

PRELIMINARY REPORT ON SOME PHYSIOLOGICAL PARAMETERS IN PREGNANT SHE CAMEL (*Camelus dromedarius*) IN NORTH AMERICA

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ABSTRACT

A study was carried out to determine the haematological, serum biochemical enzymes and hormonal values in clinically normal 9 pregnant she camels (*Camelus dromedarius*) aged 8 to 16 years. The mean values of various serum enzymes viz. sorbitol dehydrogenase, aspartate aminotransferase, alkaline phosphatase and gamma glutamyltransferase in IU/L were 2.30 ± 0.90 , 71.00 ± 3.0 , 57.0 ± 16.5 and 20.0 ± 2.9 , respectively. The serum levels of various hormones viz. progesterone, cortisol, insulin, tri-iodothyronine and thyroxine were 3.5 ± 1.5 ng/ml, 20.0 ± 5.4 ng/ml, 3.8 ± 1.2 µl/ml, 16.0 ± 3.6 ng/ml and 129.0 ± 16.0 ng/ml, respectively.

Key words: Alkaline phosphatase, aspartate aminotransferase, cortisol, gamma glutamyltransferase, insulin, pregnant she camel, progesterone, sorbitol dehydrogenase, thyroxine, tri-iodothyronine

Although many studies have been conducted to establish normal haematological, serum biochemical and endocrinological parameters in normal camels, these studies are often incomplete and scattered over many years and in different geographical location in the world (Abdalla *et al*, 1988; Bengoumi *et al*, 1997; Ghodasian *et al*, 1978; Haroun, 1994; Kataria and Bhatia, 1991; Mills and Valli, 1988; Mohamed and Hussein, 1999 and Nazifi and Maleki, 1998). To our knowledge, there are no reports of normal physiological parameters in pregnant she-camels in North America. Therefore, normal haematological, serum biochemical and certain hormonal values in clinically normal pregnant camels were determined.

Materials and Methods

Animals : Nine (8-16 years), clinically healthy, pregnant she-camels (*Camelus dromedarius*) raised on a farm in northeastern Indiana were included in the study. The animals were kept on pasture with a shaded area available and fed alfalfa/

grass hay mixture and a grain supplement twice a day. The camels were on a regular anthelmintic programme every 3 months. Animals were in the second or third trimester of pregnancy based on the actual breeding dates.

Analyses : Blood samples were aseptically collected from the external jugular vein for haematological and serum biochemical and hormonal analyses. Haematological parameters included red blood cell (RBC) count, packed cell volume (PCV), haemoglobin (Hb), mean corpuscular volume (MCV) and total white blood cell (WBC) count which were analysed using the CELL-DYN 3500 haematology analyser (Abbott Diagnostics, Santa Clara, California, 95054, USA). The mean corpuscular haemoglobin concentration (MCHC) was then calculated according to Mills and Valli formula (Bengoumi *et al*, 1997). The differential white blood cell (WBC) count was determined manually using Giemsa stain.

Serum biochemical parameters included glucose, urea nitrogen, creatinine, phosphorus,

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calcium, sodium, potassium, chloride, carbon dioxide, magnesium, triglycerides, cholesterol, sorbitol dehydrogenase (SDH), aspartate aminotransferase (AST), alkaline phosphatase (ALP) and gamma glutamyltransferase (GGT) and their concentrations were measured using a Vitros-System 750 XRC (Johnson and Johnson, USA) based on spectrophotometric principles (Pinus *et al*, 1996). Total serum protein was measured using the biuret method and the various protein fractions were determined using electrophoresis. The albumin/globulin ratio was calculated. Plasma concentrations of fibrinogen were measured using heat precipitation method (McPherson, 1996).

Serum levels of progesterone, cortisol, insulin, thyroxine (T₄) and tri-iodothyronine (T₃) were measured using Immulite (DPC Cirrus Inc., USA) based on radioimmunoassay (RIA) principles (Henry *et al*, 1996).

Results and Discussion

Haematology

The mean values of haematological parameters are presented in table 1. The mean values for RBC and Hb were in agreement with those reported by Al-Ali *et al* (1988) and Alhadrami (1997) for adult dromedaries racing camels and calves and slightly higher but within the range of those reported by Mohamed *et al* (1999). The difference in mean values could be due to age, sex, nutritional status and variations in physical and geographical conditions. The MCV and MCHC values were in agreement with previous reported by Alhadrami (1997) and Mohamed *et al* (1999). Investigations have found that haemato-logical parameters in normal camels do not significantly differ between males and females (Abdalla *et al*, 1988). The values for total WBC count were similar to the values obtained by Alhadrami (1997) and Mohamed *et al* (1999) and higher than those reported by Higgins and Kock (1984). The values for segmented neutrophils, lymphocytes, monocytes and eosinophils were slightly higher than those given by Higgins and Kock (1984). Haematological values are comparable with those reported in llamas (Weiser *et al*, 1992) and cattle (Carlson, 1996). The results of this study showed that camelids have higher neutrophil and lymphocyte counts than cattle

Table 1. Haematological values in normal pregnant she-camel in North America (n = 9).

Parameters	Mean ± SD	Range
Red blood cells (R BC 10 ⁶ /μl)	13.23 ± 1.07	12.0 - 13.8
Packed cell volume (PCV%)	36.61 ± 4.38	29.60 - 42.30
Haemoglobin (Hb g/dl)	15.54 ± 1.82	12.70 - 17.70
Mean corpuscular volume (MCV fl)	32.58 ± 2.40	28.60 - 35.20
Mean corpuscular haemoglobin concentration (MCHC g/dl)	42.51 ± 0.96	41.20 - 44.20
Total white blood cells (WBC 10 ³ /μl)	13.36 ± 4.19	7.69 - 20.90
Segmented neutrophils (10 ³ /μl)	9.25 ± 4.86	4.60 - 17.56
Band neutrophils (10 ³ /μl)	0.02 ± 0.05	0.0 - 0.16
Lymphocytes (10 ³ /μl)	2.60 ± 1.21	1.15 - 4.46
Monocytes (10 ³ /μl)	0.37 ± 0.27	0.0 - 0.92
Eosinophils (10 ³ /μl)	1.13 ± 0.60.	0.21 - 2.36

(Carlson, 1996 and Weiser *et al*, 1992). There is no reported value for band neutrophils in camels in the literature. In this study band neutrophils count was comparable to those reported for New World camelids (Fowler and Zinki, 1989 and Fowler, 1998) and other ruminants (Carlson, 1996). Plasma fibrinogen concentrations in this study are comparable to the values in normal adult dromedaries camels and adult llamas reported by Higgins and Kock (1984) and Fowler and Zinki (1989), respectively.

Serum biochemistry

Mean values of serum urea nitrogen (SUN), creatinine, total serum protein, albumin, globulin, albumin/globulin ratio and total bilirubin in normal North American pregnant she-camels are reported in table 2. SUN value in this report is higher than those given by Abdalla *et al* (1988); Bengoumi *et al* (1997) and Mohamed and Hussein (1999). Abdalla *et al* (1988) opined that hydration status affect the concentration of urea in the blood accounting for the great variation in the normal values. Serum creatinine value was found to be comparable to those values obtained by Abdalla *et al* (1988) and Mohamed and Hussein (1999) but higher than those obtained by Bengoumi *et al* (1997). Values of total serum protein and albumin were comparable to those values reported by other researchers (Abdalla *et al*, 1988; Bengoumi *et al* 1997; Higgins and Kock, 1984 and Mohamed and Hussein, 1999). Serum globulin value corroborated

those reported by Higgins and Kock (1984) in normal adult dromedaries. Serum value for total bilirubin was similar to those reported by Al-Ali and coworkers (1988) and Mohamed and Hussein (1999). The values reported here for SUN, creatinine, total protein, albumin, globulin and total bilirubin were in agreement to those reported in normal adult llamas (Fowler, 1998) and cattle (Carlson, 1996).

Mean serum concentrations of glucose, triglyceride and cholesterol are reported in table 2. Serum concentrations of glucose in this report was comparable to those obtained by Mohamed and Hussein (1999) but was slightly lower than the results obtained by Al-Ali *et al* (1988); Bengoumi *et al* (1997) and Higgins and Kock (1984). Low blood glucose levels in camels in this study might be due to high demands of glucose metabolism for the developing foetuses. Similar to other New World camelids blood glucose levels in dromedaries were significantly higher than that in other ruminants (Carlson, 1996). High blood glucose levels in camelids can be explained by the

active gluconeogenesis in these species (Mirgani *et al*, 1987). The mean concentration of triglycerides in present study was higher than those obtained by Bengoumi *et al* (1997). This could be due to negative energy balance and mobilisation of lipids during late pregnancy in order to meet energy demands for the growing foetus (Dahlborn *et al*, 1992). Cholesterol value in pregnant she camels was in agreement with the reported values in adult dromedaries (Bengoumi *et al*, 1997 and Mohamed and Hussein, 1999) and New World camelids (Carlson, 1996) and was closely similar to that reported for other ruminants (Carlson, 1996). It has been reported that cholesterol concentrations are lower in fit and athletic camels due to reduction in body fat related to regular exercise (Mohamed and Hussein, 1999).

Mean serum concentrations of sodium, potassium, chloride, phosphorus, calcium, magnesium, carbon dioxide and anion gap are presented in table 2. Mean serum concentrations of various electrolytes were similar to those obtained by Abdalla *et al* (1988); Bengoumi *et al* (1997) and Mohamed and Hussein (1999) in adult dromedaries camels and in normal adult llamas and cattle (Carlson, 1996 and Fowler, 1998). However, normal serum values for carbon dioxide and anion gap in dromedary camels were reported for the first time in this study (Table 2).

Serum enzyme activities of sorbitol dehydrogenase (SDH), aspartate aminotransferase (AST), alkaline phosphatase (ALP), and gamma glutamyltransferase (GGT) are reported in table 3. Investigators have observed significant differences in serum enzyme activities in camels kept in various climatic conditions and between different age and sex groups (Bengoumi *et al*, 1997 and Kataria and Bhatia, 1991). SDH is very specific and sensitive indicator of active hepatocellular damage in domestic animals (Carlson, 1996). Information regarding this enzyme is lacking in the literature on camels. The mean concentration of SDH in this study was similar to the reported values in llamas and adult cattle (Carlson, 1996 and Fowler, 1998). Serum activities of AST and ALP were similar to values obtained by Bengoumi *et al* (1997) and Mohamed and Hussein (1999) and higher than those obtained by Kataria and Bhatia (1991). They found that serum activities of AST and ALP were significantly higher

Table 2. Serum biochemical parameters in normal pregnant she camels (*Camelus dromedarius*) in North America (n=9).

Parameters	Mean \pm SD	Range
Urea Nitrogen (SUN) (mg/dl)	28.89 \pm 5.51	23.00 - 37.00
Creatinine (mg/dl)	1.75 \pm 0.23	1.40 - 2.12
Total serum protein (g/dl)	6.80 \pm 0.65	5.80 - 7.90
Albumin (g/dl)	3.30 \pm 0.50	2.70 - 3.90
Globulin (g/dl)	3.50 \pm 0.30	3.12 - 4.12
Albumin/globulin ratio	0.97 \pm 0.12	0.90 - 1.20
Fibrinogen (mg/dl)	300.0 \pm 120.0	120.0 - 500.0
Total bilirubin (mg/dl)	0.12 \pm 2.30	0.08 - 2.5
Glucose (mg/dl)	120.12 \pm 4.90	92.00 - 128.00
Triglycerides (mg/dl)	50.00 \pm 20.00	27.00 - 124.00
Cholesterol (mg/dl)	47.00 \pm 4.50	45.00 - 58.00
Sodium (mEq/L)	154.67 \pm 3.46	169.0 - 160.0
Potassium (mEq/L)	4.67 \pm 0.63	4.00 - 5.60
Chloride (mEq/L)	136.00 \pm 1.76	131.0 - 137.0
Phosphorus (mg/dl)	5.51 \pm 1.13	4.20 - 7.20
Calcium (mg/dl)	9.02 \pm 0.38	8.30 - 9.60
Magnesium (mg/dl)	3.12 \pm 0.26	2.80 - 3.60
Carbon dioxide (mEq/L)	27.40 \pm 3.20	23.0 - 34.0
Anion gap (mEq/L)	17.30 \pm 3.50	12.0 - 23.0

Values are means of nine readings from different animals' \pm standard deviations.

during extremely hot conditions and in young male camels. It was concluded according to the researchers that younger animals have less stable cellular membranes resulting in greater leakage of enzymes into the circulation.

Endocrinology

Serum concentrations of various hormones of progesterone, cortisol, insulin, tri-iodothyronine (T₃) and thyroxine (T₄) are given in table 3. There are no comparative studies in the literature of hormonal values in normal pregnant she camel for comparison purposes. The result of progesterone in present study corroborated the findings of Agarwal *et al* (1992) who reported that the circulating levels of progesterone in pregnant camels fluctuated between 4 and 5 ng/ml throughout the pregnancy. The animals of this study were pregnant (2nd/3rd trimester) and the reports of Agarwal *et al* (1992) showed the values at the time of calving. The mean serum insulin concentration in present study was lower than that reported by Dahlborn *et al* (1992). Nutritional status and timing of sampling could be partly responsible for this discrepancy between the two studies. Thyroid hormones play an important role in the normal development and differentiation of the fetuses in pregnant females (Agarwal *et al*, 1989). Serum concentrations of thyroxine in pregnant camels in this study were similar to the levels obtained by Agarwal *et al* (1989) in recently calved camels. However, the reported value for tri-iodothyronine was significantly higher than those obtained by Agarwal *et al* (1989). This difference in values could be due to one time sampling in this study as well as due to seasonal and climatic variations between studies.

Conclusion

Although the sample size of normal pregnant dromedary camels was small but it provided a complete and comprehensive baseline data of normal haematological, serum biochemical and certain hormonal parameters for pregnant camels.

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Table 3. Serum activities of some enzymes and hormones in normal pregnant she camels (*Camelus dromedarius*) in North America (n=9).

Parameters	Mean ± SD	Range
Sorbitol dehydrogenase (SDH) (IU/L)	2.30 ± 0.90	1.00 - 4.00
Aspartate aminotransferase (AST) (IU/L)	71.00 ± 3.00	59.00 - 91.00
Alkaline phosphatase (ALP) (IU/L)	57.00 ± 16.50	45.00 - 83.00
Gamma glutamyltransferase (GGT) (IU/L)	20.00 ± 2.90	16.00 - 24.00
Progesterone (ng/ml)	3.5 ± 1.50	0.20 - 4.7
Cortisol (ng/ml)	20.0 ± 5.40	13.0 - 27.0
Insulin (µl/ml)	3.80 ± 1.20	2.50 - 5.40
Tri-iodothyronine (T ₃) (ng/ml)	16.0 ± 3.60	7.50 - 19.60
Thyroxine (ng/ml) (T ₄)	129.0 ± 16.0	87.0 - 125.00

Values are means of nine readings from different animals ± standard deviations.

performing clinical examinations and sample collections.

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