±0.16	0.91 ±0.09	0.70 ±0.11	0.91 ±0.11	1.33 ±0.24	1.30 ±0.20	1.10 ±0.25	
	Overall	12	1.32 ^a ±0.09	1.18 ^a ±0.06	1.14 ^a ±0.07	1.26 ^a ±0.14	1.16 ^a ±0.10	1.04 ^{ab} ±0.10	0.85 ^b ±0.06	0.73 ^b ±0.07	0.96 ^b ±0.07	1.28 ^a ±0.16	1.17 ^a ±0.18	1.09 ±0.03	
T ₄ :T ₃ (ng/ml)	Male	5	114.0 ±8.6	112.4 ±10.8	101.6 ±7.2	105.7 ±1.7	98.0 ±2.5	89.0 ±5.8	75.9 ±5.7	80.5 ±6.8	82.6 ±1.9	79.2 ±4.3	64.9	93.9 ±2.6	
	Female	7	120.1 ±7.7	101.0 ±3.8	109.3 ±7.7	104.4 ±9.6	101.4 ±6.7	89.3 ±5.0	86.6 ±5.5	73.8 ±6.2	83.7 ±4.5	90.9 ±8.7	90.3 ±11.2	96.0 ±2.4	
	Overall	12	117.5 ^a ±5.6	105.8 ^a ±5.0	106.1 ^a ±5.3	104.9 ^a ±5.4	99.9 ^{ab} ±3.6	89.2 ^{ab} ±4.2	82.1 ^b ±4.5	76.6 ^b ±4.5	83.3 ^b ±2.6	87.1 ^{ab} ±6.0	115.6 ^a ±10.6	95.1 ±1.8	
T ₄ :T ₃	Male	5	108.5 ±18.7	101.2 ±11.1	94.6 ±9.4	77.5 ±8.7	85.2 ±10.8	84.5 ±6.4	101.2 ±12.9	105.7 ±11.5	79.6 ±5.6	66.5 ±6.0	71.1	91.0 ±3.6	
	Female	7	81.0 ±4.7	83.1 ±3.7	94.2 ±7.1	102.1 ±13.4	93.9 ±10.0	96.4 ±10.8	99.5 ±10.9	112.5 ±13.7	96.37 ±9.71	74.65 ±8.91	68.80 ±2.08	92.98 ±3.10	
	Overall	12	92.5 ^a ±8.7	90.6 ^a ±5.5	94.3 ^a ±5.4	91.9 ^a ±9.0	90.3 ^a ±7.1	91.5 ^a ±14.5	100.2 ^a ±8.9	109.7 ^a ±9.0	89.4 ^a ±6.4	71.9 ^a ±6.2	69.6 ^a ±1.4	92.1 ±2.6	

Means bearing similar superscripts do not vary significantly.

THERIOGENOLOGY

The thyroid hormone levels and their ratio in camels bearing male and female fetuses are summarized in Table 1. It is evident that T_4 and T_3 concentrations were significantly higher ($T_4=116.2\pm5.5$; $T_3=1.32\pm0.09$) at 2 mo pregnancy, declined gradually with advancing gestation until the tenth month, when the lowest means ($T_4=75.9\pm4.5$ ng/ml; $T_3=0.73\pm0.07$ ng/ml) were observed. This was followed by a nonsignificant rise towards the latter stages of gestation. Total thyroid hormones exhibited a similar trend as that of T_4 , but the $T_4:T_3$ ratio was almost constant upto 7 mo of pregnancy. It was slightly elevated at 8 to 10 mo of gestation, and it was low at the end of pregnancy. However, these fluctuations were not statistically significant.

All of these measures did not reveal any significant difference between camels bearing male or female fetuses (Table 1) or between camels of different age groups (Table 2). Hormone concentrations in camels that failed to conceive or that aborted, as revealed by the monitoring of progesterone (11), were in the same range as those found in pregnant camels (Table 3).

DISCUSSION

The average peripheral concentrations of T_4 and T_3 in pregnant camels was found to vary from 75.9 to 116.2 ng/ml and from 0.73 to 1.32 ng/ml, respectively. These values are similar to those reported for male camels (12). Varshney et al. (13) reported that thyroid activity was not different in male and female camels. Thyroid hormone levels were highest between 2 and 5 mo and lowest between 8 and 10 mo of gestation, followed by a mild elevation at the final stages of pregnancy. A fall in plasma T_4 concentration from early to late pregnancy in cows (1) and buffalo (2,14) and an increase in thyroid activity during the last stage of pregnancy in camels (15) also has been reported. Estrogens can alter the secretion rate and dynamics of thyroid hormones (16-18). It seems that fluctuations in thyroid activity might be due to interactions with varying concentrations of estrogens and progesterone during pregnancy (11,20). Since gestation length in the camel is about a year, climatic factors may also contribute to these fluctuations, as seasonal effects on plasma thyroid hormones in the camel has been documented (12,21). Further more, it is known (22,23) that the placenta is impermeable to thyroxine, and the maternal and fetal thyroxine pools are independent of each other. Thus it is unlikely that a change in the dam's thyroid status could be due to passage of thyroid hormones from either side. However, some thyrotrophic hormone-like activity in the camel placenta has been demonstrated during the second half of gestation (24). High levels of thyroid hormones due to increase in thyroid-binding globulin in the plasma of pregnant women (25,26) have not been substantiated in ovines and bovines (27,28). Thus, a change in the thyroid secretion rate or clearance rate from the plasma, or both, seem to be the most plausible explanation for fluctuations in thyroid hormone concentrations in pregnant camels.

Table 2. Effect of age on serum thyroid hormones in pregnant camels

Para-meter	Age group (years)	No. of camels	Length of pregnancy (months)										Overall	
			2-3	3-4	4-5	5-6	6-7	7-8	8-9	9-10	10-11	11-12		12-13
T ₄ (ng/ml)	Upto 5	2	111.0 ±21.0	95.0 ±5.0	103.5 ±1.7	111.0 ±4.0	98.0 ±4.0	76.0 ±12.0	77.0 ±7.0	80.0 ±10.0	88.0 ±8.0	78.0	92.47 ±3.82	
	5-10	4	108.6 ±5.4	106.0 ±4.8	100.9 ±9.0	105.4 ±1.8	100.81 ±4.5	92.0 ±7.8	85.0 ±4.0	79.5 ±5.7	82.5 ±2.2	76.7 ±3.3	94.2 ±2.4	
	More than 10	6	123.1 ±8.8	106.9 ±9.6	108.2 ±9.2	100.2 ±10.9	97.8 ±7.6	89.7 ±3.2	80.3 ±8.2	72.2 ±7.9	80.3 ±4.6	92.8 ±9.8	80.7 ±10.5	94.5 ±3.0
	upto 5	2	1.57 ±0.32	0.96 ±0.07	1.07 ±0.02	1.47 ±0.23	1.04 ±0.16	0.65 ±0.17	0.86 ±0.38	1.04 ±0.26	1.10 ±0.00	1.15	1.09 ±0.08	1.09 ±0.05
	5-10	4	1.14 ±0.07	1.26 ±0.09	1.18 ±0.12	1.50 ±0.19	1.19 ±0.06	1.15 ±0.13	0.92 ±0.05	0.66 ±0.08	0.90 ±0.11	1.03 ±0.19	1.47 ±0.26	1.09 ±0.05
	More than 10	6	1.36 ±0.14	1.20 ±0.09	1.14 ±0.13	1.02 ±0.21	1.18 ±0.16	1.09 ±0.16	0.81 ±0.08	0.68 ±0.08	0.96 ±0.11	1.47 ±0.26	1.17 ±0.18	1.09 ±0.05
T ₃ (ng/ml)	Upto 5	2	112.6 ±21.3	96.0 ±5.0	104.6 ±1.4	112.5 ±4.2	99.0 ±3.8	76.6 ±12.2	77.9 ±7.4	81.0 ±10.3	89.1 ±7.9	79.2	93.6 ±3.9	
	5-10	4	109.8 ±5.4	107.3 ±4.9	102.1 ±9.1	106.9 ±1.7	101.9 ±4.5	93.2 ±7.9	85.9 ±4.0	80.2 ±5.7	83.4 ±2.2	77.7 ±3.4	95.3 ±3.0	
	More than 10	6	124.4 ±8.8	108.1 ±9.6	109.3 ±9.3	101.2 ±11.1	99.0 ±7.7	90.8 ±3.3	81.1 ±8.2	72.8 ±8.0	81.3 ±4.7	94.3 ±10.0	95.6 ±3.0	
	Upto 5	2	70.8 ±1.3	98.9 ±1.3	96.4 ±3.6	76.6 ±9.0	97.1 ±18.8	120.3 ±13.0	106.5 ±39.3	79.5 ±10.2	80.0 ±7.3	67.8	90.5 ±5.2	
	5-10	4	95.8 ±4.6	85.3 ±5.5	88.0 ±12.6	74.0 ±10.1	86.6 ±6.0	81.0 ±5.2	93.9 ±8.5	126.9 ±20.9	95.9 ±12.6	79.2 ±13.2	90.9 ±3.7	
	More than 10	6	97.6 ±17.0	91.4 ±10.6	98.0 ±7.7	109.0 ±14.1	90.6 ±13.6	88.8 ±10.7	102.5 ±11.7	108.2 ±8.5	88.2 ±10.1	68.4 ±8.5	93.5 ±3.6	

Table 3. Serum thyroid hormones (ng/ml) in non-pregnant camels and those that have aborted

Camel brand no.	Para-meter	Months post coitus												Overall
		2-3	3-4	4-5	5-6	6-7	7-8	8-9	9-10	10-11	11-12	12-13		
661	T ₄	130.0	120.3		97.1		100.2	105.0	78.7	88.2	110.0	115.7	105.0	
	T ₃	1.80	1.10		1.25		0.66	0.78	0.64	1.80	2.90	3.9	1.65	
	T ₄ :T ₃	131.8	121.4		98.3		100.8	105.7	79.3	90.0	112.9	119.6	106.6	
	T ₄ :T ₃	72.2	109.1		77.6		151.5	134.6	121.6	148.9	37.9	29.5	87.2	
	T ₄	122.4		125.5		90.1	90.0	112.6	76.3	100.2	96.4	140.5	105.9	
697	T ₃	0.94		1.30		1.25	0.88	1.00	0.70	2.40	3.20	3.50	1.68	
	T ₄ :T ₃	123.3		126.8		91.3	90.8	113.6	77.0	102.6	99.6	144.0	107.6	
	T ₄ :T ₃	129.8		96.1		72.0	102.2	112.0	108.6	41.7	30.0	40.0	81.38	
	T ₄	117.4	105.0	122.5	68.8	78.6	100.4	115.6			105.7		101.7	
	T ₃	1.40	0.96	0.88	0.82	2.10	3.20	4.00			1.15		1.81	
583	T ₄ :T ₃	118.8	105.9	123.3	69.6	80.7	103.6	119.6			106.8		103.5	
	T ₄ :T ₃	83.6	109.4	138.6	82.9	37.10	31.20	28.75			91.3		75.36	
	T ₄	117.2			120.4	73.0	105.6	100.0	105.6		110.0		104.6	
	T ₃	1.25			1.20	0.78	1.00	2.90	4.00		4.00		2.16	
	T ₄ :T ₃	118.4			121.6	73.7	106.6	102.9	109.6		114.0		106.7	
596	T ₄ :T ₃	93.6			100.0	93.6	105.0	34.5	26.2		27.50		68.63	

Arrow indicates abortion.

The observation that plasma thyroid hormone levels are not influenced by age is consistent with the findings of other workers (12,13). However, Dixit et al. (29) have reported a decrease in Protein Bound Iodine (PBI) levels of camels with age. Lack of influence of the fetal sex on the thyroid status of the dam confirms findings in goats (5). Absence of any significant change in thyroid hormones of nonpregnant camels or those that have aborted confirms that the fetal load does not alter the thyroid status of the animal to diagnostic levels. The results of our study suggest that plasma thyroid hormones in the camel are suppressed during mid pregnancy and are not influenced by the age of the dam or the sex of fetus.

REFERENCES

1. Shoda, Y. and Ishii, T. Effect of season, pregnancy and lactation on serum thyroxine levels in dairy cattle. *Japanese J. Zootech. Sci.* 47:659-664 (1976).
2. Khurana, M.L. and Madan, M.L. Effect of stage of pregnancy on circulating thyroidal hormones among Karan-Swiss and Murrah animals. *Indian J. Dairy Sci.* 34:128-132 (1986).
3. Katovich, M., Evans, J.W. and Sanchez, O. Effect of season, pregnancy and lactation on thyroxine turnover in mares. *J. Anim. Sci.* 38:811-818 (1974).
4. Varshney, V.P., Pande, J.K. and Sanwal, P.C. Studies on thyroid activity and sexual maturity in male and female black Bengal goats. *J. of Nucl. Agric. Biol.* 9:161-162 (1980).
5. Agarwal, V.K., Agarwal, S.P., Kanoujia, A.S., Balain, D.S. and Dwaraknath, P.K. Thyroid hormones in pregnant goats as related to litter size and fetal sex. *J. of Nucl. Agri. Biol.* 14:29-31 (1985).
6. Annison, E.F. and Lewis, D. Thyroid metabolism in sheep during pregnancy. *J. Agric. Sci.* 52:79-86 (1959).
7. Robertson, H.A. and Falconer, I.R. Reproduction and thyroid activity. *J. Endocrinol.* 22:133-142 (1961).
8. Heshmat, H.A., Taha, A., Ismail, A.A. and Sami, M.B.A. Levels of thyroid hormones in the plasma of pregnant camel (*Camelus dromedarius*). *Indian J. Anim. Sci.* 54:663-665 (1984).
9. Agarwal, V.K., Agarwal, S.P., Dixit, N.K., Singh, N. and Dwaraknath, P.K. A 24-hour temporal variation in peripheral levels of testosterone and thyroid hormones in male buffaloes. *Theriogenology* 20:37-45 (1983).
10. Snedecor, G.W. and Cochran, W.G. *Statistical Methods*. Oxford and IBH Publishing Co., New Delhi, 1968.
11. Agarwal, S.P., Khanna, N.D., Agarwal, V.K. and Dwaraknath, P.K. Circulating levels of estrogen and progesterone in female camels (*Camelus dromedarius*) during pregnancy. *Theriogenology* 28:849-859 (1987).

THERIOGENOLOGY

12. Agarwal, S.P., Khanna, N.D., Agarwal, V.K. and Dwaraknath, P.K. Thyroidal status of male camels during breeding and non-breeding season. *Indian J. Anim. Sci.* 56:1036-1038 (1986)
13. Varshney, V.P., Khanna, N.D., Pande, J.K. and Tandon, S.N. Studies on the status of thyroid activity in the arid zone in India. *J. Vet. Physiol. Allied Sci.* 3:52-54 (1984).
14. Pichaicharnarong, A., Loypetjra, P., Chaiyabutr, N., Usanakornkul, S. and Djurdjevic, D.J. Thyroid activities of non-pregnant, pregnant, post-partum and new born swamp buffaloes. *J. Agri. Sci.* 98:483-486 (1982).
15. Abdo, M.S., Al-Kafawi, A.A. and Al-Gawbi, A.S. Thyroid function of female camels during the various phases of reproductive cycle and in cases of cystic ovaries. *Vet. Med. J. Giza.* 16:183-190 (1969).
16. Boccabella, A.V. and Alger, E.A. Influence of estradiol on thyroid: serum radioiodide concentration of gonadectomised and hypophysectomised rats. *Endocrinology* 74:680-688 (1964).
17. Yamada, T., Takemura, Y., Kobayashi, I. and Shichijo, K. Reevaluation of the effect of estrogen on thyroid activity in the rat and its mechanism. *Endocrinology* 79:849-857 (1966).
18. Chen, H.J. and Walfish, P.G. Effect of estradiol benzoate on thyroid-pituitary function in female rats. *Endocrinology* 103:1023-1030 (1978).
19. Elias, E., Bedrak, E. and Yagil, R. Peripheral blood levels of progesterone in female camels during various reproductive stages. *Gen. Comp. Endocr.* 53:235-240 (1984).
20. Elias, E., Bedrak, E. and Yagil, R. Estradiol concentration in the serum of the one-humped camel (Camelus dromedarius) during the various reproductive stages. *Gen. and Comp. Endocr.* 56:258-264 (1984).
21. Yagil, R., Etzion, Z. and Ganani, J. Camel thyroid metabolism: effect of season and dehydration. *J. Appl. Physiol.* 45:540-544 (1978).
22. Dussault, J.H., Hobel, C.J. and Fisher, D.A. Maternal fetal thyroxine secretion during pregnancy in the sheep. *Endocrinology* 88:47-51 (1971).
23. Nathanielsz, P.W., Comline, R.S., Silver, M. and Thomas, A.L. Thyroid function in the fetal lamb during the last third of gestation. *J. Endocrinol.* 58:535-546 (1973).
24. Abdou, M.S.S., Elwishy, A.B., Abdo, M.S. and Elswaf, S.A. Hormonal activities of the placenta of the one-humped camel (Camelus dromedarius) Part I. Gonadotrophic, adrenocorticotrophic and thyrotrophic hormones. *J. Anim. Morph. Physiol.* 18:11-16 (1971).

25. Dowling, J.T., Freinkel, N. and Ingbar, S.H. Thyroxine binding by sera of pregnant women, new born infants and women with spontaneous abortion. *J. Clin. Invest.* 35: 1263 (1956).
26. Guillaume, J., Schussler, G.C. and Goldman, J. components of the total serum thyroid hormone concentrations during pregnancy. High free thyroxine and blunted thyrotropin (TSH) response to TSH-releasing hormone in the first trimester. *J. Clin. Endocrinol. Metab.* 60:678-684 (1985).
27. Annison, E.F. Thyroxine binding in sheep serum. *Aust. J. Agri. Res.* 11:539-547 (1960).
28. Blincoe, C. and Weeth, H.J. serum binding of radiothyroxine in sheep and cattle. *J. Anim. Sci.* 26:372-373 (1967).
29. Dixit, V.P., Agarwal, V.K. and Nangia, O.P. Plasma protein bound iodine levels in the camel. *J. Endocrinol.* 48:463-464 (1970).