

Factors Affecting Some Blood Constituents in Camels - A review

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ABSTARCT

This paper reviews levels of some blood biochemical parameters in camels. These are blood glucose, blood urea nitrogen, total serum proteins, alkaline phosphate and amylase enzymes activities. The paper discussed the effect of some factors on camel blood biochemical parameters such as age, sex and breed.

Key Words: Blood biochemistry, Breeds, Camel.

INTRODUCTION

Blood is an index for several metabolic processes of the body, so differential concentrations and periodic change of blood metabolites may determine the genetic potential of a species. The existence of a strong relationship between levels of glucose, total protein, blood urea and certain enzymes with growth characteristics in different farm livestock has been established. The present paper gives a comprehensive review of these indicators of blood biochemistry in Indian, African and Arabian breeds of camel and identification of various factors such as breed, age, sex and physiological status affecting them.

Glucose concentration in blood and factors affecting it

A review on the estimates for average concentration of glucose in the blood of camels is presented in table 1, where different workers have

Table 1: Blood glucose levels in camels reported by various researchers

Glucose conc. (mg/dl)	References
95.0 (N. African dromedary)	Chavanne & Bone (1950)
110 ± 11.4 (Indian camels, 4 - 7 years)	Kumar & Banerjee (1962)
110.01 ± 10.7 (Indian camels)	Lal <i>et al.</i> (1962)
80.0 ± 2.22 (Somalian camel)	Soliman & Shaker (1967)
109, 107, 108 (Iranian camel < 1 year old, 1-5 years old, > 5 years old)	Ghodsian <i>et al.</i> (1978)
129, 106.6 (Fed camels, Fasted camels)	Chandara senta <i>et al.</i> (1979)
110.5 ± 4.0 (Camels weighing between 380 and 410 kg)	Kouadier & Kolb (1982a)
9.2 ± 0.8 mmol (Newborn calves)	Elias & Yagil (1984)
11.9 ± 1.0 mmol/l, 11.9 ± 0.8 mmol/l, 11.3 ± 0.7 mmol/l, 9.1 ± 0.8 mmol/l (after birth)	Elias & Yagil (1984)
7, 14, 21 and 30 days of parturition)	
6.4 ± 0.31 mmol/l (She camel after birth of calf)	Elias & Yagil (1984)
5.6 ± 0.18 mmol/l, 4.6 ± 0.09 mmol/l, 4.3 ± 0.07 mmol/l, 4.7 ± 0.07 mmol/l (7, 14, 21 and 30 days of parturition)	Elias & Yagil (1984)
37.0 - 67.0 (All purpose camels)	Abdel Gadir <i>et al.</i> (1984)
96.0, 94.0 (Male camels, Female camels)	Chiericato <i>et al.</i> (1986a)
138 ± 17.7 (Healthy camels)	Al-Ali <i>et al.</i> (1988)
31.24 - 128.67 (Wide range of age, ranging from 3 month- 25 years)	Azwai <i>et al.</i> (1990)
100.6, 53.6, 52.3, 28.6, 47.6, 71.6, 27.6, 72.6, 123.1, 45.0, 125.0, 103.8 (from Jan. to Dec.)	Mehrotra & Gupta (1989)
91.43 ± 3.98, 88.10 ± 9.57, 85.80 ± 11.76 (Bikaneri, Jaisalmeri and Kachchhi camels)	NRCC (1990)
125.9 ± 4.5 in August, 103.0 ± 2.6 in September (Between Aug. 15 th and Sept. 16 th after rainfall)	Mohamed <i>et al.</i> (1990)

observed a wide variation in the blood glucose concentration of camels. The glucose level of blood ranged from 27.6 mg/dl in adult camels (Mehrotra & Gupta, 1989) to 214.37 ± 18.0 mg/dl in 7 day old calves (Elias & Yagil, 1984). Chavanne & Bone (1950) reported no significant variation in glucose concentration of male and female camels. Chiericato *et al.* (1986a) also did not observe any significant difference in concentrations of glucose in males (96.0 mg/100 ml) and in females (94.0 mg/100 ml). Age is a significant factor, which affects glucose levels of blood in camels. Roussel *et al.* (1982), Elias & Yagil (1984) and NRCC (1990) reported that the blood glucose levels decreased with the advancement of age. On the other hand, Ghodsian *et al.* (1978) did not notice a significant difference in glucose levels up to five years of age.

Chandra Sena *et al.* (1979) observed a non-significant difference in 24 hours starved and unstarved camels. While reviewing physiology of digestion in camels, Bhatia (1986) reported the range 75-120 mg/dl and concluded that concentration of glucose in the blood of camels is generally higher than that in other ruminants. Mehrotra and Gupta (1989) reported seasonal differences in the concentration of this parameter. These workers observed 100.6, 53.6, 52.3, 28.6, 47.6, 71.6, 27.6, 72.6, 123.1, 45.0, 125.0 and 103.8 mg/dl from January to December respectively. However, they did not put forward any explanation for the seasonal variability of this parameter.

Total serum proteins and factors affecting it

Proteins are complex nitrogen containing organic compounds found in all animals and vegetable cells, where they constitute a major part of living protoplasm. All enzymes and many hormones that regulate biochemical reactions are functional proteins. In Indian camels the total protein and different fractions of proteins were reported by Kumar *et al.* (1961). Total serum protein was 6.40 ± 0.55 g/dl (range 5.6 - 7.3) in adult camels (Table 2). The total protein levels in camels ranged from 6.19 (Sharma, 1980) to 8.02 g/dl (Bansal *et al.*, 1970).

Table 2. Total serum protein levels in camels reported by various researchers

Total serum protein (g/dl)	Reference
6.40±0.55	Kumar <i>et al.</i> (1961)
6.98, 6.68 (Male, Female)	Perk & Loble (1961)
6.60	Jatkar <i>et al.</i> (1962)
3.0±0.07 (calf 2 yrs.)	Bhargava <i>et al.</i> (1964)
7.03 (percent)	Soliman & Shaker (1967)
8.02±0.35	Bansal <i>et al.</i> (1970)
6.85, 6.34 (Winter, Summer)	Ghosal <i>et al.</i> (1973)
7.30±0.51	Abdel Gadir <i>et al.</i> (1984)
6.19±0.24, 6.80±0.415 (Male, Female)	Sharma (1980)
6.46	Mathur <i>et al.</i> (1981)
6.24±0.83	Biagi (1983)
7.4±1.4	Mura <i>et al.</i> (1985)
6.9, 7.0 (Male, Female)	Chiericato <i>et al.</i> (1986)
7.1±1.6	Yagoub (1988)
4.97 - 12.32 (3 month to 25 yrs.)	Azwai <i>et al.</i> (1990)
7.53±0.09	Kataria <i>et al.</i> (1991)

The variation in the serum protein due to age, sex, pregnancy, rut and infections was studied by Bhargava *et al.* (1964). They reported 3.0 ± 0.07 , 6.6 ± 0.18 , 6.2 ± 0.16 , 5.9 ± 0.25 and 6.1 ± 0.24 g/dl total protein in camel calves of two years age, adult males in rut, adult non-rut males, non-pregnant and pregnant females, respectively. Koudier *et al.* (1988) also estimated total protein in the blood plasma of camels over one calendar year and reported it to be 7.8 ± 0.61 g/dl during breeding season (October - January) and 6.53 ± 0.44 g/dl in quiescent period (February - September). The total protein in different age groups was estimated by Ghodsian *et al.* (1978). These workers reported total protein in the camel calves younger than one year, from one to five years and older than five years of age. The total protein concentration ranged from 5.5 to 8.0, 5.1 to 8.4 and 5.8 to 9.3 g/dl, respectively. The average protein level was 6.8 g percent in all age groups.

Total protein concentration in different age groups was reported in Indian camels by NRCC (1985). According to these reports the averages for total serum protein were 7.48, 7.42, 8.01, 8.76 and 7.84 g/dl in camels from 6 months to 1 year, 1 to 2 years, 2 to 3 years, 3 to 4 years and older than 4 years, respectively. In age groups of < 4, 4-10 and > 10 years, Kataria *et al.* (1991) reported total protein levels of 8.10 ± 0.19 , 7.65 ± 0.15 and 6.86 ± 0.11 g/dl, respectively. The mean values according to age groups were significantly different from each other. It was highest in young animals below 4 years of age and then gradually declined as the age advanced.

Chartier *et al.* (1986) divided 132 samples from camels in 6 groups based on age and sex and the average serum proteins for camels younger than 1 year were 63.4 g/l and 63.1 g/l for males and females respectively; and for camels 1-7 years old were 81.9 g/l and 82.7 g/l for males and females respectively; and for camels older than 7 years were 81.4 g/l and 80.7 g/l for males and females respectively. These workers observed that the serum protein level was significantly low in animals below one year of age. However, within age groups the protein levels were not affected by the sex. Chiericato *et al.* (1986a) also reported similar results.

Heller & Hassan (1966) in Sudan working on camels maintained at two different feeding levels reported the serum protein values as 8.31 ± 0.85 g/dl and 8.07 ± 0.25 g/dl in high and low protein diets, respectively. Influence of season on concentration of total protein in serum was studied by Ghosal *et al.* (1973) who observed mean protein values were 6.85 g/dl in winter and 6.34 g/dl in summer. Elias & Yagil (1984) in their study of serum biochemical values in newborn calves estimated total protein as 44.2 ± 2.0 , 48.2 ± 1.5 , 53.1 ± 2.0 , 59.0 ± 2.4 , and 60.2 ± 1.5 g/l and in their lactating mothers were 58.1 ± 2.8 , 64.1 ± 1.5 , 64.1 ± 2.6 , 64.6 ± 2.6 and 62.5 ± 2.3 g/l after 0, 7, 14, 21 and 30 days postpartum, respectively.

Breed comparisons in terms of protein levels in Indian camels were made by NRCC (1987). The total protein was estimated in Bikaneri breed as 7.06 ± 0.73 and 6.95 ± 0.59 g/dl in male and female camels, respectively. In the Kachchhi breed, it was estimated as 7.14 ± 0.66 g/dl

in males. However, the variability between the two breeds in this parameter was not significant.

Mehrotra & Gupta (1989) studied seasonal variations in certain blood constituents in camels and found protein concentration as 6.8, 4.2, 6.1, 8.1, 6.8, 10.7, 9.0, 10.5, 10.4, 10.1, 9.6 and 7.7 g/dl from January to December, respectively. The protein concentration was relatively higher in the rainy season. Mohamed *et al.* (1990) studied diurnal variation in blood levels of some haematochemical and hormonal parameters in the grazing dromedary. Total serum protein concentration was 6.0 ± 0.1 and 6.4 ± 0.2 g/dl in samples collected at 15 and 60 days after the cessation of rainfall, respectively.

Blood urea nitrogen and factors affecting it

Estimates of average blood urea reported by various researchers are presented in table 3. Blood urea ranged from 11.8 ± 0.3 (Elias & Yagil, 1984) to 78.12 mg/dl (Azwai *et al.* 1990).

Table 3. Blood urea levels in camels reported by various researchers

Blood urea (mg/dl)	Reference
40.0 (32.0 - 55.0)	Chavanne & Bone (1950)
9.7 ± 0.40 (8-12) (urea nitrogen)	Kumar <i>et al.</i> (1961)
20.0 ± 1.21	Soliman & Shaker (1967)
25.7 ± 4.9	Koudier & Kolb (1982a)
31.72 (21.82-78.12)	Azwai <i>et al.</i> (1990)
11.8 ± 0.3	Elias & Yagil (1984)

Elias & Yagil (1984) made a comparison of blood urea in newborn versus their mothers up to 30 days postpartum. In newborn calves they measured the concentration of urea as 16.9 ± 0.4 , 10.3 ± 0.6 , 9.4 ± 0.5 , 7.7 ± 0.5 and 9.1 ± 0.4 mmol/l. In lactating females the urea concentrations were 12.0 ± 0.3 , 11.9 ± 0.3 , 10.1 ± 0.6 , 9.0 ± 0.4 and 6.9 ± 0.3 mmol/l after 0, 7, 14, 21 and 30 days postpartum respectively, while in adult non-lactating camels the urea concentration was reported as 11.8 ± 0.3 mmol/l.

Chiericato *et al.* (1986a) reported urea concentration as 39.9 and 36.6 mg/dl in males and females, respectively. They did not observe any sex related difference in urea concentration. The effect of the breeding season on urea concentration was studied by Koudier *et al.* (1988). Blood urea during breeding season was 4.89 ± 0.67 mmol/l while during the non-breeding season it was 6.84 ± 0.87 mmol/l.

Azwai *et al.* (1990) analysed 142 blood samples from dromedaries aged 3 months to 25 years belonging to both sexes and reported overall mean concentration of blood urea as 31.72 mg/dl (range 21.82 - 78.12 mg/dl). Mohamed *et al.* (1990) observed urea concentration as 45.7 ± 1.6 and 39.2 ± 1.4 mg/dl on the 15th and 60th day after the cessation of rainfall. The probable cause of the difference in the two periods was attributed to availability and quality of forages.

Alkaline phosphatase activity and factors affecting it

Normal blood contains alkaline phosphatase enzyme which catalyses the liberation of inorganic phosphates from phosphate esters such as glycerol phosphate etc. Alkaline phosphatase is most active at optimum 9.0 pH. The enzymatic activity of serum or plasma with respect to this enzyme is established in terms of the rate of hydrolysis of suitable phosphate ester substrates buffered to the proper pH (Bodansky, 1932). The plasma alkaline phosphatase levels may be increased during the diseases related to bone and liver while activity of acid phosphatase is related with some carcinoma (Shinowara *et al.*, 1942). The mean levels of alkaline phosphatase reported by various workers in different kinds of experimental groups of camels are compiled in table 4. A critical

appraisal of the information compiled herein, revealed high variability in the concentration or activity of alkaline phosphatase.

Table 4. Alkaline phosphatase activity levels in camels reported by various researchers

Alkaline phosphatase	Experimental material	Reference
2.50±0.19 BU/100 ml	Healthy camels	Chouhan (1972)
2.53±0.20BU/100 ml	camels with mandibular fractures	
5.15±0.73KAU/100ml	Camels	El-Abdin & Hamza (1972)
8 - 12 KAU/ 100 ml	Camels in Sudan	Harvey & Obeid (1974)
46 IU/l	Healthy male dromedary Camels	Boid (1980)
57.8±25.6 IU/l	Male 2.7 years	Halabi <i>et al.</i> (1982)
33.3±9.3 IU/l	Male 5.9 years	
45.8±11.1IU/l	Female 2.5 years	
45.8±11.1 IU/l	Female 7.3 years	
289.1±43.2	Newborn calves	Elias & Yagil (1984)
34.4±4.81 IU/l	Camels	Koudier & Kolb (1982b)
92.2±11.82 IU/l	Male, 1 year age	NRCC (1988)
184.8±23.02 IU/l	2-3 years age	
32.4±07.27 IU/l	adults	
84.0±15.43 IU/l	Female, 1 year age	
80.8±07.57 IU/l	2-3 years age	
68.6±02.24 IU/l	adults	
6.3±01.1 IU / dl	Healthy camels	Al-Ali <i>et al.</i> (1988)
6.06±0.16 BU/dl	< 4 years	Gahlot & Bhatia (1989)
4.92±0.12 Bu/dl	4 - 10 years	
4.01±0.08 BU/ dl	>10 years	

Different researchers used different units in expressing the activity of this enzyme. Most of the workers measured it in terms of IU/l, whereas others (Chouhan, 1972; Gahlot & Bhatia, 1989; Adval *et al.*

1969) measured it in terms of BU/100 ml of plasma. A few workers (El - abdin & Hamza, 1972; Harvey and Obeid, 1974) measured it in terms of KAU/100 ml of plasma.

The activity of alkaline phosphatase ranged from 2.50 ± 0.19 BU/dl (Chouhan, 1972) to 319.0 ± 21.6 IU/l (Elias & Yagil, 1984). A high level of alkaline phosphatase was reported by Elias & Yagil (1984) in the newborn calves, where it was observed to be as 289.1 ± 43.2 , 265 ± 16.4 , 319.0 ± 21.6 , 167.4 ± 22.9 and 187.9 ± 16 IU/l at birth, 7, 14, 21 and 30 days after birth, respectively. The alkaline phosphatase activity in lactating mothers was reported to be 31.5 ± 1.4 , 36.3 ± 0.9 , 37.1 ± 0.7 , 32.6 ± 0.7 and 36.3 ± 1.8 IU/l after 0, 7, 14, 21 and 30 days postpartum, respectively. The alkaline phosphatase activity in adult non lactating camels was estimated to be 27.5 ± 2.2 IU/l. This study reflected that the alkaline phosphatase activity was associated with the metabolic rate of young calves and lactating mothers.

Halabi *et al.* (1982) measured activities of alkaline phosphatase in the serum of male and female camels of different ages (Table 4) but no consistent trend for effect of age in the two sexes. On the other hand in cattle, sheep and camels the effect of age on alkaline phosphatase activity was noticed by Vertor & Swaton (1969), where the serum alkaline phosphatase activity was considerably higher in young animals.

In Indian camels, the difference in the alkaline phosphatase activity between males and females was found to be non-significant (NRCC, 1986). Similarly, Chiericato *et al.* (1986b) could not establish a significant difference between sexes in alkaline phosphatase. Significant effect on alkaline phosphatase activity due to age and sex of animals was reported in camels (NRCC 1988). They reported higher activities in males than females. Animals younger than three years of age had higher activity than adult males. Progressive decline in alkaline phosphatase activity with the advancement of age in camels was also observed (NRCC, 1990).

Higher alkaline phosphatase activity was reported by Koudier & Kolb (1982b) in their studies for diurnal glucose level and enzyme activity, where the initial mean activity of alkaline phosphatase was

found to be 34.4 ± 4.81 IU/l. These workers recorded no significant change in activity due to increasing air temperature.

Amylase activity and factors affecting it

Mura *et al.* (1985) estimated amylase activity in serum and organ, in *camelus dromedarius*. In serum, they reported average activity of amylase as 2325 ± 629 U/l. Al-Ali *et al.* (1988) estimated α -amylase as 203 ± 54 IU/dl in a comparative biochemical analysis of the camel. Chiericato *et al.* (1986b) in their study of characteristics of blood enzymes in the dromedary, could not establish a significant difference between the two sexes in respect of amylase activity.

Comprehensive blood analysis in Bikaneri camel

Bissa (1993) conducted a comprehensive study on several metabolites from birth to six months of age in Bikaneri, Jaisalmeri and Kachchhi breeds. At birth the average glucose concentration ranged from a minimum of 135.1 ± 156 g/dl and maximum of 169.6 ± 5.27 mg/dl. Values of blood urea nitrogen averaged 14.1 ± 0.47 mg/dl at three months. Whereas activities of amylase and alkaline phosphatase were maximum (191.1 ± 9.24 IU/dl and 496.8 ± 27.0 IU/l) at birth. Activities of these enzymes decreased with the advancement of age. Maximum variability was observed in glucose concentration at birth and three months, and alkaline phosphatase activity at three months. The effect of sex and parity was not significant on any of the blood parameters.

At birth, Bikaneri calves had maximum glucose concentration (182.7 ± 9.65 mg/dl) followed by Kachchhi (160.3 ± 11.1 mg/dl) and Jaisalmeri (131.9 ± 12.2 mg/dl). At three months of age, glucose concentration was maximum in Jaisalmeri breed (150.9 ± 6.24 mg/dl) followed by Bikaneri (134.1 ± 4.93 mg/dl) and Kachchhi (126.4 ± 5.65 mg/dl). The activity of alkaline phosphatase was maximum (490.7 ± 47.53 IU/l) in descending order at three months. The effect of age was highly significant ($P < 0.01$) on glucose concentration and activity of amylase and alkaline phosphatase. Only breed x age and sex x parity interactions affected the glucose concentration significantly.

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