Short communication

Impact of natural vegetation on some biochemical parameters of the Arabian camel (*Camelus dromedarius*) in Algeria

Naima Sahraoui[1], Aissa Doudou[1], Oussama Douadji[1], Baaissa Babelhadj[2], Jean-Luc Hornick[3]

[1]Blida 1 University, Algeria; [2]Ouargla University – Algeria; [3]Unit of nutrition, Liège University -Belgium

Abstract

In Algeria the Arabian camel (*Camelus dromedarius*) has always been an integral part of the socioeconomic landscape in the Southern part of Algeria, both desert and steppe. Despite the economic and social importance, little information is available on the blood biochemistry.

In order to better understand the biology of the camel and the effects of breed, sex and age on the main biochemical blood parameters, our study was carried out on 22 camels (16 males and 6 females) fed a grass diet. Camels were divided into two age groups, young (1-4 years) and Adult (5 -8 years) and belonged to two breeds Sahraoui and Tergui.

The results showed an average serum glucose value of 5 ± 2.11 mmol/L, average values for urea and creatinine were of 2.56±0.72 mmol/L and 130.9 µmol/L, respectively and values of lipids were represented by total cholesterol (1mmol/L), triglycerides (1 mmol/L), HDL (0.0 mmol/L) and LDL cholesterol (0.06±0.09mmol/L). Blood biochemical parameters were influenced by age, sex and breed. HDL was higher ($P<0.05$) for the Sahraoui breed than Tergui breed (0.06±0.06 vs 0 ± 0.04 mmol/L). The LDL values were higher ($P<0.05$) in young camels (0.11 ±0.11vs 0.006± 0.06g mmol/L). These values are to be considered by the clinician for the early detection of metabolism and nutrition disorders in camels.

Keywords: biochemical profile, camel age, camel sex, camel breed.

*__Corresponding author__: Naima Sahraoui, nasahraoui@gmail.com

Introduction

In the desert and steppe of Algeria, camel has always been important animal and contributed to the social and economic sustainability of the farming communities and played an integral part of the peoples' social well-being and the socio-economic landscape. Unfortunately, this animal has and continues to be badly exploited following the traditional practices in animal husbandry.

Several studies have shown that the Arabian camel has a better ability to digest poor forage than other domestic ruminants due to greater retention of the solid particles in the pre-stomachs (Faye et al., 1993). Therefore, camels would be more suited for the arid and semi-arid southern Algeria where feeds are scarce and often of low quality. The Arabian camel is well adapted to the desert and hot climate with range of physiological and biochemical adaptations that allow it to manage the environmental constraints (strong circadian temperature, low nutritional value and dispersion of food resources). Indeed, in addition to its traditional use for production (milk, meat, leather, and fiber), camel plays a key role as a pack animal or work. It represents an important adjunct to the use and exploitation of spaces and the desert or semi-desert flora.

Despite its economic and social importance, little work on the physiology, pathology and biochemistry of this animal were undertaken in Algeria. In this context, our work aims to determine the normal values of the main blood biochemical parameters in camels and relate that to some physiological parameters such as age, sex and breed.

Materiel and Methods

Our study was carried out in the slaughterhouse of the Ouargla province (800 km from the capital Algiers). It was conducted during the period March-August, 2015.

At the slaughterhouse, 22 healthy camels were examined and clinical examination revealed no pathology. Any animal having had a medical history or of suspect clinical condition at the time of sampling was eliminated. These animals were of different sex (male and female) of any age (young, 1 to 4 years; adult, 5-8 years) and from two breeds, Sahraoui and Tergui. These camels were from natural arid grasslands, whose vegetation is native herbs, such as the saltbush (*Atriplex halimus*), *Astragalus* sp. and mugwort (*Artemisia vulgaris*).

Sampling

In sternal recumbence, the blood sampling from the jugular vein is made easier when

the neck folded up against the body. Such position makes waking up difficult. The blood samples were collected into a pre labeled tubes, stored on ice and transported to the laboratory. Each sample was accompanied by a sheet of information that includes the date and place of sampling, age, sex and breed. In the laboratory, the tubes were immediately centrifuged (15 minutes at 3000 rpm) and serum was immediately retained.

From the animals examined, 22 samples were taken in order to determine the normal values of the main blood biochemical parameters. Analyses focused on the following metabolic traits: glucose, urea, creatinine, total cholesterol, high density lipoprotein (HDL) Cholesterol and low density lipoprotein (LDL) cholesterol.

Biochemical Analysis

Serum glucose was measured by the glucose-oxidase method; serum cholesterol (total, LDL, and HDL) and triglycerides levels were assayed by standard enzymatic methods. .

Statistical analysis

The effects of gender, age and breed were tested by analysis of variance (ANOVA).The results are expressed as mean± se, where se is the standard error of the mean.

Results and discussion

Mean values of biochemical profile are presented in Table 1.

Glucose

Our results show an average serum glucose concentration of 5±2.11mmol/L. This value is similar to that reported by Ben Romdhane et al. (2003). Higher values have been reported by Bogin (2000) and Nyang (1997). These higher values can be explained by the fact that the animals received barley based grain supplements. However, Bengoumi et al. (2002) reported that blood glucose in camels over two seasons remain relatively stable, but noted that, in the dry season, glucose was significantly higher ($P<0.05$) than that in the wet season.

The Arabian camel has an active gluconeogenesis which allows it to maintain an almost normal blood sugar when food deprivation (Bengoumi and Faye, 2002). After water deprivation for 10 days, blood glucose levels rise 20 to 80% according to the authors (Banerjee and Bhattacharje, 1963; Macfarlane et al., 1962) while glucose remains zero. Hyperglycemia is due to the absence of renal elimination of glucose and the decrease of its use. Moreover, the camel's energy metabolism differs in particular from that of ruminants. The Arabian camel

presents a normal glucose value of 5 mmol/L, which is similar to that reported for simple stomach animals. This phenomenon has been explained by a high gluconeogenesis and a very low level of insulin in camels (Souilem et al., 1999).

Creatinine

Our results show a mean serum creatinine of 130.9±24.1 µmol/L, Al Jassim (2016) reported that the mean normal range of creatinine was 110.4 ± 5.5 (88-135), Snow (1998) on a set of nine camels recorded an average of 16.1 mg /l. Such variations can be explained by various factors, including differences in assay techniques used, the type of farming, feed, season and geographical area (Ben Romdhane, 2003).

Urea

Our results (2.56±0.72 mmol/L) were closed with those reported by Al Jassim (2016) (2.5-4.3 mmol/L), and those of Nazifi et al. (1998) (1.96 g /l). We assume that natural vegetation provides a significant intake of protein. Otherwise, the amount of urea excreted in urine is very low due to the camels' remarkable capacity to recycle urea. This recycling allows the animal to respond well to protein dietary deficits and maintain protein synthesis in the rumen. This is manifested by a rather stable urea concentration in the Arabian camel (Faye and Mulato, 1999).

Table 1. Means values of biochemical parameters of Arabian camels in Algeria.

Blood parameters	**Mean ± SE**	**Minimum**	**Maximum**
Glucose (mmol/L)	5±2.11	1.44	11.17
Creatinine (µmol/L)	131±24.1	44	194
Urea (mmol/L)	2.6±0.72	0.72	5.61
Total Cholesterol (mmol/L)	1±039	0.17	2.44
Triglycerides (mmol/L)	1± 0.39	0.22	5.56
HDL Cholesterol (mmol/L)	0.0±0.04	0.00	0.22
LDL Cholesterol (mmol/L)	0.06±0.09	0.011	0.3

Indeed, Faye (1997) reported that in a protein deficit situation, the camel excretes only 1% of urea in urines. The metabolism of urea is strongly influenced by dehydration and a remarkable increase in uremia is noted (Orskov & Whitelaw, 1989; Bengoumi, 1992; Faye, 1997). Contrary to the other mammals, the Arabian camel has very particular anatomical structures in the kidney, which limit considerably the urea elimination by the urine (Mahmud et al., 1984). The urea appears to play a significant role during dehydration in the Arabian camel. Indeed, by its osmotic effects, the urea attracts the water of other mediums towards the plasma (Gihad et al., 1989).

Lipid profile

Results of lipid profile including total cholesterol, triglycerides, HDL cholesterol and LDL cholesterol are presented in Table 1. The known capacity of the Arabian camel to resist to thirst and lack of feed is related to its remarkable adaptive mechanisms, including the mobilization of the body reserves of lipids (fatty tissue) during malnutrition and the storage of fat during favorable periods (Tarik et al., 2003; Dereje and Ud'en, 2005).

Total cholesterol

For cholesterol (1mmol/L), our results are similar to those reported by Al Jassim et al. (2016) (0.5- 1.2 mmol/L). The concentration of cholesterol increases in the dehydrated Arabian camel as a consequence of the hypothyroidism (Nazifi, 1999).

The lipids of the camel's hump are composed especially of phospholipids and traces of triglycerides. The hump's volume varies depending on the nutritional state. Lipogenic activity is comparable with that of the liver. The fat concentration in this locality contributes to limit the dispersion of the "fat" in the other parts of the body, limit their distribution under the skin and thus facilitate the cutaneous dissipation of heat (Souilem et Berhoumi, 2009).

Triglycerides

Our results show a high average plasma triglyceride (1mmol/L) compared with those reported in a study of 21 camels by Nazifi et al (1998) (0.000116) and Al Jassim (2016) (0.5 mmol/L) and a lower one from those indicated by Faye et al. (1991) (0.266 g/ l or 1.48 mmol/L), in a study conducted on a set of 52 camels. Moreover, Nazifi et al (1998) show that triglycerides vary with climate, age and gender.

In dehydrated camel, liver lipid content decreases by 2.5 to 13%, indicating a

mobilization of liver fat (Bengoumi and Faye, 2002). In contrast, triglyceride levels and the concentration of free fatty acids remain unchanged (Mahmud et al. 1984).

HDL cholesterol

The average value of HDL was 0.00 ± 0,04 mmol/L. It ranged from 0.00 and 0.22 mmol/L. Our results were similar to those reported by Alshamsi (2015) (0.0001257 g /L or 0 mmol/L) and Ben Romdhane et al. (2003) (0.0002578 g /L).

LDL cholesterol

Nazifi et al. (1999) showed that the concentrations of lipid parameters in Arabian camel vary depending on the climate and are higher in winter than in summer. This could be the likely increased energy needs during the cold period. These values could also report the status of starvation animals especially during the dry season. This period corresponds to the famine and also to very poor foods. This would be consistent with Kolb (1975) who noted a decrease in lipid levels during starvation. However, Faye et al. (1991) observed a much lower concentration in cholesterol in cattle. Moreover, Al Rehaimi (1989) showed that cholesterol and lipids have a significantly lower value in the camel compared to sheep.

Biochemical parameters in camels were influenced by a several factors such as genetics, physiology, diet and geographical location. It seemed thus important to look for changes in these parameters mainly age, gender and breed. The comparison between age groups showed higher values for young camels compared to adults for these parameters: glucose, total cholesterol, HDL and LDL cholesterol, and triglycerides, without significant difference (Table 2). On the other hand, urea was slightly lower among young camel than the adults, . whereas, creatinine values were similar between the two groups. However, LDL was significantly higher for the young animals than the adults.

Statistically significant variations according to the age were also observed for several parameters. For younger camels (age <4 years) we noted an increase in glucose serum level, triglycerides and HDL compared to adults (Ben Romdhane, 2003) but there were no significant difference (table 2).

About serum glucose, urea and creatinine, the values were slightly higher in males than in females, while the other parameters such as total cholesterol, LDL cholesterol and triglycerides, have a lower value in males compared to females. For the value of HDL cholesterol, similar values were

observed in males and females. Regarding the physiological status of female, Nazifi et al. (1999) showed that the values of cholesterol and triglyceride levels were higher in females that in males, this may be probably due to food complementation distributed to females.

According to the breed, our results showed a high value of cholesterol, HDL cholesterol, LDL and triglycerides and lower ones for glucose, urea and creatinine, among the Sahraoui breed than Targui breed. Breed factor had a statistical effect (P=0.036). Total cholesterol was slightly higher for the Sahraoui breed than for Targui breed (table 2). HDL value was significantly higher for the Sahraoui breed than for Targui breed (p=0.032). It must be noted that Sahraoui et al. (2014) showed that the meat of Sahraoui is richer in fats than Targui breed.

Conclusion

Our study shows that glucose serum content in the Arabian camel is similar to those reported in the literature. In comparison to ruminant animals, the Arabian camel has a higher blood glucose levels, close to that of simple stomach animals.

For the levels of creatinine and urea levels, similar concentrations were found when compared to the literature. The lipid represented by total cholesterol, LDL cholesterol, and HDL, and triglycerides were within the normal ranges reported by others.

The plasma metabolites were influences by breed, age and sex, in agreement with previous results.

References

Al Jassim R.A.M., Shahsavari A., Owen H. and Khamas W. 2016. Gross pathology, biochemistry and histology of selected organs of camels suffering from suspected monensin toxicosis in Australia. *Journal of Veterinary Science and technology*, 7 (3): 1-5.

Al Rehaimi A.A., Al Ali A.K., Mutairy A.R. and Dissanayake A.S. 1989. A comparative study of enzyme profile of camel (*Camelus dromedarius*) hump and sheep (Ovis aries) tail tissues. Comparative Biochemistry & Physiology, B. 93(4): 857-858.

Alshamsi N.S., Ksiksi T.S. and Ashraf S.S. 2015. Altered serum enzymes and biochemical levels in arabian racing camels with bone fractures. *Journal of Animal & Plant Sciences*, 25(4): 1072-1080.

Banerjee S. and Bhattacharjee R.C. 1963. Distribution of water body in the camel (*Camelus dromedarius*). *American Journal of Physiology*, 204: 1045-1047.

Table 2. Effect of age, sex and race on the blood parameters of Arabian camels in Algeria.

Blood parameters	Age		Sex		Breed	
	Young [1-4 years]	Adult [5-8 years]	Male	Female	Sahraoui	Tergui
Glucose (mmol/L)	11±1.83	9.33±3.94	10.33±2.94	10.28±3.83	9.61±3.67	11.61±1.44
Urea (mmol/L)	2.28±0.78	2.72±1.28	2.61±1.11	2.22±0.78	2.44±1.17	2.56±0.72
Creatinine (µmol/L)	129±20.7	129±39.6	134±34.7	115.9±14.1	128±36.2	131±20.8
Total Cholestérol (mmol/L)	1.78±0.89	1.11±0.78	1.28±0.72	1.78±1.17	1.67±10	1±0.39
Triglycerides (mmol/L)	2±1.28	1.06±0.83	1.5±1.28	1.72±0.94	1.56±0.89	1.5±1.56
HDL (mmol/L)	0.06±0.11	0±0.06	0.06±0.06	0.06±0.06	0.06±0.06	0 ±0.04
LDL (mmol/L)	0.11 ±0.11	0.06±0.06	0.06±0.06	0.11±0.11	0.11±0.06	0.06±0.06

Bengoumi M. and Faye B. 2002. Adaptation du dromadaire à la déshydratation Science et changements planétaires / Sécheresse, 13 (2).

Bengoumi M. 1992. Biochimie clinique du dromadaire et mécanismes de son adaptation à la déshydratation. Thèse Doctorat Sciences Agronomiques. IAV Hassan II, Rabat, Maroc.184 pp.

Bengoumi M., Faye B. and De La Farge F. (1998). Clinical enzymology in the dromedary camels. Part IV. Effect of dehydration on serum AST, ALT, GGT, AP, and LDH activities. *Journal of Camel Research and Practices* 5: 119-122.

Bengoumi M., Kouniba A., Vias G. and Faye B. 2002. Camel milk and traditional cheese in the subsaharian Africa: cheese art, 04-09 June 2002, Ragusa, Italy.

Ben Romdhane S., Romdane M.N., Feki M., Sanhagi H., Kaabachi N. and M'bazaa A. 2003. Valeurs usuelles des principaux constituants biochimiques sériques du dromadaire *(Camelus dromedarius) Revue Médecine Vétérinaire,* 154 (11) : 695-702.

Bogin E. 2000. Clinical pathology of camelids: present and future. Revue Medicine Véterinaire 151: 563-568.

Dereje M. and Ud´en P. 2005. The browsing dromedary camel. Behaviour, plant preference and quality of forage selected. Animal Feed Science and Technology, 121: 297-308.

Faye B. and Mulato C. 1991. Facteurs de variations des paramètres protéo - énergétiques enzymatiques et minéraux dans le plasma chez le dromadaire de Djibouti. *Revue d'Elevage et de Médecine des pays tropicaux*, 44: 325-334.

Faye B. 1997. Guide de l'élevage du dromadaire. Edition CIRADEMVT, Montpellier, 126 p.

Faye B., Ratovonanahary M. and Cherrier R. 1993. Effet d'un facteur alimentaire sur la pathologie néonatale : résultats d'une enquête rétrospective sur la distribution de mangrove aux chamelons en République de Djibouti. Revue d' Elevage et Medecine. Veterinaire. Pays Trop., 46(3): 471-478.

Gihad E.A., El-Gallad T.T., Sooud A.E., Farid M.F.A. and HM Abou El-Nasr. 1989. Feed and water intake, digestibility and nitrogen utilization by camels compared to sheep and goats fed low protein desert by-products. Options Méditerranéennes - Série Séminaires, 2: 75-81.

Kolb E. 1975. Physiologie des animaux domestiques». Paris, Vigot Frères.; ed., 1 vol., 974 p.

Macfarlane W.V., Morris R.J.H. and Howard B. 1962. Water metabolism of merino sheep and camels. *Australian Journal of crop Science*, 25: 112-21.

Mahmud H.M., Abdulhamid H.M. and Locatelli A. 1984. Water deprivation

effects on the hematological and hematochemical pictures of (Camelus domedarius). *Revue Elevage Médecine Véterinaire Pays Trp.,* 37: 313-317.

Nazifi S. and Gheisari H.R. 1999.The influences of thermal stress on serum lipids of camel (*Camelus dromedarius*). *Journal Camel Practice. Research*, 6: 307-309.

Nazifi S. and Maleki K. 1998. Biochemical analysis of serum and cerebrospinal fluid in clinically normal adult camels (*Camelus dromedarius*). Research in *Veterinary Science.* 65: 83-84.

Nyang A.O. 1997. A study of some hematological and biochemical parameters of the normal dromedary camel in Kenya. *Journal Camel Practice. Research*, 4: 31-33.

Orskov E.R. and Whitelaw F.G. 1989. Le recyclage de l'azote dans les tractus gastro-intestinal. Options Méditerranéennes - Série Séminaires, 2: 99.

Sahraoui N., Dotreppe O., Brahim Errahmani M., Boudjenah S., Babelhadj B., Guetarni D. and Hornick J.L. 2014. Caractérisation des acides gras de la viande cameline en Algérie», *cahiers de nutrition et diétitique*.

Snow D.H., Billlah A. and Ridha A. 1998. Effect of maximal exercise on the blood composition of the racing camel, *Veterinary Research*, 123: 311-312.

Souilem O. and Barhoumi K. 2009. Physiological Particularities of Dromedary (*Camelus dromedarius*) and Experimental Implications Scand. Journal of Laboratory Animal Science. Vol. 36 No. 1.

Souilem O., Chine O., Alguemi C. et. Gogny M. 1999. Étude de la glycémie chez le dromadaire (Camelus dromedarius) en Tunisie: résultats préliminaires. *Revue de Medecine vétérinaire*, 1506: 537-542.

Tarik N.R., El-Faer M.Z. and Koreish S.A .1994. Fatty Acid Composition of the Meat and Fat of the One Humped Camel (*Camelus dromedarius*). Meat Science, 37: 149-155.