International Journal of Innovation Scientific Research and Review
Vol. 04, Issue, 03, pp.2480-2484, March 2022
Available online at http://www.journalijisr.com
SJIF Impact Factor 4.95

ISSN: 2582-6131

Research Article

EFFECTS OF RUNNING EXERCISE ON SOME HEMATOLOGICAL PARAMETERS OF RACING CAMEL (CAMELUS DROMEDAIRUS) IN SUDAN

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Received 13th January 2022; Accepted 15th February 2022; Published online 21th March 2022

ABSTRACT

This study was carried out at the University of Kordofan, in North Kordofan State, Sudan. Twenty male of dromedary camels (Camelus dromedarius) at similar age were used in this study. The objective of the study was to investigate the effects of racing and running exercise on some blood constituents of the camels. Blood samples were collected before and after racing. The effects of racing on some blood hematological metabolites, some minerals profile, non-estrified fatty acids and blood urea were studied. The data were statistically analyzed using analysis of variance and T- test was used to evaluate the effects of racing on blood constituents of the camels and simple correlation coefficients between the parameters were applied. The results showed highly significant differences ($P<0.05$) in hemoglobin (HB) and packed cell volume, PCV, after racing and lower before racing. Similarly total protein and albumin concentrations increased after maximal exercise. On the other hand blood glucose values were higher ($P< 0.001$) before racing compared with its values after racing. The results also indicated that plasma Ca and P levels were highly significant ($P<0.001$) after racing. non-estrified fatty acids were highly significant ($P<0.001$) after racing compared with values before racing as well as blood urea concentration. High correlation coefficients (positive or negative) between blood constituents were found after racing. It was concluded that all blood constituents of camels were greatly influenced by racing. They increase after racing except glucose that decrease after racing. The results indicated lower levels of glucose reserve in blood content after running, indicated by a minimal increase in hemoglobin concentration and haematocrit. On the other hand there were marked increases in plasma lactate (to over 20 mmol/litre), plasma ammonia and plasma glucose and a pronounced decrease in circulating free fatty acids. There were small but significant increases in plasma calcium and phosphorous concentrations. It was recommended that through investigation and further studies be conducted for assessment the effects of maximal exercise on all camel blood constituents.

Keywords: camel, racing Exercise, blood constituents.

INTRODUCTION

Sudan is a vast agricultural country in Africa. It has over 130 millions heads of livestock and ranked the second country in the world in camel population. According to last estimations of camels in Sudan there we 3.908 million heads (MARF, 2005). Camels in the Sudan are spread in a belt known as camel belt. This belt extends between latitudes 12-16 N. It is characterized by erratic rainfall, less than 75-150 mm/year. Migration to the southern parts of the country is limited by diseases such as Trypanosomosis, internal and external parasites and the unsuitability of the clay soils with camel pads (Bakheit *et al.,* 2006). The majority of camels are kept under patterns of pastoralists "*Abbala*". Sudan is the home to some of the most well-known camel nomads. camel owners prevail with limited resources in subsistence production systems (Pacholek *et al.,* 2000,). Most camels are raised within pastoral systems in the western Kordofan and Darfur and eastern regions of the country. Kordofan alone owns 1.45 million heads. In other words, about 37 percent of the total camel population in the country is in Kordofan (Administration of Animal Resources North Kordofan State, 2006). The Kababish, Hawaweer, Kawahla, Hammar and Shanabla tribes of North Kordofan are the main communities who herd camels. Camel (*Camelus dromedarius*) is an important multipurpose animal in arid and semi-arid areas of the world. There are about 20 million camels in the world (FAO, 2003). They are kept for a variety of purposes e.g. transportation, racing and as source of human food for instance milk and meat (Faye, 2008). The camel is the most famous animal of the desert and it can cross the scorching expanse of the Sahara. The extraordinary attributes of the camel as a riding and pack animal have been appreciated by many desert travelers (Pacholek *et al.,* 2000; Shuiep *et al.,* 2008). Camel research in the Sudan has been focused mainly on functional anatomy, diseases and reproduction. However, research on husbandry and management systems, feeding and nutrition and production performance are scanty (Faye *et al.,* 2014). In the last few years some new patterns of camel husbandry practices were developed for the improvement of the traditional systems of camel keeping systems. In recent years a considerable amount of research has been carried out on the blood chemistry of the camel. Much of this has taken place in India, Egypt and Sudan, and to a lesser extent in Israel. Unfortunately, many of the results appear to be contradictory, the anomalies perhaps arising from different methods of analysis and the difficulties of reproducing the same conditions in exactly the same way. Some of the differences can be explained by seasonal and nutritional factors and by the effects of sex and the rut but many anomalies are unexplained. The ability of the animal to meet the high metabolic demand of the functional gland depends on the differing environmental or nutritional conditions and genetic capacity. In camels, however, little is known about the physiological mechanism controlling these processes and the biochemical blood content.

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The objective of the study

The main objectives of this study to:

- Study the effect of maximal exercise running on camel blood biochemistry
- Investigate the role of blood minerals in racing camels-
- Study the haematological and serum biochemical values of racing camels
- Assess the impact of hard exercise and stress on racing camel blood components.

MATERIALS AND METHODS

the Study Area

This study was conducted in North Kordofan State during the period October 2016 to study the effect of running exercise on camel blood Components. The study area extends between latitudes 11°:15'to16°:30'N; longitudes 27-32°E; altitudes. North Kordofan is divided into three agro-climatic zones; the semi desert zone with a rainfall varying from 75-150 mm/year and growing season from 30 to less than 60 days, an desert with a rainfall of 0-75 mm/year and a growing season from 60 to less than 90 days and low rainfall savanna precipitation varying from 350-450 mm/year and a growing season duration of 90 to less than 120 days. Average temperature are modified by precipitation varies between 30-35°C during most of the year with peaks of above 40°C during April, May and June. The rainy season extends from July to October with maximum rainfall in August (Technoseve, 1987; El-Tahir *et al.*, 1999). Soils vary from sandy in the north to heavy cracking clay in the south. Sandy soils cover about 60% of the cultivable area, while clay and sandy loam soils cover only 30%. The sandy soil is stabilized sand dunes locally known as "*goz*". The central sandy soils are covered with *Acacia senegal* savannah. Traditionally, the area is known for production of gum Arabic. The clay soils in the south are covered with thorny savannah woodland *Acacia seyal* and *Balanites aegyptiaca*. Understory vegetation is dominated by annual grasses (over 90.0%) with leguminous plants and forbs confined to low lying areas and silt depressions (Khatir and Jadalla, 2014).

Experimental Animals

A total of twenty (20) male of dromedary racing camel were selected in similar age proximately. The experimental animals were marked by clear numerical characters before racing. Samples were obtained from two year-old male camels which were grazing naturally in the area of Abu Deleig (North-east of Khartoum town). A further 48 samples were obtained from twelve two-years old camels housed in open shades at Sudan University of Science and Technology (SUST) Experimental Farm. The camels were kept on roughage, concentrate mixture to satisfy their nutritional requirements**.**

Hematological Indices:
Blood samples Collection and Processing:

Samples of blood were collected from camels jugular vein puncture. the samples were taken without anticoagulant from the camel jugular vein for blood biochemical analysis, using sterilized disposal Vacutanors, isolated ice-boxes were used for blood transferring to the laboratory. Blood samples were collected from each camel using 10 ml plastic disposable syringes before and after exercise immediately. five milliliter (5cc) of the blood sample were immediately taken before and after racing, The samples were transferred to cap and heparin zed tubes (Medical Disposable Industrial Complex MDIC). These camel blood samples were used for the hematological analyses and the determination of plasma glucose concentration. The rest of the samples were allowed to clot for 2h at room temperature, the sera were then separated by centrifugation at 3000 rpm for 15 min and stored frozen at -20C for further analysis. From these blood samples, glucose, non-esterified fatty acids and urea contents were measured. Blood samples were kept for 15 minutes at room temperature and then centrifuged to obtain serum for biochemical analysis which kept in freezer pending chemical analysis for blood biochemical parameters that included Blood Heamoglobin (HB), packed cell volume (PCV), total protein, albumin, glucose, calcium, phosphorous, non-esterified fatty acids and urea concentrations.

Packed Cell Volume (PCV) and Hemoglobin:

Packed cell volume was determined by the micro-haematocrit method using a special centrifuge. Haemoglobin concentration was determined by the cyano-methaemoglobin method as described by Van Kampen and Zijlstra(1966).

Plasma Glucose

The glucose of the serum was determined according to Hisham *et al*., (2007) using enzymatic method (Glucose RTU, KIT, Ref. 61 270). Glucose is the main source of energy for cells (glycolysis). It is supplied by food in the form of polysaccharides, disaccharides, or simple sugars which they are hydrolyzed during digestion into monosaccharide, including glucose. In the liver and muscles, glucose is partially transformed into glycogen, a storage polymer. In case of increased energy needs, glycogenolysis and/or biosynthesis of glucose occurs in the liver.Glucose is determined using the glucose oxidase – peroxidase – chromogen sequence.

$$\text{Glucose} + O_2 \xrightarrow{\text{glucose oxidase}} \text{gluconic acid} + H_2O_2$$

The hydrogen peroxide formed is tittered according to the small reaction (Hisham *et al*., (2007).

$$2H_2O_2 + \text{phenol} + \text{4-aminoantipyrine} \xrightarrow{\text{peroxidase}} \text{quinoneimine} + 4H_2O$$

The color intensity (quinoneimine), measured at 505 nm is proportional to the quantity of glucose in the sample.

Serum Metabolites

Serum total protein concentration was determined using Biuret reagent (King, and Wootton, 1956). Serum albumin concentration was determined by a colorimetric method according to (Douman *et al.*, 1971).

Blood Minerals Concentrations (Ca & P):

Phosphorus and Calcium in blood plasma were determined according to the methods of **(**Henry and winkalman 1974**).**

Determination of Non-esterified Fatty Acid (NEFA)

Non-esterified fatty acids in serum were determined according to enzymatic colour test ACS-ACOD Method (Mulder *et al*., 1983). The ACS-ACOD Method for NEFA Kit test utilizes an *in Vitro* enzymatic colorimetric method the quantization of non-esterified fatty acid in serum.

$$\text{Acyl-CoA} + \text{AMP} + \text{PPi} \xrightarrow{\text{RCOOH}} + \text{ATP} + \text{CoA-SH} \quad \text{ACD}$$

$$\text{Acyl-CoA} + O_2 \xrightarrow{\text{ACOD}} \text{2,3-trans-Enoyl-CoA} + H_2O_2$$

Quinoneimine-color + $4H_2O2H_2O_2$ + 4-Aminophenazone + MEHA POD

The intensity of the red pigment is proportional to the concentration of free fatty acids in the sample. Ascorbic acid is removed by ascorbate oxidase from the sample.

Determination of Blood Urea

Urea of the serum is determined according to Orsonneau *et al.*,(1992) using enzymatic method (Urea, KIT S, Urease-modified Berthelot reaction, Ref. 61 912/ 61 913). Urea end product of amino acids catabolism. Is synthesized in the liver and for 90% eliminated in the urine. Urea-Kit S enables end point enzymatic determination of urea concentration (Urea-modified Berthelot reaction). Urease hydrolyzes urea by producing ammonium.

$2NH_3 + CO_2 \longrightarrow$ Urea + H_2O urease

In an alkaline medium, the ammonium ions react with the salicylate and hypochlorite to from a green colored indophenol (2,2-dicarboxylindophenol). The reaction is catalyzed by the Sodium nitroprusside. The colour intensity is proportional to the urea concentration in the sample.

The effects of Running exercise on Hb and pcv of camels

The results of the study showed that maximal exercise was affected significantly on Packed Cell Volume (PCV) and Hemoglobin (HB) of the camel. The data presented in table (1) indicated that HB after racing was significantly(P< 0.00)increased compared with before racing also PCV% was higher after racing (35.12%) and lower before racing (32.65) .

Table 1. Effect of Running Exercise on Camel HB and PCV

No	20	20	
Items	Mean before Racing	Mean after Racing	
HB	7.175	8.65	17.72***
PCV%	32.65	35.12	49.02***

Effects of running exercise on total protein and albumin in camel

The results indicated that the total protein and albumin concentrations were affected significantly by hard exercise of racing camel, the results indicated that there were increasing in concentration after racing 10.49% and 4.77% compared with 5.25% and 3.95% before racing for total protein and serum albumin, respectively.

Table 2. The Effect Exercise on total protein and Albumin of camel blood

No	20	20	
Items	before Racing	after Racing	T test
total protein	5.25	10.47	16.68***
Albumin	3.94	4.77	17.74**

Effects of Running Exercise on blood glucose

From the data presented in table (3) the results demonstrated that the glucose level glucose before racing .the findings of this study showing that there were significant effect (P<0.01) on the concentration of blood glucose the lowest level of glucose (g/l) recorded after racing (0.53 g/l) and higher before racing (0.81 g/l**).**

Table (3).The effect of running exercise on camel blood on Glucose

	Mean	T test
before Racing	0.81 g/l	**.006*** **
after Racing	0.53 g/l	

Effects of Running Exercise on blood Ca and P

The data demonstrated the effect of racing on plasma calcium and phosphorus levels are displayed in Table (4) . The results showed that plasma Ca and P levels were highly significant (P<0.000) after racing compared with before racing. The results indicated that the concentrations of camel blood minerals Ca and P were increased from 6.6 and 9.26 before exercise to 11.92 and 112.96 after racing, respectively.

Table 4 .The effect of exercise on camel blood Ca and P concentration

No.	20	20	
Items	Mean before Racing	Mean after Racing	T test
Calcium	7.60	11.92	35.53***
Phosphorous	9.26	12.96	18.31***

Effect of running exercise racing on Non-esterified Fatty acids Content

In table (5) the data demonstrated the effect of Racing on camel blood non-strified fatty acids. The results showed that the Racing have highly significant (P<0.01) effect on non-estrified fatty acids and the average mean before Racing and after Racing was 0.30 mmol/l and 0.42 mmol/l, respectively. non-estrified fatty acids were increased significantly (P<0.000) after racing compared with before racing

Table 5. The Effect of running exercise on Non-esterified Fatty acids Content

Item	No	Mean	T test
before Racing	20	0.302 mmol/l	0.006***
after Racing	17	0.422 mmol/l	

Effect of racing on camel Blood Urea concentration

The results indicated that the Effect Of Racing was highly significant (P<0.001) and the average means of the blood urea content was (0.19) and (0.34) before Racing and after Racing, respectively, the results showed increased in the urea level after exercise and racing, table (6).

Table 6. the effect of racing on camel Blood Urea concentration

Item	No	Mean	T test
before Racing	20	0.19 g/l	0.008***
after Racing	20	0.34 g/l	

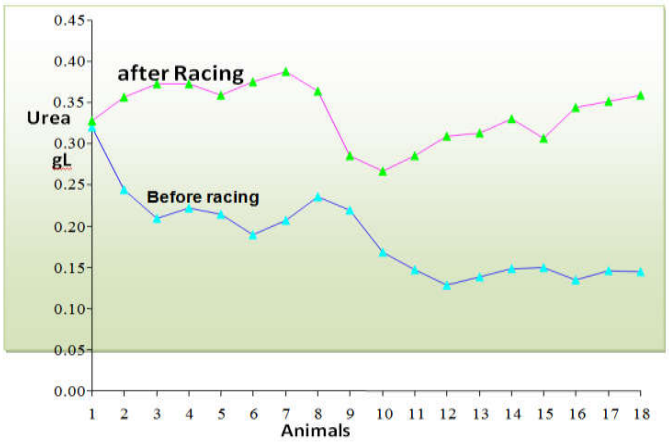

Figure (1).Effect of racing on Blood Urea Concentration (g/l)

Correlation between racing and haematological parameters in racing camel

Table (4.7**)** displays simple correlation coefficients among the different Camel blood parameters studied. HB after racing simple correlation coefficients was highly positive (P<0.01) with PCV% after **(r= .63) ,** but negative with total protein after, Glucose after and Ca but they were not significant (P>0.05). PCV% after was found to be positively correlated (P>0.05) with Albumin after **(r=.24)** but negatively correlated with blood glucose (r=-0. **121**), total protein (r=-0**.38**) , Ca (r=-0. **634**) and Ph (r=-0 **.186**) but they were not significant (P>0.05). Blood protein after racing simple correlation coefficients was positive (P<0.05) with blood glucose, Ca and P and negatively correlated with blood Albumin but they were not significant (P>0.05). Albumin was found to be negatively correlated (P>0.05) with blood glucose, Ca and P. Also blood glucose was negative correlated (P>0.05) with Ca and P contents.

Table 7. Simple correlation coefficients among the different parameters.

	HB after Racing	PCV% after racing	total protein after racing	Albumin after racing	Glucose after racing	Ca After racing	*PH* after racing
HB after racing	1	.63**	.13ns-	.32ns	45ns-	ns-39	.00 5ns
PCV% after racing		1	ns.-.38	.24 ns	ns.-.121	.-**.634	ns**.**-.186
protein after racing			1	ns.-.421	..09ns	.019ns	.164ns
Albumin after racing				1	ns.-.311	ns.-.196	ns**.**-.006
Glucose after racing					1	ns.-.116	**.**-*.48
Ca After racing						1	**.**.009NS
Ph After racing							1

DISCUSSION

Haematological parameters including, Hb and PCV were studied in dromedary camels examined in study area (n=20) to investigate the effect of race stress on blood constituents of camels (*Camelus dromedarius*) kept under tropical conditions in North Kordofan State, Sudan. The results obtained would be useful for establishment of normal hematological indices, normal serum metabolites including glucose , urea, non-esterified fatty acids, total protein and albumin also mineral profile for camels (Ca and P) were studied. Results of effect of Racing on HB and PCV, were showed that HB after racing was significantly increased (P < 0.00) compared with before Racing also PCV% was higher after Racing (35.12%) and lower before Racing (32.65). The findings of this study were inline of the same parameters were studied in dromedary camels in fatty acids , total protein and albumin (n=4). Mean and standard deviation values for Hb, PCV, 6.18 ± 1.86 mmol/L, 0.29 ± .09, respectively). Haematological and blood biochemical changes were studied in nine camels after maximal exercise over 4 or 5 km. There was, indicated by a minimal increase in haemoglobin concentration and haematocrit (Snow, et al. 1988) and this result was on line with this study. Results of effect of racing on serum metabolites are shown in (Table 2). Racing was significantly affected on total protein and Albumin total protein was higher (P < 0.00) after racing (10.47) and lower before racing (5.25). Also Albumin was high after racing (P < 0.01) compared with before racing. There were small but significant increases in plasma calcium and phosphate concentrations (Snow, et al. 1988) The average means of glucose content in the present study was 0.81 ± 0.007 g/l and 0.53 ± 0.005 g/l before and after racing respectively. The results indicated that the Glucose concentration was higher in camels managed before racing which compared with that raised after racing this may be attributed to the low level of glucose in camel reared after racing to the highly stress. These results which presented as in line with the findings of Faye *et al* (1992) who reported that the average of plasma Glucose concentration was 79.7±5.4 mg/100ml; the authors observed that the Glucose level was higher before racing and decreasing after racing and this will attributed to the consumption of energy due to the efforts that was done during racing exercise. On the other hand, the glucose content after racing was agreement of the mentioned author. The results of this study showed that the camels reared before racing, management and allowed supplementation diets recorded highest values of glucose content and this coincidence could be justified by the concentration diets which allowed to camels also the results before racing were agreement with the findings of Chandrasena *et al*., (1979). The average means of non-estrified fatty acids content in the present study was 0.30 ± 0.004 mmol/l and 0.42 ± 0.007 mmol/l in before and after racing respectively. The results indicated that the NEFA concentration in the blood of the camels reared after racing was significantly (P<0.05) higher than that recorded before racing, this may be attributed to the effect of racing that allowed to the animals. The results of the present study were agreement with the findings of Faye et al (1992) who reported that the mean value for free fatty acids was 0.25 ± 0.07 mmol/l. The average means of blood urea content in the present study was 0.19 ± 0.01 g/l and 0.34 ± 0.005 g/l before and after racing respectively. The results of this study were in line of the findings of Faye *et al.,*(2008) who reported that the plasma urea concentration was 30.0±14.8 mg/100 ml. the results showed that the level of urea was significantly (P<0.05) higher in camels reared after racing and having nothings as supplemented food, this may be due to the breakdown of amino acids of the tissue protein to supply the energy so the camels in the previous management were hit by starvation due to the shortage of food during dry periods,

CONCLUSION AND RECOMMENDATION

The study concluded that the hard exercise or running affected significantly on Camel blood composition like Hematological parameters and mineral profile. In It can be recommended that more studies need to be carried out to investigate the effect of racing stress on camels with regard to the other variables which may influence the blood constituents.

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