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INFLUENCE OF AGE AND SEX ON VARIOUS SERUM ENZYME ACTIVITIES OF CAMELS

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ABSTRACT

The activities of various diagnostic enzymes viz. Butryl cholinesterase (ButChE), a Amylase (a Amyl), aspartate aminotransferase (AST), alanine aminotransferase (ALT), lactate dehydrogenase (LDH), creatine kinase (CK), gamma-glutamyltransferase (GGT) and alkaline phosphatase (ALP) were determined in serum of 238 healthy camel of either sex and different ages. The results were analysed with respect to sex and age. The mean activities of ButChE, a Amyl, AST, ALT, LDH, CK, GGT and ALP were 111.0 ± 23.9 and 112.6 ± 28.0 U/L; 1404 ± 160.2 and 1366.8 ± 137.8 U/L; 87.4 ± 13.1 and 85.6 ±11.5 U/L; 11.2 ± 2.3 and 11.4 ± 2.3 U/L; 776.5 ± 91.9 and 767.1 ± 102.2 U/L; 87.6 ± 31.4 and 73.1 ± 27.2 U/L; 12.1 ± 4.0 and 11.6 ± 3.6 U/L; 305.2 ± 111.9 and 268.4 ± 91.2 U/L, respectively in male and female camels. Analysis of data revealed that CK and ALP activities in the serum of males were significantly higher than females.

Key words: Age, camel, enzyme, serum, sex

The analysis of blood often provides valuable information for diagnosis and also helps us to select specific course of treatment. Serum enzymes reflect physiopathological changes in specific organ(s). The normal levels of various diagnostic enzymes in camels have been reported in different countries (Eldirdiri *et al,* 1987; Al-Ali *et al,* 1988; Kataria and Bhatia, 1991; Bengoumi *et al,* 1997; Khadjeh *et al,* 1997, Wernery *et al,* 1999). Information on activities of enzymes in the serum of normal Emirates camels is scarce. The present study was designed to estimate normal serum levels of various diagnostic enzymes in camels of different age and sex, which will serve as reference values to clinicians.

Materials and Methods

The study was carried out on 238 apparently healthy camels of either sex belonging to different training camps. All females used in this study were non-pregnant and non-lactating. On the basis of age, the camels were divided into 5 groups.

Group A: 1-2 years of age (25 males and 17 females).

Group B: 2-3 years of age (23 males and 16 females).

Group C: 3-4 years of age (17 males and 46 females).

Group D: 4-5 years of age (31 males and 31 females).

Group E: above 5 years of age (16 males and 16 females).

Blood samples were collected from jugular vein in plain vaccutainers for serum enzyme activity measurement. Blood samples were transported to laboratory and analysed immediately. All the enzymes expressed in Unit/Litre were measured on biochemistry auto-analyser (Hitachi 704) using Roche/Hitachi kits. The enzymes analysed were butryl cholinesterase (BurylChE), a amylase (a Amyl), Asparatate aminotransferase (AST), Alanine aminotransferase (ALT), Creatine Kinase (CK), Lactate Dehydrogenase (LDH), Gamma -glutamyltransferase (GGT) and Alkaline Phosphatase (ALP).

The overall means, group mean and standard deviation were calculated for each enzyme separately and 't' test was applied to determine the effect of sex and age.

Results

The mean ± SD, values of serum enzyme activities of healthy male and female camels at different ages is presented in Table 1.

The effect of sex was significant on the creatine kinase and alkaline phosphatase, mean values were higher in male animal than females. The data were distributed according to sex and then subgrouped as per age to find out the changes. The effect of age was significant on cholinesterase, amylase, AST, LDH, CK, GPT, GGT and ALP in males and on cholinesterase,

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AST, LDH, CK, GGT and ALP in females. The data were classified according to age group and subdivided into males and females. In group A significant sex effect was observed on ButChE and LDH and mean values were high in females. In group C significant sex effect was observed on AST. In group D significant sex effect was observed on ButChE, amylase and CK and mean values were high in males. In group E, significant sex effect was observed only on CK.

Discussion

Butryl Cholinesterase (ButChE) which hydrolyses butrylcholine found in serum, plasma, liver, and pancreas and white matter of brain, represents an important group of related enzymes. Serum ButChE level is of importance in the diagnosis of cholinesterase inhibition disorders. Serum ButChE level decreases in acute infection, pulmonary infection, muscular dystrophy, chronic renal disease and pregnancy (Richterich, 1961; Richterich and Colombo, 1981; Zimmerman and Henry, 1984).

The overall mean value (111.2±24.3 U/L) for ButChE activity in present study (Table 1) was higher than the values reported by Al-Ali *et al* (1988) for Saudi camels (87±10.2 IU/L) The difference in enzyme activity between males and females, regardless of age, was not significant. This was in accordance to the findings of Khaliq and Ali (1997). However, values were significantly high for two sexes when compared to our values. A change in ButChE activity in camels of two sexes with age was observed (Table 1) but no specific trend was noticed.

Alpha amylase is a calcium containing metalloenzyme that is produced by the pancreas and normally acts extracellularly to cleave starch into smaller carbohydrate groups by hydrolysis of internal alpha-1, 4-glycoside bonds. Serum a-amylase level is of importance in the diagnosis of acute pacreatitis and severe renal disease (Talwar *et al,* 1989).

The mean activity of amylase (1348.5±149.6 U/L) in the present investigation was found lower than the values reported by Mura *et al* (1985) and Al-Ali *et al* (1988). Higher values were observed in camels of Emirates than those reported by Khadjeh *et al* (1997) and Nazifi *et al* (1998) for Iranian camels. The difference in values of serum amylase in males and females were not significant (P> 0.05). Similarly Chiericato (1986) also reported non-significant difference in amylase activity in two sexes.

Asparate aminotransferase (AST) and alanine aminotransferase (ALT) are present in high concentration in liver cells where they catalyse the transfer of asparate and alanine a-amino groups to the a-keto groups of ketoglutaric acid to produce oxaloacetic and pyruvic acids. Injury to liver cell membranes causes leakage of aminotransferases into the circulation (Lott and Wolf, 1986; Dufour *et al,* 2000; Kew, 2000).

Overall mean activity of AST (86.4±12.3 U/L) obtained in the present study was comparable to corresponding activities as reported by Abdalla *et al*(1988) and Al-Ali *et al* (1988). Reviews on estimates of average activity of AST in blood of adult camels showed that different worker have observed a wide variation in blood AST activity of camels. The level of AST ranged from 12±5 U/L (Haroun, 1994) to 135.5±5 U/L (Khadjeh *et al,* 1997). In the present study the influence of sex on AST activity was nonsignificant. Similar findings were reported by Eldirdiri *et al* (1986), Sarwar *et al* (1992) and Bengoumi *et al* (1997).Mean values of AST (87.6±13.1 U/L) in males were found close to those reported by Abdelkhaliq and Ali (1999) but higher than those reported by Kataria *et al* (1991) and Hussein *et al* (1993). However, the AST values (85.6±11.6 U/L) in females were in accordance to the findings of Abdelkhaliq and Ali (1999) (83.5±3.1). Contrary to these findings Osman and Al-Busadah (2000) reported significantly higher values in Saudi females (123±10 U/L). Wernery *et al* (1999) reported AST values of racing dromedaries to be 60-120 IU/L and desert dromedaries to be 40-45 IU/L in age group 2 to 12 years.

A wide variation in serum transaminase has been reported by number of workers due to variation in season, sex, age and climatic condition (Kataria *et al,* 1991). Our results on alanine aminotransferase (ALT) were in good agreement with the findings of Ghosal and Dwarkanath (1971) and Khadjeh *et al* (1997) but higher than those reorted by Boid (1980), El-Amrousi and Wasfi (1984), Kataria *et al* (1991) and Haroun (1994) and lower than those reported by Mohamed and Husse (1999). Concerning the effect of sex on serum ALT activity in camels, contradictory results are reported in literature. In accordance to our findings, Sulatani and Biagi (1983), Cheiricato *et al* (1986), Eldirdiri *et al* (1987), Sarwar *et al* (1992) and Hussein *et al* (1993) reported significant effect on serum ALT activities due to sex. Whereas, Adam *et al* (1974) and Kataria *et al* (1991) reported significantly higher value of ALT in males than females. Our figures for serum ALT in males and females fell within the ranges recorded by Hussein (1993), Abdelkhaliq and Ali (1999) and Khadjeh (2002). However, Sarwar *et al* (1992) and El-Amrousi

and Wasfi (1984) reported much lower value in males and females. At the same time Bengoumi *et al* (1997), Nazifi and Maleki (1998) and Osman and Al-Busadah (2000) recorded much higher values corresponding to our results in like sexes. ALT values of present study fall in range given by Wernery *et al* (1999) for age group 2-12 years.

Creatine kinase also known as creatine phosphokinase catalyses the reversible phosphorylation of creatine by adenosine triphosphate to form creatine phosphate. Creatine kinase is found predominately in muscle and activity of this enzyme in serum or plasma is frequently used to detect skeletal or cardiac muscle damage in many species.

Mean CK level (79.9±30.1 U/L) of serum (regardless of age and sex) had a range of 30.0 to 149.0. This mean was found close to that reported by Khadjeh *et al* (1997) and lower than that reported by Mohamed and Hussein (1999). The mean value of CK (87.6±31.4 U/L) in males was found similar to that reported by Abdelkhaliq and Ali (1999). Contrary to these findings significantly higher values were observed by Nazifi (1998) in Iranian male camels (198.0±5.7 U/L). CK values in females were found close to those reported by Abdelkhaliq and Ali (1999) and Khadjeh (2002). Our statistical data revealed that sex affected the CK values and there was a significant difference ($P<0.0001$) in values of serum CK in males and female regardless of age which agreed with Eldirdiri *et al* (1987) who reported significant difference in males and females CK values. Contrary to these findings, Salitini and Biagi (1983), Chiercato *et al* (1986) and Hussein *et al* (1993) observed non-significant difference between male and female. However, Wernery *et al* (1999) has given a wide range of 60-120 IU/L in 2-12 years of dromedaries.

Lactate dehydrogenase is an enzyme which catalyses the inter-conversion of lactic acid to pyruvic acid. It is widely distributed in the body, being present in most, if not all tissues. The relatively high concentration in tissues, as opposed to normal serum or plasma, makes increased serum or plasma LDH a good indicator of tissue damage. The liver and skeletal muscles have greater concentration, followed by heart. LDH is also present in red blood cells. There are quantitative differences in amount of LDH in various tissues. The determination of LDH activity in serum and tissues are utilised in diagnosis and monitoring of myocardial infarction, liver diseases, diseases of blood cells and muscle diseases.

The overall mean value of LDH (771.5±97.4 U/L) in the present study was found higher than those reported by Eldirdiri *et al* (1987), Kataria and Bhatia. (1991), Khadjeh *et al* (1997) and Wernery *et al* (1999). The mean activity of LDH in males (776.6±91.9 U/L) and females (767.1±102.2 U/L) regardless of age was close to the findings of Hussein *et al* (1993). However, some discrepancies can also be observed between the results of present study and those carried out by other workers. Serum LDH activities were was lower in findings of Kataria and Bhatia (1991), Abdelkhaliq and Ali (1999) and Khadjeh (2002) for females. However, Nazifi and Maleki (1998) reported very high values of LDH in Iranian male camels. As reported by Chiercato *et al* (1986), Eldirdiri *et al* (1987) and Hussein *et al* (1993), nonsignificant differences were observed between male and female camels in the present study (Table 1). These results disagreed with the findings of Kataria and Bhatia (1991) who reported significant difference between activities of LDH in two sexes. Analysis of data in present analysis showed that age affected the LDH values in male and females which corroborated with the previous findings (Kataria and Bhatia, 1991 and Bengoumi *et al,* 1997). Significant difference ($P<0.0001$) in male and female activity was observed in camels of age group 1-2 years.

Gamma-glutamyltransferase is a carboxy-peptidase which cleaves C-terminal glutamyl groups and transfer them to peptides and other suitable acceptors. The greatest amount of cellular GGT is in the brush borders and bile duct epithelia (Kaneko, 1989). Serum GGT is commonly used indicator of hepatobiliary disease in cattle, sheep, goat and horses. In cholestatic injury to the liver, serum GGT activity increases several folds to its upper limit (Dufour *et al,* 2000). GGT activity is found in high concentration in renal tissues. Increase in urinary GGT with urinary ALP indicates toxic kidney damage (Braun *et al,* 1983; Kaneko, 1989).

GGT activity of Emirate camels was found lower than the value reported earlier (Eldirdiri *et al,* 1987 and Mohamed and Hussein, 1999). However, it was comparable with that reported by Khadjeh *et al* (1997) and Wernery *et al* (1999). Concerning the effect of sex on serum enzyme activity of GGT, contradictory results are reported in literature. The results obtained in this study were in accordance with Hussein *et al* (1993) and Ali *et al* (1999) who reported that sex had no effect on serum GGT activity. Contrary to these findings Eldirdiri *et al* (1987) reported significant effect of sex on serum GGT activities. Significant age related variations in males and females were observed

Table 1. Serum enzyme activities (Mean±SD) of male and female camels of different age.

S No.	Effects	ButChE	α Amyl	AST	ALT	LDH	CK	GGT	ALP
1.	**Sex**								
	i) Male (112)	111.0± 23.9	1404.5± 160.2	87.4± 13.1	11.2± 2.3	776.5± 91.9	87.6± 31.4[a]	12.1± 4.0	305.2± 111.9[b]
	ii)Female (126)	112.6± 28.0	1366.8± 137.8	85.6± 11.5	11.4± 2.3	767.1± 102.2	73.12± 27.2[a]	11.6± 3.6	268.4± 91.2[b]
	Overall (238)	111.2± 24.3	1384.5± 149.6	86.4± 12.3	11.3± 2.3	771.5± 97.4	79.9± 30.1	11.9± 3.8	285.7± 102.9
	Range (238)	58.0- 170.0	1025.0- 1770.0	47.0- 119.0	4.0- 19.0	452.0- 1000	30.0- 149.0	4.0- 25.0	100.0- 598.0
2.	**Sex and age (Male)**								
	i) Group A	108.0± 25.7[a]	1296.4± 148.8[a]	78.8± 14.9[b]	12.4± 2.2[a]	794.7± 66.7[a]	100.7± 25.1[c]	10.5± 4.3[b]	383.0± 83.3[a]
	ii) Group B	95.5± 22.2[a]	1413.2± 166.3[a]	90.4± 11.1[b]	10.9± 2.9[a]	810.9± 91.8[a]	80.1± 32.4[c]	11.3± 2.7[b]	401.9± 80.7[a]
	iii) Group C	109.3± 23.9[a]	1358.4± 156.5[a]	90.8± 11.4[b]	12.2± 1.8[a]	742.7± 59.8[a]	71.8± 24.7[c]	12.0± 3.0[b]	265.7± 74.9[a]
	iv) Group D	123.9± 19.5[a]	1462.4± 116.9[a]	90.6± 9.3[b]	10.5± 2.0[a]	802.7± 103.2[a]	95.1± 31.6[c]	12.6± 4.4[b]	264.6± 79.3[a]
	v) Group E	114.4± 17.7[a]	1497.9± 149.1[a]	87.0± 16.2[b]	9.9± 1.8[a]	683.7± 60.4[a]	79.6± 35.4[c]	14.9± 3.7[b]	165.4 ± 55.1[a]
3.	**Sex and Age (Female)**								
	i) Group A	135.0± 21.6[a]	1358.7± 185.7	85.9± 10.3[c]	12.4± 2.7	870.8± 81.1[a]	100.0± 30.4[a]	9.3± 3.0[b]	370.0± 73.4[a]
	ii) Group B	87.1± 13.5[a]	1360.4± 147.1	84.9± 8.7[c]	11.6± 1.7	777.8± 115.1[a]	75.4± 28.3[a]	11.7± 3.5[b]	368.9± 75.6[a]
	iii) Group C	112.6± 26.3[a]	1340.1± 118.8	82.5± 10.1[c]	11.4± 2.2	737.5± 85.0[a]	63.7± 19.6[a]	11.3± 2.9[b]	244.2± 64.8[a]
	iv) Group D	112.0± 16.8[a]	1372.1± 122.6	91.5± 11.9[c]	11.1± 2.6	785.2± 89.2[a]	81.2± 20.6[a]	12.8± 4.1[b]	237.1± 70.1[a]
	v) Group E	106.5± 21.9[a]	1446.0± 135.5	82.4± 14.4[c]	10.6± 1.6	695.8± 89.9[a]	53.4± 27.0[a]	13.0± 3.6[b]	190.4± 51.3[a]
4.	**Age and Sex (Group A)**								
	Male (25)	108.0± 25.7[b]	1296.4± 148.8	78.8± 14.9	12.4± 2.2	794.7± 66.7[a]	100.7± 25.1	10.5± 4.3	383.0± 83.3
	Female (17)	135.0± 21.6[b]	1358.7± 185.7	85.9± 10.3	12.4± 2.7	870.8± 81.1[a]	100.0± 30.4	9.3± 3.0	370.0± 73.4
5.	**Age and Sex (Group B)**								
	Male (23)	95.5± 22.2	1413.2± 166.3	90.4± 11.1	10.9± 2.9	810.9± 91.8	80.1± 32.4	11.3± 2.7	401.9± 80.7
	Female (16)	87.1± 13.5	1360.4± 147.1	84.9± 8.7	11.6± 1.7	777.8± 115.1	75.4± 28.3	11.7± 3.5	368.9± 75.6
6.	**Age and Sex (Group C)**								
	Male (17)	109.3± 23.9	1358.4± 156.5	90.8± 11.4[c]	12.2± 1.8	742.7± 59.8	71.8± 24.7	12.0± 3.0	265.7± 74.9
	Female (46)	112.6± 26.3	1340.1± 118.8	82.5± 10.1[c]	11.4± 2.2	737.5± 85.0	63.7± 19.6	11.3± 2.9	244.2± 64.8
7.	**Age and Sex (Group D)**								
	Male (31)	123.9±19. 5[c]	1462.4± 116.9[b]	90.6± 9.3	10.5± 2.0	802.7± 103.2	95.1± 31.6[c]	12.6± 4.4	264.6± 79.3

S No.	Effects	ButChE	α Amyl	AST	ALT	LDH	CK	GGT	ALP
	Female (31)	112.0± 16.8[c]	1372.1± 122.6[b]	91.5± 11.9	11.1± 2.6	785.2± 89.2	81.2± 20.6[c]	12.8± 4.1	237.1± 70.1
8.	**Age and Sex (Group E)**								
	Male (16)	114.4± 17.7	1497.9± 149.1	87.0± 16.2	9.9± 1.8	683.7± 60.4	79.6± 35.4[c]	14.9± 3.7	165.4 ± 55.1
	Female (16)	106.5± 21.9	1446.0± 135.5	82.4± 14.4	10.6± 1.6	695.8± 89.9	53.4± 27.0[c]	13.0± 3.6	190.4± 51.3

ButChE=Butryl Cholinesterase (U/L); a Amyl=a Amylase (U/L); AST=Serum asparatate aminotransferase (U/L); ALT=alanine aminotransferase (U/L); LDH=Lactate dehydrogenase (U/L); CK=Creatine kinase (U/L); GGT= Gamma glutamyl transferase (U/L); ALP=Alkaline phosphatase (U/L)

i) Mean superscribed by letter 'a' for a given parameter and effect differ significantly (p = 0.0001 to p = 0.0009) from each other.

ii) Mean superscribed by letter 'b for a given parameter and effect differ significantly (p = 0.001 to p = 0.009) from each other.

iii) Mean superscribed by letter 'c' for a given parameter and effect differ significantly (p = 0.01 to p = 0.09) from each other.

iv) Figures in parentheses indicate the number of animals.

v) Groups A, B, C, D and E denote the division of animals according to age as 1-2 years of age, 2-3 years of age, 3-4 years of age, 4-5 years of age and above 5 years of age, respectively.

vi) No superscription on the mean values indicate nonsignificant differences (p > 0.05)

Table 2. Sex and age interaction of serum enzyme activities in male and female camels of different age group.

S.No.	Sex and age interaction	ButChE	a Amyl	AST	ALT	LDH	CK	GGT	ALP
1.	**Male × Age**								
	(a) Group A × B	NS	NS	*	NS	NS	NS	NS	NS
	(b) Group A × C	NS	NS	*	NS	NS	*	NS	***
	(c) Group A × D	NS	***	**	*	NS	NS	NS	***
	(d) Group A × E	NS	***	NS	**	***	NS	**	***
	(e) Group B × C	NS	NS	NS	NS	NS	NS	NS	***
	(f) Group B × D	***	NS	NS	NS	NS	NS	NS	***
	(g) Group B × E	NS	NS	NS	NS	***	NS	*	***
	(h) Group C × D	NS	NS	NS	NS	NS	NS	NS	NS
	(j) Group C × E	NS	NS	NS	*	NS	NS	NS	**
	(i) Group D × E	NS	NS	NS	NS	***	NS	NS	***
2	**Female × Age**								
	(a) Group A × B	***	NS	NS	NS	*	*	NS	NS
	(b) Group A × C	**	NS	NS	NS	***	***	NS	***
	(c) Group A × D	**	NS	NS	NS	*	NS	**	***
	(d) Group A × E	**	NS	NS	NS	***	***	*	***
	(e) Group B × C	***	NS	NS	NS	NS	NS	NS	***
	(f) Group B × D	**	NS	NS	NS	NS	NS	NS	***
	(g) Group B × E	NS	NS	NS	NS	NS	NS	NS	***
	(h) Group C × D	NS	NS	**	NS	NS	*	NS	NS
	(i) Group C × E	NS	NS	NS	NS	NS	NS	NS	NS
	(j) Group D × E	NS	NS	NS	NS	*	**	NS	NS

· Significant (p=0.05); ** Significant (p=0.01); *** Significant (p=0.001); NS=Nonsignificant

in the study. It appears from present findings that GGT values increase linearly in males and female as age progresses. Studies pertaining to GGT activity in camels are lacking in available literature. However, other studies in human (Van Der Meulen *et al*, 1993) showed an increasing effect of age. Whitefield *et al* (1978) reported increasing value of GGT upto age of 50 years in human.

Alkaline phosphatase is a group of enzymes that hydrolyse monophosphatase esters at alkaline pH. It is generally localised in membranes of cells. For practical purposes serum level may be considered to derive from liver, bone intestine and placenta (Burke, 1975). Alongwith GGT it is an indicator of toxic kidney damage (Rabb, 1972 and Junge *et al* 1986). Total serum ALP activity has also diagnostic value in hepatic and bone diseases in dogs and cats (Kaneko, 1989).

The mean level of ALP reported by various workers in different kind of experimental groups of camels revealed high variability in activity. The ALP activity obtained in present study was higher than those reported by Koudier and Kobe (1982), NRCC (1988), Al-Ali *et al* (1988), Kataria and Bhatia (1991) and Wernery *et al* (1999) but it was close to that reported by Snow *et al* (1988) and Khadjeh *et al* (1997). The variation in activity of ALP in male and females was significant ($p<0.001$). Highest activity was found in males. It was contrary to the findings of Eldirdiri *et al* (1987) who reported high value of ALP in females. However, it was in accordance to a report on camels by NRCC (1988). Consistent trend for effect of age on serum activities of ALP in males and females was observed in this study. Vertor and Swaten (1969) also noticed effect of age on ALP in cattle, sheep and camel. The difference in activity of ALP with age has been observed in other species (Sharma and Bisol, 1995) and is a result of faster growth rate in young animals, and leakage of enzyme from growing bones and intestine into the blood (Kaneko *et al,* 1997 and Avidar *et al,* 1981).

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