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SEASONAL EFFECTS ON BLOOD AND TISSUE LIPIDS OF CAMELS (*Camelus dromedaries*)

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ABSTRACT

Blood and tissue lipids of camels were studied in summer and winter, where fat mobilization and deposition, respectively, may prevail parallel to the changing food availability and the nutritional state. When animals were better nourished in winter, serum concentrations of total lipids, triglycerides and total cholesterol increased. Extracted fat content in adipose tissue was also greater in winter than in summer. Adipose fatty acids were less saturated and average chain length was shorter in winter than in summer. Further experimentation dealing with possible metabolic adaptations in camels in comparison to ruminants is warranted.
Keywords: Camel, season, blood lipids, tissue lipids.

INTRODUCTION

The ability of camels to cope with food and water shortage and heat stress is exceptional. This can be attributed to several mechanisms of adaptation: behavioral, anatomic, physiologic and metabolic. Among these is the mobilization of body fat reserves when undernourished and regeneration when food is available (Chilliard *et al*., 2004). Under these conditions, camels exhibit physiological adaptations including high plasma glucose and low insulin levels (Kaski *et al.,* 2001 and Wensvoort *et al.,* 2001) when the rate of non estratified fatty acids (NEFA) released from the adipose tissue is increased. Characteristics of blood serum, and hump and abdominal lipids were studied in normal subjects as well as during rut and the effects of age and sex (Mirgani, 1977; Nazifi *et al.,* 2000; Kadim *et al.,* 2002; Mohamed, 2008 and Patodkar, 2010). The present study was carried out to examine the characteristics of blood serum and tissue lipids of camels in summer where animals may be faced with heat stress and feed shortage compared to that occurred in winter.

MATERIALS AND METHODS

Two experiments were carried out. The first was at Maryout Desert Research Station. Five non-pregnant and non-lactating adult female dromedaries were used. Their average live body weight ranged between 562 and 642 kg. They were fed a maintenance ration consisting of a commercial concentrate mixture, clover hay and rice straw. Water was offered free choice once daily. The experimental camels were kept in an open yard and no shade was provided.

Jugular blood was sampled on the mid-days of the summer months of June, July and August and the winter months of December, January and

February. Blood was allowed to clot and serum was separated by centrifugation. Concentrations of total lipids were determined by the method of Zoelner and Kirsch (1962). Boehringer Mannheim GmbH, Germany, diagnostic kits were used for the analysis of total cholesterol and triglycerides.

In the second experiment, adipose tissue samples were collected from the slaughter house during summer and winter seasons from five camels within each season. Adipose samples were collected from three regions: sub-cutaneous, viscera and hump. Total lipids were extracted in chloroform-methanol (2-1 v/v) according to the method of Folch *et al.* (1957) and fatty acids methyl esters were prepared for gas-liquid chromatography (GLC) analysis in a Pye-Unicum apparatus with flame-ionization detector. Melting point and the saponification value were determined by the method of Mehlenbacher and Salee (1959) whereas the iodine number was determined according to Mehlenbacher (1950).

Split-plot analysis of variance (Steel and Tourrie, 1960) was used to assess the significance of differences between seasons (winter *vs* summer) and among sites of adipose tissue sampled.

RESULTS AND DISCUSSION

In the present experiment, average live body weight (LBW) of camels was lower by 80 kg (12.5%) in summer than in winter (Table 1).

Table (1): Serum lipid concentrations of female camels during summer and winter.

Season		Body weight kg	Total lipids mg/100 ml	Total Cholesterol mg/100 ml	Tri-glycerides mg/100 ml
Summer	Average	562	301.1	183.4	68.8
	June	522	297.4	180.6	66.4
	July	572	303.2	181.2	69.6
	August	592	302.6	188.4	70.6
Winter	Average	642	375.6	192.1	88.2
	December	624	390.0	190.0	88.4
	January	656	345.0	191.2	86.8
	February	646	391.8	195.2	89.4
	SEM	10.9	13.0	7.81	2.36
	F-test (season)	*	**	**	**

The effect of season on the concentration of serum total lipids, total cholesterol and triglycerides was significant ($P<0.01$). All concentrations increased in winter as compared to summer (Table 1). These differences appear to be related to the nutritional state of the animal and may be attributed to changes in LBW.

Extracted fat in the adipose tissue (g/100 g) was also season-related (Table 2). In all three adipose regions (sub-cutaneous, visceral and hump), extracted fat was significantly ($P<0.01$) less in summer than in winter by about 25%. It also differed between adipose regions, but the differences

were small and erratic. These results indicated fat mobilization during summer and fat deposition during winter which are in accordance with the nutritional state of the animal.

Table (2): Characteristics of depot fats of female camels during summer and winter.

Fat Characteristics	Season	Sub-cutaneous	Visceral fat	Hump fat	F-test[1]
Extracted fat, g/100 g	Summer	55.70	57.50	59.50	S**
	Winter	76.10	73.30	72.10	R**
	SEM				0.82
Unsaturated, %	Summer	53.70	57.20	55.98	R**
	Winter	39.38	42.10	37.60	
	SEM				0.61
Iodine number	Summer	76.20	79.60	80.50	S**
	Winter	54.60	71.60	57.60	R**
	SEM				2.60
Saponification value	Summer	194.2	197.2	209.8	S**
	Winter	214.8	223.0	227.0	
	SEM				2.20
Melting point, ^{o}C	Summer	37.8	35.2	36.2	S**
	Winter	40.4	40.6	42.3	R**
	SEM				0.38

1. Significant main effects: S=season and R=region/tissue.

Season of the year did not only affect the amount of extracted fat in the adipose tissue but also affected its characteristics as summarized in Table 2. Triglyceride fatty acids deposited in winter seem to be less unsaturated, i.e. more saturated, and the iodine number was higher. The saponification value increased in winter indicating that deposited fatty acids were of shorter chain, and that fatty acids mobilized in summer were also more of the shorter chain acids. Melting point is an indication of both fatty acid chain length and its degree of unsaturation. The increased melting point of fat sampled in winter is not in agreement with the observed changes of the saponification value.
After fat mobilization during summer the remaining fat depots were more unsaturated with higher iodine numbers and the saponification value was less than winter, indicating longer average chain length of fatty acids (Table 2).

Statistical differences between seasons were significant ($P<0.01$). Those between regions/tissues were also significant ($P<0.01$), but the magnitude of differences was small. Only the iodine number of visceral fats showed small differences between summer and winter, and was notably higher than in the other two fat tissues during winter possibly indicating metabolic differences between the three tissues.

Summer is when herbivores grazing arid lands are challenged with heat stress as well as the shortage of food and water. Energy stored as fat in adipose tissue, mainly in the hump and viscera are used to varying degrees and the animal loose weight. In winter and with the advent of the grazing season animals gain weight and adipose energy stores are replenished.

The camels' ability to withstand prolonged periods of food deficit through behavioral and physiological mechanisms does not rule out

biochemical mechanisms and metabolic adaptations (Ouajd and Kamel, 2009). Under such conditions camels have a unique ability to control lipolytic and gluconeogenic pathways to prevent or postpone the state of ketosis (Wensvoort et al., 2001). Under optimum conditions camels and llamas have lower levels of B-hydroxybutyrate (BHB) and higher levels of glucose than sheep and cattle. When fasted for five days, camels and llamas maintained low levels of BHB and higher levels of glucose than cattle and sheep, but the levels of non-esterified free fatty acids (NEFA) and urea increased. Cattle and sheep showed a rise in serum BHB, and much higher increases of NEFA, than camels and llamas, whereas sheep had decreased levels of glucose.

The results may indicate that fasted camelids, through metabolic adaptation, can supply 4-carbon metabolites, mainly succinate, for the maintenance of active TCA cycle and to supply precursors for gluconeogenesis from amino acids, thus preventing or postponing the advent of the malaise condition of ketosis. Further experimentation is warranted to investigate metabolic adaptation differences between camels and true ruminants.

Conclusion

The present results and the literature may indicate that fasted camelids, through metabolic adaptation, can supply 4-carbon metabolites, mainly succinate, for the maintenance of active TCA cycle and to supply precursors for gluconeogenesis from amino acids, thus preventing or postponing the advent of the malaise condition of ketosis. Further experimentation is warranted to investigate metabolic adaptation differences between camels and true ruminants.

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التغيرات الموسمية لدهون الدم والأنسجة في الجمل وحيد السنام

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تمت دراسة دهون الدم والأنسجة في الجمال صيفا وشتاء حيث يتم تحول الدهون وتراكمها تبعا للتغير في تواجد الغذاء والحالة الغذائية. في الشتاء حيث وفرة الغذاء تزيد الدهون الكلية والثلاثية والكلسترول في سيرم الدم ، كما تزيد كمية الدهون المستخلصة من الأنسجة الدهنية أيضا ، كما أن الأحماض الدهنية في الأنسجة كانت أقل تشبعا في الشتاء عنها في الصيف مع قصر متوسط طول السلسلة. يوصى بمزيد من التجارب التي تتعلق بالتأقلم الأيضي في الجمال بالمقارنة مع الحيوانات الأخرى.

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