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SERUM BIOCHEMICAL CHANGES ASSOCIATED WITH EXPERIMENTALLY-INDUCED HYPOTHYROIDISM IN ONE- HUMPED CAMELS (*Camelus dromedarius*)

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ABSTRACT

A state of hypothyroidism was induced in camels by the repeated daily intramuscular injection of sodium thiocyanate (3 mg kg^{-1} Body weight) for 3 consecutive months. Serum biochemical parameters and blood glucose were studied. The means and standard deviations of total protein: 6.46±0.42, 5.98±0.57 and 5.62±0.48 g/dl; albumin: 2.68±0.21, 2.26±0.30 and 2.30±0.11 g/dl; globulins: 3.79±0.53, 3.73±0.47 and 3.34±0.44 g/dl; inorganic phosphorus: 6.14±1.03, 5.98±0.69 and 4.60±0.77 mg/dl; cholesterol: 71.04±7.91, 72.57±22.39 and 73.57±5.55 mg/dl; triacylglycerols: 49.41±7.59, 58.62±14.6 and 51.04±11.61 mg/dl; glucose: 88.65±8.59, 101.43±16.74 and 101.39±9.67 mg/dl; alkaline phosphatase activity: 27.61±2.8, 36.30±6.52 and 25.95±4.2 IU/L; creatinine: 1.93±0.24, 1.88±0.26 and 1.86±0.17 g/dl for the 1^{st}, 2^{nd} and 3^{rd} months, respectively. The results showed significant ($p<0.01$) reduction in serum total protein, albumin, globulin, inorganic phosphorus concentrations and significant ($p<0.01$) increase in serum cholesterol concentration, alkaline phosphatase activity and blood glucose levels throughout the course of the experiment. No significant change was observed in creatinine level.

Key words: Biochemical changes, dromedary, hypothyroidism

Among the many goitrogenic xenobiotics that increase the incidence of thyroid tumours and exert a direct effect on the thyroid gland to disrupt one of the several steps in the biosynthesis and secretion of thyroid hormones are thiocyanate and perchlorate through inhibition of the iodine-trapping mechanism (Capen, 1994).

Thiocyanate has a profound effect on iodide uptake by the thyroid. It prevents accumulation and uptake of iodine by thyroid gland (Abdel Rahman, 1987) by acting either as a potent competitor of iodine at entry into the thyroid cells or as an inhibitor of thyroid hormones synthesis through increased urinary losses of iodine (Bourdoux *et al,* 1978). It is capable of inducing iodide deficiency within the gland, in presence or absence of adequate iodide intake, sensitising it to goitrogens and inhibiting iodide organification (Lindsay *et al,* 1992). It also binds serum albumin and displaces thyroxine and so helps its degradation and excretion (Ermans *et al,* 1973).

Hypothyroid patients have a decreased ability to utilise glucose and less sensitive to insulin (Murray *et al*, 1999). Thyroxine stimulates cholesterol synthesis and its removal from circulation by liver. As hypercholesterolaemia is usually seen in a half to a third of hypothyroid cases, cholesterol level in the serum is considered a useful diagnostic aid in man and animal (Benjamin, 1978 and Kaneko, 1980). Ibrahim *et al* (1984) stated that carbimazole-induced hypothyroidism in goats resulted in increased triacylglycerols production by the liver. Serum proteins, particularly albumin and globulins play important roles in binding and transport of thyroid hormones, i.e. Thyroxine Binding Prealbumin (TBPA) and Thyroxine Binding Globulin (TBG). Thyroid hormones enhance general protein synthesis and cause positive nitrogen balance by binding to target gene receptors and regulating the rate of specific mRNA synthesis. Hence, imbalances in these hormones may affect serum protein levels.

The aim of this study is to investigate the biochemical changes in thiocyanate-induced hypothyroid dromedary camels.

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Materials and Methods

Experimental design

Four healthy adult female camels (*Camelus dromedarius*) aged 4-6 years were selected for the study. The weights of the animals ranged between 350 and 398 kg. They were housed in one large pen and were fed on sorghum hey and watered *ad libitum*.

The camels were given daily injection of N/10 (580 mg/100 ml) sodium thiocyanate solution (sodium sulphocyanide, Hopkin & Williams, Essex, England), at a dose rate of 3 mg kg^{-1} Body weight, intramuscularly for 3 consecutive months. About 10 ml of blood was collected every 3 days at 8-10 am by jugular vene-puncture into plain vacutainers, allowed to clot and the sera were separated by centrifugation at 3000 rpm for five minutes and stored at -20^{o}C until analysed.

Samples of whole blood were collected from animal by jugular vein puncture in clean dry vacutainer tubes containing sodium fluoride, centrifugation at 3000 rpm for 5 minutes within 30 minutes of collection. The plasma was separated and used for blood glucose estimation.

The concentrations of serum constituents were determined by chemical methods using commercial kits (Randox Laboratories Ltd., UK) in a spectrophotometer (Jenway 6105 U. V./Vis, Jenway Ltd, Felsted, Dunmow, Essex CM63LB UK).

Serum total protein expressed in g/dl was measured by biuret reaction according to King and Wooton (1967). The absorbance was read at a wavelength of 546 nm in the spectrophotometer. Serum albumin expressed in g/dl was determined according to Bartholomew and Delany (1966). The absorbance was read at a wavelength of 630 nm. Serum globulins was obtained by subtracting the concentration of albumin from that of total protein. Serum creatinine expressed in mg/dl was determined as described by Henry (1974). The absorbance was read at a wavelength of 490 nm. Serum alkaline phosphatase activity expressed in IU/L was determined according to Bowers and McComb (1975). The absorbance was read at a wavelength of 405 nm in the spectrophotometer.

Serum inorganic phosphorus expressed in mg/dl was measured by the method used by Varley (1967). The absorbance was read at a wavelength of 405 nm. Serum cholesterol expressed in mg/dl was measured according to Thomas (1992). The absorbance was read at a wavelength of 546 nm. Blood glucose expressed in mg/dl was determined according to Barham and Tinder (1972). The absorbance was read at a wavelength of 500 nm. The triacylglycerols were enzymatically hydrolysed to glycerols and determined according to Fossati (1982). The absorbance was read at wavelength 546 nm. The thiocyanate concentration expressed in mg/dl was determined by colorimetric method according to Varley (1967). The absorbance was read in the spectrophotometer (Pye Unicum SP6 200) at a wavelength 602 nm.

The results of serum biochemical investigation were statistically analysed according to Gomez and Gomez (1984). The mean values of each parameter during 2nd and 3rd months were compared with the respective mean value during first month.

Results and Discussion

The findings showed that there were significant ($P<0.05$) differences between the means of serum thiocyanate concentration values of the three months. The mean of the third month (5.30±2.47 mg/dl) being significantly higher than that of both the first and the second months (2.92±0.32 and 3.81±1.23 mg/dl, respectively). The last was also significantly higher than that of the first month (Table 1).

The serum total protein, albumin and globulin concentrations were significantly ($P<0.01$) lower throughout the course of the experiment. Although the means of the values for the 1st, 2nd and 3rd months, (6.46±0.42, 5.98±0.57 and 5.62±0.48 g/dl) for serum total protein, 2.68±0.21, 2.26±0.30 and 2.30±0.11 g/dl for serum albumin and 3.79±0.53, 3.73±0.47 and 3.34±0.44 g/dl for globulins, were non-significantly different and all values were lower than the findings recorded by Idris and Tartour (1977), Abdel Gadir *et al* (1984) and Abu Damir *et al* (1990) in normal camels suggesting that this state of reduced serum total hypoproteinaemia, hypoalbuminaemia and hypoglobulinaemia is attributed to low levels of circulating T_4 and T_3 produced by administration of NaSCN. This agrees with Murray *et al* (1999) who stated that the major effect of T_3 and T_4 is to enhance general protein synthesis and cause a positive nitrogen balance.

The serum creatinine concentration was significantly ($p<0.01$) affected with time. The means of the values were 1.93±0.24, 1.88±0.26 and 1.86±0.17 g/dl for the 1st, 2nd and 3rd months, respectively. Although there was a non-significant difference

Table 1. Changes in serum biochemical constituents of sodium thiocyanate-induced hypothyroid camels (*means±SD., ±SE. and range in parenthesis*).

Month	1st month	2nd month	3rd month	±SE.
Thiocyanate (*mg/dl*)	2.92^{c}±0.32 (2.2-3.4)	3.81^{b}±1.23 (1.8-4.6)	5.30^{a}±2.47 (2.4-10.1)	±0.27
Total protein (*g/dl*)	6.46^{a*}±0.42 (5.9-7.1)	5.98^{a}±0.57 (5.1-6.8)	5.62^{a}±0.48 (4.5-6.1)	±0.26
Albumin (*g/dl*)	2.68^{a}±0.21 (2.3-3.1)	2.26^{a}±0.30 (1.9-3)	2.30^{a}±0.11 (2.2-2.5)	±0.17
Globulin (*g/dl*)	3.79^{a}±0.53 (3-4.5)	3.73^{a}±0.47 (3-4.4)	3.34^{a}±0.44 (2.3-3.9)	±0.16
Creatinine (*g/dl*)	1.93^{a}±0.24 (1.6-2.4)	1.88^{a}±0.26 (1.6-2.4)	1.86^{a}±0.17 (1.6-2.1)	±0.20
ALP activity (*IU/L*)	27.61^{b}±2.8 (23.7-32.4)	36.30^{a}±6.52 (28.1-48)	25.95^{b}±4.2 (22-34.3)	±0.93
I. phosphorus (*mg/dl*)	6.14^{a}±1.03 (4.3-7.6)	5.98^{a}±0.69 (4.5-6.8)	4.60^{b}±0.77 (3.2-6)	±0.08
Cholesterol (*mg/dl*)	71.04^{a}±7.91 (57.6-78.6)	72.57^{a}±22.39 (43.8-104.7)	73.57^{a}±5.55 (66.8-80.2)	±19.72
Triacylglycerols (*mg/dl*)	49.41^{b}±7.59 (41.5-60.2)	58.62^{a}±14.6 (39.4-76.4)	51.04^{b}±11.61 (39.4-65.1)	±1.98
Glucose (*mg/dl*)	88.65^{b}±8.59 (76.4-99.5)	101.43^{a}±16.74 (83.2-140.1)	101.39^{a}±9.67 (84.1-112.7)	±1.07

* Means on the same row having similar superscripts are not significantly different at $p \leq 0.05$

between them, the means of the second and third months were slightly higher than that of the first one. The values were similar to the findings in normal camels reported by Abdel Gadir *et al* (1984).

The serum inorganic phosphorus level was significantly (p<0.01) lower during the thiocyanate treatment. Comparison of the mean values of serum inorganic phosphorus level for the 3 months (6.14±1.03, 5.98±0.69 and 4.60±0.77 mg/dl) showed that there was a non-significant difference between the mean of values of the first and second months and they were comparable with the values of both normal and goitrous camels reported by Abu Damir (1990) but somewhat higher than the values of normal camels recorded by Wahbi *et al* (1984). The mean value from the third month was significantly (p>0.05) lower than those from the first two months, and lower than those reported by Wahbi *et al* (1984) and Abu Damir *et al* (1990) in both normal and clinically goitrous camels. The decreased serum inorganic phosphorus level is attributed to the hypothyroid state induced by thiocyanate which support the findings of McCaffrey and Quamme (1984) who observed a state of hypophosphataemia in ^{131}I-sodium radioiodide-induced hypothyroid rats. This was explained by increase in urinary excretion of phosphate due to tubular leakage.

Measurement of serum cholesterol concentration showed a significant (p<0.01) increase with time throughout the experiment. The results showed that there were non-significant differences between the means of values of the three months (71.04±7.91, 72.57±22.39 and 73.57±5.55 mg/dl, respectively), but there was a pronounced tendency to increase with time suggesting that a degree of hypercholesterolaemia had occurred. The findings in this study were higher than the reports of Abdel Gadir *et al* (1984); Wasfi *et al* (1987) and Abu Damir *et al* (1990). This result agree with the findings of Ibrahim *et al* (1984) who reported significantly increased liver cholesterol levels in carbimazole-induced hypothyroidism in goats. As half to third of hypothyroid cases in human manifested hypercholesterolaemia, cholesterol level in the serum is considered a useful diagnostic aid in man and animals (Benjamin, 1978 and Kaneko, 1980).

The serum triacylglycerol concentration was significantly (p<0.01) increased with time. The means of the values for the three months were 49.41±7.59, 58.62±14.6 and 51.04±11.61 mg/dl for the 1st, 2nd and 3rd months, respectively. It was found that there was a non-significant difference between the means of the first and third months but both were significantly (p<0.05) lower than that of the second month. The values were found to be higher than the results of Wasfi *et al* (1987). The findings agree with the results of Ibrahim *et al* (1984) who reported that carbimazole-induced hypothyroidism in goats increased serum triacylglycerols. The hypertriacylglycerolaemia might have resulted from increased output of triacylglycerols by the liver as a consequence of an increased triacylglycerol synthesis and/or of a decreased oxidation of fatty acids.

Blood glucose level was significantly (p<0.01) increased throughout the course of the experiment. Comparison of the mean values of blood glucose level of the three months which were 88.65±8.59, 101.43±16.74 and 101.39±9.67 mg/dl, respectively, revealed a significant (p<0.05) elevation in the means of both the second and third months. This suggests that a degree of hyperglycaemia might have started to occur. This supports the report of Yagil (1985) who concluded that the decrease in the thyroid activity in camel was accompanied by a reduction in insulin secretion resulting in hyperglycaemia. The values of camel's normal blood glucose level, reported by several workers varied greatly. Barakat and Abdel Fattah, (1970) reported the range 80-140 mg/dl, Abdel Gadir *et al* (1984) found the level being 50±8.2 mg/dl (mean±SD) and Elbagir, (1992) reported 106±3.0 mg/dl as the normal level of glucose in plasma of camels.

The serum alkaline phosphatase activity was significantly (p<0.01) elevated during the thiocyanate treatment. Regarding the means of the values of serum alkaline phosphatase activity for the three months (27.61±2.8, 36.30±6.52 and 25.95±4.2 IU/L, respectively), it was found that there was a non-significant difference between the mean of the first and third months, but both were significantly (p<0.05) lower than the mean of the second month. Kramer (1980) stated that hypothyroidism is one of the conditions that increase serum alkaline phosphatase activity.

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^{99m}Tc-Ciprofloxacin in imaging of clinical infections in camelids and a goat

^{99m}Tc-Ciprofloxacin was used to image five adult camelids and a juvenile goat with clinical and /or radiographic signs of infection. ^{99m}Tc-Ciprofloxacin (range 10-33 MBq/Kg) was injected intravenously and a series of 2 min static images were acquired at 1- and 4-h post injection. At 24-h postinjection, 5-min static images were acquired. Only the skull or abdomen was imaged in the adults; the whole body was imaged in the goat. The quality of the 1-, 4- and 24-h studies was evaluated subjectively. Normal and abnormal areas of ^{99m}Tc-Ciprofloxacin uptake were recorded and subjectively graded as mild, moderate and intense. Image quality was best 4-h postinjection. Twenty four hour images were poor because of insufficient radioactivity. ^{99m}Tc-Ciprofloxacin imaging resulted in true positive or true negative scans in four of six animals. Two false negative studies occurred. Intense ^{99m}Tc-Ciprofloxacin activity was seen in the lungs and urinary bladder, moderate/intense activity in the kidneys, and mild actrivity in the physes/epiphyses, liver and internmittently in the gastrointestinal tract. The normal distribution of ^{99m}Tc-Ciprofloxacin in camelids/small ruminants differed from people. Further studies to determine the sensitivity and specificity of infection detection using ^{99m}Tc-Ciprofloxacin in animals are warranted.

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