Milk
and
Nutrition

73. Impact of Long-Term Feeding *Atriplex* (Saltbush) On Camel's Milk Production Under Arid Conditions

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Introduction

Camels are reliable milk producers with a long lactation period and they maintain milk production throughout long dry spells when milk from cattle and goats is scarce. The information on the milk off take of camels varies according to the management of camels in their natural environment or under improved condition (Yagil, 1982). *Atriplex* (saltbushes) are the main forage resource for feeding ruminants in arid and semi-arid regions. There are claims that feeding saltbushes to small ruminants has drastic effects on milk production and composition (Abu-Zanat and Tabbaa, 2005). Therefore, the objective of this study was to assess the long-term of feeding *Atriplex* on camel milk yield, gross composition and milk production requirements.

Materials and Methods

A flock of dry female camels before meeting season was blocked by weight into two groups. Each animal of the two groups was fed concentrate mixture of 60 % ground yellow corn plus 40% ground barley grains to cover 100% of the maintenance energy requirements (Wardeh and Farid, 1990) with *ad lib.* Berseem hay for the first group (BHG) and *ad lib.* fresh *Atriplex halimus* for the second group (AHG). This experimental dietary regimen lasted throughout the pregnancy period up to weaning. At the beginning of lactating season two groups of lactating female camels (average weight 515.4± 3.60 kg and aged 7-9 years) were used (8 camels each). Fresh tape water was a viable for drinking once daily. Daily milk yield was measured every two weeks along period of 10 months by using the standard hand–milking procedure. Milk samples were analyzed according to the procedure of AOAC (1990), phenol–sulfuric spectrophotometric method and atomic absorption spectroscopy.

The data analysis were carried out according to the SPSS package (SPSS v.12, 2001),

Results and Discussion

Inclusion fresh *Atriplex* (saltbush) instead of berseem hay in the diet of camels increased ($p<0.05$) the milk production (4.00 *vs.* 3.31 kg/day/camel, respectively) which could be attributed to the higher moisture content of fresh *Atriplex*in comparison with berseem hay (72.43 *vs.* 12.73 %, respectively).

Camels fed *Atriplex* had a lactation curve with two peaks at fifth and seventh months of calving whereas, the lactation curve of camel group fed berseem hay has one peak at fourth month of calving. Al –Sheikh and Salah (1994) indicated that lactation curve of camels differ from that of cows and it may be have one or two peaks and reached their milk peak during the first 6-10 weeks (Chamberlain, 1989) after parturition. This difference of camel milk peak timing reveals the camel persistence on high milk production and may be due to variation in nutritional state of camels (Lan dete –Castillajos *et al*, 2002).

Chemical composition of camel milk is in the range of: 2.9-5.5 % fat, 2.5-4.5 % total protein, 2.9-5.8 % lactose, 0.35-0.95 % ash and 11.5-13.7 % total solid (Khan and Iqbal 2001). These differences in chemical composition of camel milk may be due to factors such as stage of lactation, age, number of calving, nutritional state and water intake (Chamberlain, 1989). It was noticeable that the milk of AH camel group contains the highest ($P<0.05$) protein level. This was mainly attributed to the higher crude protein (%) content of *Atriplex* than berseem hay (16.89 *vs.* 12.68 %) which confirmed the early conclusion that the feed protein content will directly affect milk protein (%) content and is also responsible for increasing milk lactose (%) content (Wilson, 1984).

The milk titrable acidity and conductivity values of camels group fed BH were higher ($P<0.05$) than those of camels group fed AH. This is may be due to the secondary compounds (oxalates and tannins) and higher salt content of *Atriplex*. These anti-nutritional factors have ability to bind with minerals forming insoluble salts (Nagwa *et al*., 2002) which lead to decrease ($P<0.05$) milk

conductivity value of camel group fed AH, whereas, milk conductivity mainly depend on soluble salt fractions (Noberg, 2005).

Milk macro-elements (Na, K and Ca %) content of the AHG were higher ($P<0.05$) than the BHG. This may be due to the higher *Atriplex* content (%) of Na, K and Ca (Nabag *et al*., 2006) than those in berseem hay (Khattab, 2007).

Calculated protein and energy requirements to produce one litre of camel's milk were 2.08, 1.35 Mcal ME and 79.51, 76.73 gm DCP for BHG and AHG camel groups, respectively (Shawket and Ahmed, 2009 and Shawket *et al*., 2010). These results indicated that the experimental nutritional regimen were enough to cover the nutrient requirements need for both maintenance and milk production requirements.

Conclusion

Camels are able to produce milk under prolonged feeding of *Atriplex* (saltbush) with suitable source of energy supplementation without changing either milk chemical composition or milk physical properties. This system of nutrition successfully provided more than the protein and energy needs for both maintenance requirements or milk production.

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Table 1: Effect of feeding *Atriplex* (saltbush) on chemical composition of camel milk

Item	Milk chemical composition				
	Total solids	Total protein	Fat	Lactose	Ash
Berseem hay group	12.10[b]±0.16	3.10[b]±0.14	3.30±0.14	4.80[b]±0.18	0.83±0.03
Atriplex halimus group	12.32[s]±0.93	3.34[a]±0.24	3.20±0.26	4.98[a]±0.81	0.98±0.08

[a, b] Means followed by different latter in the same column are significantly different, P<0.05

Table 2: Effect of feeding *Atriplex* (saltbush) on physical properties of camel milk

Item	Milk physical properties			
	PH	Titrable acidity (%)	Specific gravity	Conductivity mS/cm(18°c)
Berseem hay group	6.67±0.05	0.170[a]±0.01	1.03±0.02	5.98[a]±0.25
Atriplex halimus groupp	6.78±0.09	0.164[b]±0.01	1.03±0.01	5.16[b]±0.37

[a, b] Means followed by different latter in the same column are significantly different, P<0.05

Table 3: Effect of feeding *Atriplex* (saltbush) on macro – elements (%) content in camel milk

Item	Milk macro – element (%) content			
	Na	K	Ca	mg
Berseem hay group	66.78[b]±0.8	109.37[b]±1.9	115.99[b]±3.8	12.46±0.40
Atriplex halimus group	72.19[a]±1.6	119.76[a]±2.5	118.07[a]±2.6	12.39±0.21

[a, b] Means followed by different latter in the same column are significantly different, P<0.05

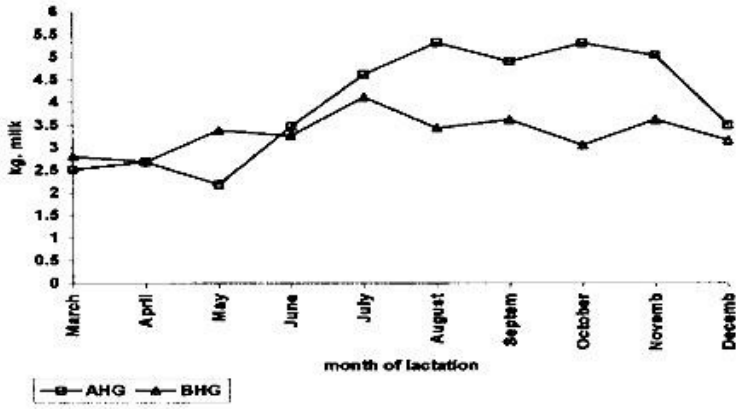
Table 4: Calculated values of energy (MJ ME/kg$^{0.75}$) and protein (g/kg$^{0.75}$)requirements for maintenance and producing milk compared to the recommended stander requirements for suckling camels

Item	Experimental diets		Requirements according to Wardeh and Farid*	
	BHG	AHG	BHG	AHG
ME MJ	0.79	0.76	0.58	0.62
DCP gm	5.78	5.78	4.31	4.67

1kg TDN = 3.62 Mcal /ME 1Mcal = 4.18 MJ

* Wardeh and Farid (1990)

Fig(1) Effect of month of lactation and type of diets on camels milk production



74. Camel Gruyere Cheese Making

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Introduction

The uniqueness of camel milk is illustrated by its low quantity of k-caseins of only around 3% compared to cow milk 13% (Farah, 1993). Traditionally, processing of camel milk is only for fermented liquid products. However, after several studies on technological aspects it is now possible to produce camel cheese. Some authors described some technologies to make soft and hard type of cheese (Ramet, 1985). Nevertheless the variety of available cheese from camel milk is quite limited. Most of the researches focused on the origin of chymosin to improve the clotting efficiency rather than to adapt technologies for increasing the variability of final products. The objectives of the present study are to make camel cheese type gruyere (cooked or not) and to control microbiological safety.

Material and Methods

Camel milk was collected from healthy dromedary camels from the herd of the Camel and Range Research Center, Al-Jouf, Kingdom of Saudi Arabia (KSA) at mid of lactation stage. For clotting, camel milk specific chymosin for camel milk (ChyMax Hansen©, Denmark) was used. To produce Gruyere cheese, specific ferments comprising Lactobacillus helveticus and Lactobacillus lactis(Coquard ™, France) were used.

Two trials were carried out using 5 and 10 liters of camel milk, but the procedure was the same. Gruyere ferments were added to whole camel milk at ambient temperature, and then incubated for 1 hour. Camel chymosin was added for clotting (for 1-2 h) and then the clot was cut into cube of 1 cm^3. After incubation for 1.5 hour the clot was either heated (at 55^oC for 40-45 minutes) or not heated. It was then hand-filled into cloths; for a first draining for 15 minutes, and a second one in moulds for 4-24 h. After draining, the pressed cheese (375 kg per m^2) was put in brine (10-20%) for 0.5-10 hours. Ripening of cheese was achieved in two steps: for 2-3 weeks at 10-14^oC and 2-4 weeks more at 24-26^oC.

Evaluation analysis was achieved according to the standards: 9225-84 Milk and milk products. Microbiological method of analysis, 30347-97 Milk and milk products. Method of determination of *Staphylococcus aureus*, 10444.11-91 "Food products. Method of detection of lactic microorganisms". By using those standard, mesophilic aerobe and anaerobe facultative bacteria, coliforms, pathogen *Staphylococcus aureus* and lactic bacteria were quantified.

Results and Discussion

Finally, ten cheeses were prepared, six from 5 liters camel milk and 4 from 10 liters. Half of the cheeses in both groups were cooked (n= 5) and the others non-cooked (n=5). The average yield was 6.3 ± 1.3% with slight variability according to cooked or non-cooked status and according to processed milk quantity (Table 1).

Table 1. Cheese yield according to quantity of processed camel milk and cooking status

Type of cheese	From 5 liters	From 10 liters	Total
Cooked	7.3 ± 0.9	5.0 ± 0.5	6.4 ± 1.4
Non-cooked	6.9 ± 0.3	4.9 ± 0.8	6.1 ± 1.2
Total	7.1 ± 0.7	4.9 ± 0.5	6.3 ± 1.3

The higher yield in small quantity of processed camel milk is mainly due to the duration of ripening time. Texture (crumbly or firm), color (white to yellow) and taste (more or less salty) varied according to different parameters (quantity of processed milk) cooking status, duration of brining and/or ripening (Photos 1).

Microbiological results. Regarding microbiological status, no pathogen microflora was detected, except for very small quantity of *St.aureus* in two cheeses (Table 2). The presence of pathogen bacteria could be attributed to post processing contamination.

Photo 1. Camel cheese Gruyere type. **a**. non-cooked type. **b**. cooked type. **c**. section of non-cooked cheese. **d**. section of cooked cheese.

Table 2. Number of bacteria in one gram of camel cheese type gruyere

Cheese nb	Total microflora	Coliform	St.aureus	Lactobacillus	Streptococcus	Moistures
1	$5,4*10^{-7}$	n d	n d	n d	$7,7*10^{-7}$	nd
2	$1,6*10^{-5}$	n d	n d	n d	$3,3*10^{-5}$	nd
3	$3,4*10^{-6}$	n d	n d	$1,3*10^{-4}$	$4,1*10^{-6}$	nd
4	$1,6*10^{-7}$	n d	10	$5,5*10^{-4}$	$6,1*10^{-6}$	nd
5	10^{-8}<	n d	6	$9,6*10^{-6}$	10^{-8}<	Penicillium
6	10^{-8}<	n d	n d	$8,7*10^{-6}$	10^{-8}<	Penicillium
7	$1,5*10^{-8}$	n d	n d	$5,3*10^{-6}$	10^{-8}<	Penicillium
8	$9,3*10^{-6}$	n d	nd	$5,6*10^{-6}$	$3,2*10^{-7}$	nd
9	$1*10^{-8}$	n d	nd	$6,6*10^{-7}$	$2*10^{-8}$	nd
11	$8,5*10^{-7}$	n d	nd	$1,6*10^{-7}$	$2,8*10^{-8}$	nd
12	$6,6*10^{-7}$	n d	nd	$4,3*10^{-6}$	$4,1*10^{-7}$	nd

Conclusion

Camel milk could be processed into tasty safe cheese with high value, but the yield remains lower than for cow milk.

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75. he Effect of Parity Number on Some Mineral Level Rations in Camel's Milk. A Case Study: North Kordofan State, Sudan

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Introduction

The camel population of Sudan was estimated at 2.903 million heads, ranking the country only second to Somalia worldwide (FAO 1986). Most camels are raised within pastoral systems in the western (Kordofan and Darfur) and eastern regions of the country. Kordofan alone has some 1.05 million heads, about 36% of the total camel population in the country (Sakr 1998).

The Kababish, Hawaweer, Kawahla and Shanabla tribes of north Kordofan are the main communities who herd camels. They spend the rainy season in their home territories, moving in November to January to the juzo grazing area in the northeast corner of the region. From there they move south, through their home territories, into south and west Kordofan. There they stay until the onset of the rains in June, when they move back to their home territories. (Sakr 1998).

Camel milk constitutes an important part of the diet in pastoral societies in arid and semi-arid regions (Holter, 1981; Yagil, 1980). Nawito *et al*. (1967) reported that in north Kenya under desert conditions, camel's milk contained 3.8 percent fat, 3.5 percent protein and 3.9 percent lactose. During subsequent lactations, the levels of protein and fat were elevated and those of lactose and pH witnessed a decline (Sheriha, 1986). However, limited information is available on camel milk production and its chemical composition under pastoral systems in north Kordofan, Sudan. This study attempts to elucidate the effect of parity number on some mineral levels in milk of the Shanabla tribes camels in North Kordofan.

Materials and Methods

This study was carried out in the Laboratory of Biochemistry, Nutrition and Toxicology at the Veterinary Research Corporation Centre in Khartoum in order to investigate the effects of parity number on some mineral levels in the milk of the one humped camel *(Camelus dromedaries)*. These include phosphorus, copper, ferrus, iodine, calcium, sodium and potassium. Milk samples were collected from sixteen she-camels with parity ranging from first till fifth from camel herds of the Shanabla tribe. They herd camels by traditional nomadic system at Elrahad locality in Umrowaba province, North Kordofan State. Analysis of variance was used to analyze the data as complete randomized design (CRD) with least significant difference (LCD) used to detect differences between means. For determination of elements, a flame photometer and spectrophotometer were used in addition to titration methods.

Results and Discussion

Table 1 and 2 indicated that the level of minerals in camel's milk was affected by parity. The levels of phosphorus, ferrous, sodium and potassium were markedly increased with parity number. The levels of phosphorus in parity one and three were 1.13% and 1.4% respectively, while in the last parity it was 1.8%. The copper level was not different in all parity numbers.

Table 1: The levels of minerals in camels milk according to parity (%).

Parity No	Phosphorus Mean±SD	Copper Mean±SD	Ferrous Mean±SD	Iodine Mean±SD	Sodium Mean±SD	Calcium Mean±SD	Potassium Mean±SD
1st Parity	1.13±0.047	0.1±0.0021	1.7±0.029	6.0±0.002	0.65±0.02	5.27±0.92	3.37±0.93
2ndParity	1.35±0.070	011±0.0013	1.73±0.029	5.45±0.31	0.75±0.04	2.37±0.28	3.5±0.082
3rdParity	1.4± 0.082	0.12±0.013	1.84±0.026	5.17±0.24	0.80±0.03	2.28±0.19	3.6±0.082
4thParity	1.5±0.082	0.12±0.0013	1.77±0.076	4.13±0.31	0.86±0.02	2.25±0.07	3.73±0.047
5thParity	1.8±0.082	0.12±0.0013	1.91±0.01	3.21±0.17	0.90±0.006	1.55±0.12	4.1±0.82

On the other hand, the ferrous levels were not significantly different; 1.7%, 1.84%, and 1.91% in the first, third and last parity, respectively.The iodine contents were dramatically decreased with increasing parity number which ($p \leq 0.05$) with values of 6.0, 5.17, and 3.21% of first, third, and last parity.This phenomena confirmed the relationships between the iodine and fertility rate in camels as well as the majority of vertebrates.

Table 2: Least significant means of mineral in camel milk

Parity No	Phosphors	Cupper	Ferrous	Iodine	Sodium	Calcium	Potassium
1st Parity	1.13 [a]	1.10 [a]	1.70 [a]	6.00 [a]	0.65 [a]	5.27 [a]	3.37 [a]
2nd Parity	1.35 [a]	1.11 [a]	1.73 [a]	5.45 [a]	0.75 [a]	2.37 [b]	3.50 [a]
3rd Parity	1.40 [a]	0.12 [a]	1.84 [a]	1.84 [b]	0.80 [a]	2.28 [b]	3.60 [a]
4th Parity	1.50 [a]	0.12 [a]	1.77 [a]	1.77 [b]	0.86 [a]	2.25 [a]	3.73 [a]
5th Parity	1.80 [a]	0.12 [a]	1.91 [a]	1.90 [b]	0.80 [a]	2.55 [b]	4.10 [a]

*Means having the same letter are not significantly difference at 0.05%.

The sodium levels slightly increased with the increase of parity number ranging between 0.65 and 0.95% in the first and last parities. The calcium markedly ($p \leq 0.05$) decreased with increasing parity number recording a value of 5.2 % and 1.55% for the first and last parities respectively, which is in agreement with the values reported by Bakheit (1999).

The levels of potassium ranged between 3.37% to 4.1% for the first and last parities. All elements increased with the parity number except iodine and calcium. On the basis of results obtained, it could be recommended to increase awareness of the nomads about the importance of the nutritive value of camel‘s milk.

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76. Comparison of the Composition of Milk from Humans, Camels and Cows with Commercial Infant Formulas

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Introduction

Milk is a biological fluid of exceptional complexity, containing essential nutrients for the growth and development of infants. Human milk contains specific proteins, lipids and other components designed to be easily digestible and having important roles to play in child development. However, bovine milk-based dried formulations have become a prominent feature of infantile dietetics. Emphasis has previously been laid on the manufacturing infant formulas with compositional and biochemical characteristics similar to human milk. To the contrary, camel whey lacks β-lactoglobulin, a major serum protein found in other ruminant livestock milk. Other whey proteins which have been identified in camel milk include serum albumin, α-lactalbumin, immunoglobulins, lactophorin and peptidoglycan recognition protein (Kappeler *et al*., 2004, El Hatmi *et al*., 2007). Camel milk is similar to human milk in that it contains a high percentage of β-CN; this high percentage could reflect its high digestibility rate and lower incidence of ―allergy‖ in the infants gut, as β-CN is more sensitive to peptic hydrolysis than αS-CN (Elagamy *et al*., 2009). The aim of this work was to characterize proteins by polyacrylamide gel electrophoresis, and to compare the physico-chemical composition of camel, human, cow milk and commercial infant formula.

Material and Methods

Camel milk samples were collected from a multiparous 8-year-old female from a local herd of camels belonging to the experimental farm of the Arid Land Institute, Livestock and Wildlife Laboratory, Tunisia. Milking was performed manually. Bovine milk samples were collected from a local herd. Human milk samples were obtained from three volunteer mothers at different stages of lactation at the city of Medenine, Tunisia. Bovine milk formula was purchased from the Tunisian market. Samples of milk were analyzed for fat content by the Gerber Method, total proteins, total solids (TS), carbohydrates and ash according to the AFNOR method (1993).Proteins milk samples were separated with the aid of sodium dodecyl sulfate polyacrylamide gel electrophoresis (SDS-PAGE) in the presence of 1.1% (w/v) SDS and 5% (v/v) 2-mercaptoethanol. The molecular mass standards (Sigma) were used.

Results and Discussion

Table 1: Physico-chemical characteristics of human, camel, cow and commercial infant formula (CIF)

	Human milk	Camel milk	Cow milk	CIF
pH (20°C)	7.03 ± 0.23	6.40±0.07	6.54±000	6.86±0.06
Dornic acidity (°D)	5.36 ±0.93	18.10± 1.13	15.50±0.50	7±0.00
Density	1.032±0.07	1.028±0,001	1.026±0.00	1.028±0.00
Total solids (g/l)	110.80±20.26	110.67±4.91	94.86±1.86	128.83±0.88
Ash (g/100 ml)	0.17± 0,01	0.86±0.02	0.66±0.01	0.32±0.01
Fat (g/l)	30.4± 7,33	34.57±4.77	25.50± 1.80	34.50±3.50
Glucids (g/l)	73.93± 2,79	49.05±1.27	44.60±3.19	65.32± 2.43
Total proteins (g/l)	16.50±6,15	47±6.94	46±7.26	27.81± 6.37

The pH of fresh camel milk was lower than that of human, cow and commercial infant formula. The gross composition presented in Table 1 of camel milk was similar to that of cow milk, total solids of commercial infant formula was very high (128.83 g/l) compared to human and camel milk (110 g/l). Camel milk had a very high ash content (0.86g/l), compared with human milk (0.17 g/l), Farida *et al*., 2001 reported that the concentration of manganese and iron in camels‘ milk was higher (7-20-fold and 4-10-fold, respectively) than in human milk, cows‘ milk and infant formula.

However, the remarkably high content of iron in camels‘ milk suggests that this milk can be a better alternative to human milk under certain circumstance. Camel milk has a low content of carbohydrates compared to human milk and commercial infant formula. On the another hand, Cardoso *et al*., (2010) confirmed that camel‘s milk can be considered as an alternative for the individuals intolerant to lactose who presents symptoms when ingesting cow‘s milk.

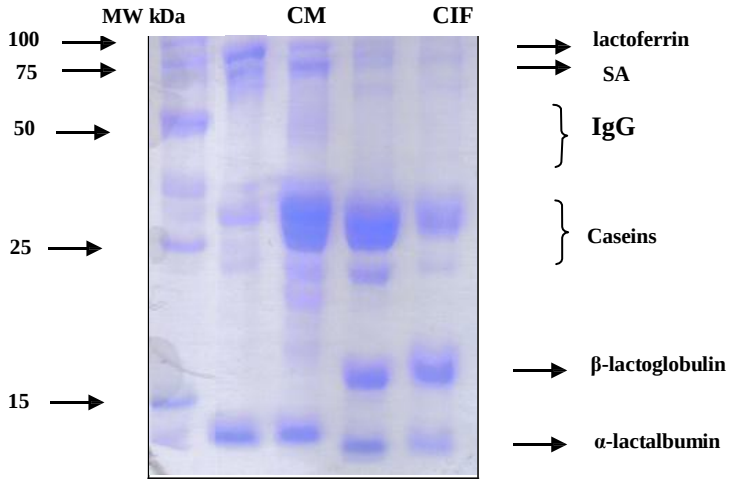

Figure 1: SDS-PAGE of human, camel, cow and commercial infant formula (HM: human milk; CM: camel milk; BM: bovin milk; CIF: commercial infant formula, SA: serum albumin, IgG: immunoglobulins G).

There are similarities between human milk and cow‘s milk, but also some differences. With respect to the protein profile (Figure 1), alpha-lactalbumin (α-La) was a common protein present in the three types of milk and the commercial infant formula. On the other hand, beta-lactoglobulin (β-Lg) is the main protein in whey of BM and CIF (about 50% of total whey proteins), but it was not present in human or camel milk. This protein has been demonstrated to be one of the main sources of infant allergy that limits the use of cow‘s milk for the preparation of infant formula (Uchida *et al*., 1996). Proteins can be extensively or partially hydrolyzed in infant formula and some authors agree that only extensive hydrolysate should be used to avoid any reaction in highly sensitive infants (Chan *et al*., 2002). Hydrolysis of whey proteins (especially β-Lg) is under study in order to cause an extensive protein hydrolysis avoiding even β-Lg traces. Another approach to produce infant formulas similar to human milk is to try to remove β-Lg from cow's milk or its derivates. However, many of the commercial products to feed infants contain great amounts of β-Lg (Lönnerdal, 1995; Pouliot *et al*., 1999). This is because of the difficulty to find an economic process to remove this protein from milk or whey, while maintaining the properties of the rest of proteins. In conclusion, the absence of β-Lg in camels‘ milk suggests that it can be a better alternative to human milk.

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77. Medicinal Properties in Camel Milk for Treatment of 'Epidemic' Diseases

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Introduction

Camel milk use against hunger and as a remedy for different kind of diseases has been first mentioned in the Moslem Holy Scriptures, *Bukhari 7:71 "Medicine"* #589 and #590, Words of the Prophet. This claim is still valid today; it can be more and more substantiated by research results of modern medicine. An increasing number of scientific publications focus on the medicinal potency of camel milk with its special components.

Currently three prevalent diseases facing people around the world in epidemic proportions, which are food allergies, autism and Crohn's disease, which are most probably associated with the intake of cow milk and its products.

This paper gives an overview of the current knowledge on medicinal properties in camel milk.

Results and Discussion

Camel milk is very suitable for human nutritional requirements, and its composition has similarities to mother milk. Many folklore tales as well as erious scientific research focus on myth of highly potent medicinal properties of camel milk have been brought to public attention in the early seventies. These early treatments have mainly been conducted in Asian countries, where Bactrian camels predominanted. Research on milk of the dromedary, however has been done at a later time in greater detail than in the bacterian camel (Yagil and van Creveld, 2000).

- **Treatment of human tuberculosis and liver diseases**

Urazakov and Bainazarov (1974) and Yagil (1982) reported that clinics in Kazaksthan treated tuberculosis with camel milk. Patients, who were given standard therapies along with raw camel milk of 1 liter per day as a supplement, gained body weight due to increased appetite. Furthermore, radiological improvement in terms of lung expansion with no pass formation was also observed. The treatment was especially beneficial for those patients with multiple drug resistances. Similar observations were reported by Sharmanov *et al*. (1978); Zagorski *et al*. (1998) and Zhangabilov *et al*. (2000).

The exact course of the improved condition of patients consuming additional camel milk has not been thoroughly investigated yet.

Latest research on the successful treatment of various human diseases with camel milk can be explained by the discovery of components and their medicinal activities.

- **Treatment of diabetes**

Camel milk contains double the amount of insulin of cow milk (Wernery *et al*., 2000). Treating diabetes discussed at an International Conference in Mauritania (Yagil *et al*., 1994), and studies in India strongly indicated, that Insulin Dependent Diabetes Mellitus (IDDM) patients considerably profited from daily intakes of 500 ml camel milk, by having their blood sugar significantly reduced, as well as their HbA1C levels (Agrawal *et al*., 20002). A possible reason for this remarkable effect could be explained by the fact that camel milk does not curdle in an acid environment.

- **Milk allergies and lactose intolerance**

Milk allergy is an autoimmune disease and occurs globally in 1-7% of all infants. The fact, that camel milk lacks ß-lacto globulin, a powerful allergen in cow milk, makes camel milk a potent alternative for children suffering from milk allergies (Makinen-Kijunen & Palovsvo, 1992).

Lactose intolerance occurs mainly in people older than 5 years and is a completely different entity than milk allergy. It is caused by the decrease or absence of the enzyme lactase in the gastrointestinal tract, which metabolizes the milk sugar lactose. Approximately 90% of black and 25%

of Caucasian individuals throughout the world have partial or complete lactose intolerance, associated with nausea, vomiting, cramps and diarrhea. Lactose intolerance as a result of drinking camel milk is unknown, even though the concentration of lactose in camel and cow milk is similar.

- **Multiple sclerosis (MS)**

The success of treatment of MS can be explained by recent investigation described by El-Agamy (2010). Camel milk fat does not only contain long-chain fatty acids (85%), compared to short-chained fatty acids (15%), but also the fat contains sphingomyelin with a high proportion of nervonic acid, which plays an important part in the biosynthesis of nerve cell myelin, which may prevent or even cure MS.

- **Psoriasis vulgaris**

Tissue repair proteins in camel milk, which are not yet clearly defined, triggered a healing process in patients with Psoriasis, first described by Yagil. A clinical study, conducted in a German hospital, with 20 patients suffering from a serious, ambulant resistant state of Psoriasis, further substantiated this achievement by topical application of a cream, containing 40% camel milk.

- **Autism**

Recent scientific findings related to autism revealed a connection to cow milk casein. When cow milk casein is digested properly, it breaks down into large peptides like casomorphine, and should then be broken down further into smaller amino acids. It was reported, that urine samples of people with autism contain high amounts of casomorphin peptides, because of a malfunction of their immune system. These casomorphin peptides are called neuropeptides, because they have been shown to react with areas of the brain such as the temporal lobes, which are involved in speech and auditory integration. Neuropeptides also decrease the ability to feel pain and affect cognitive function. Neuropeptides can react with opiate receptors in the brain and consequently mimicking the effects of opiate drugs like heroin and morphine.

Even though there is only anecdotal evidence of symptom remission after exclusion of all dairy products from cow, autistic children drinking camel milk have had amazing improvements in their behavior and diets.

- **Crohn's disease**

A connection between Crohn's disease and *Mycobacterium avium sp. paratuberculosis* (MAP) seems to exist. Therefore, the effect of camel milk may positively influence the severity of symptoms of the disease. MAP could enter the human mucosa as a saprophyte, since it is not always completely destroyed by pasteurization. Severe stress can lead to a secondary autoimmune response, paving the way for Crohn's disease. As the bacteria belongs to the family of tuberculosis and as camel milk has been used to treat tuberculosis, it becomes apparent, that the powerful bactericide properties of camel milk, combined with PGRP (Peptidoglycan recognitian protein) have a quick and positive effect on the healing process. Additionally the intake of camel milk seems to strengthen the patient's immune system.

Components of the milk have been described in various publications by different authors, defining clearly the bacteriostatic and virucidal activities as further outstanding attributes of camel milk, generated by the activities of protective proteins (Kappler, 1998). The presence of these proteins helps explain some of the healing properties of camel milk.

However, profound clinical trials are still not been carried out to substantiate these claims and we hope that this forum will be inspired by this presentation to initiate research on these subjects.

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78. solation and Characterization of Camel Milk Protein Hydrolysate with ACE (Angiotensin I Converting Enzyme) Inhibitory Activity

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Introduction

ACE (Angiotensin I Converting Enzyme) has been classically associated with the renin-angiotensin system which regulates peripheral blood pressure, where it catalyzes both the production of the vasoconstrictor angiotensin-II and the inactivation of the vasodilator bradykinin (Hall and Guyton, 2006).Naturally occurring peptides in snake venom were the first reported competitive inhibitors of ACE and thereafter, many other ACE inhibitors were discovered from enzymatic hydrlysates or the related synthetic peptides of bovine and human caseins (CNs), as well as plants and other food proteins (Sheih *et al*., 2009). Food products containing hypotensive peptides are of interest for maintaining good health of humans with moderate hypertension (Mullally *et al*., 1997). In principle, milk products with hypotensive peptides can be produced in two ways, i.e., by enrichment with antihypertensive peptides produced by enzymatic hydrolysis of precursor proteins, or by fermentation of milk with lactic acid bacteria (LAB) (Mullally *et al*., 1997).

Materials and Methods

Both Camel and Bovine milk casein (0.5% protein) and bovine and camel whey were fermented using pepsin , trypsin as well as various Lactic Acid Bacteria (LAB) species, including *Lactobacillus delbrueckii subsp. Bulgaricus* SS1, *L.acidophilus* LA 102, *L. plantarum* LA 301, *L.salivarius* LA 302, *Streptococcus thermophilus* LA 104, *Lactococcus lactis subsp. Lactis* and *Cremoris and Bifidobacterium lactis* Bb 12 at 44°C for 4-6 hours till the pH reaches 4. Fermented milk was then subjected to centrifugation at 16000 x g at 10°C, for 30 minutes and the resulting supernatant obtained was further processed by ultra filtration using hydrophilic 3000Da cut off membrane.The permeate and retentate obtained after ultra filtration from the fermented milk was then tested for ACE inhibition property.

The ACE-inhibition study was carried out in using the spectrophotometric assay and RP-HPLC. The Angiotensin Converting Enzyme Inhibition (ACEI) activity was initially measured by a spectrophotometric assay according to the method of Cushman and Cheung (1971) with some modifications.

Results and Discussion

A set of in vitro spectrophotometric and RP HPLC assay conditions were selected for the determination of ACE inhibition activity in camel milk by the enrichment of gastrointestinal enzymes (pepsin and trypisn) and also by lactic acid bacteria fermentation (LAB) using seven different strains, all known for ACE inhibition activity in cow milk. The mode of reaction was the interaction between sample and ACE enzyme, resulting into amounts of HA (hippuric acid) and HL (histidyl leucine). The HA is then absorbed at 228 nm and the measurements of absorbances are proportional to the inhibition exercised by the assayed sample (inhibitor), such that a decrease in absorbance concludes low activity of sample (inhibitor).

Table 1: Percentage (%) ACEI (Angiotensin converting enzyme inhibition) of different protein hydrolysates.

Type of enzymatic hydrolysate *	% ACEI of Camel Casein	% ACEI of Camel Whey	% ACEI of Bovine Casein	% ACEI of Bovine Whey
Pepsin	83.34%	82.84%	89.37%	91.53%
Trypsin	79.47%	78.08%	82.74%	85.53%

* Each experiment conducted twice and mean of 5 measurements for each experiment.

Spectrophotometric assay for both the simulated enzymatic hydrolysis and functional fermented camel milk casein and whey samples concluded that camel milk consists of ACE inhibition peptides encrypted in the primary structure, which when either hydrolysed or fermented release ACE inhibition peptides as observed in gastrointestinal enzymes pepsin, i.e.,83.34% for camel casein and 82.84% for camel whey, some trend was observed in trypsin such that 79.47% for camel casein and for camel whey 78.08% (Table 1). However, ACE inhibition was observed higher in *Lactococcus lactis subsp. Lactis* and *Cremoris (79.58),Bifidobacterium lactis (79.11%) and L.acidophilus* LA 102(78.65%) respectively. Reversed phase HPLC was followed by spectrophotometric analysis, which confirmed the results of spectrophotometric assay, thus validating the presence of ACE inhibition activity in camel milk protein, both casein and serum proteins (Figure 1).

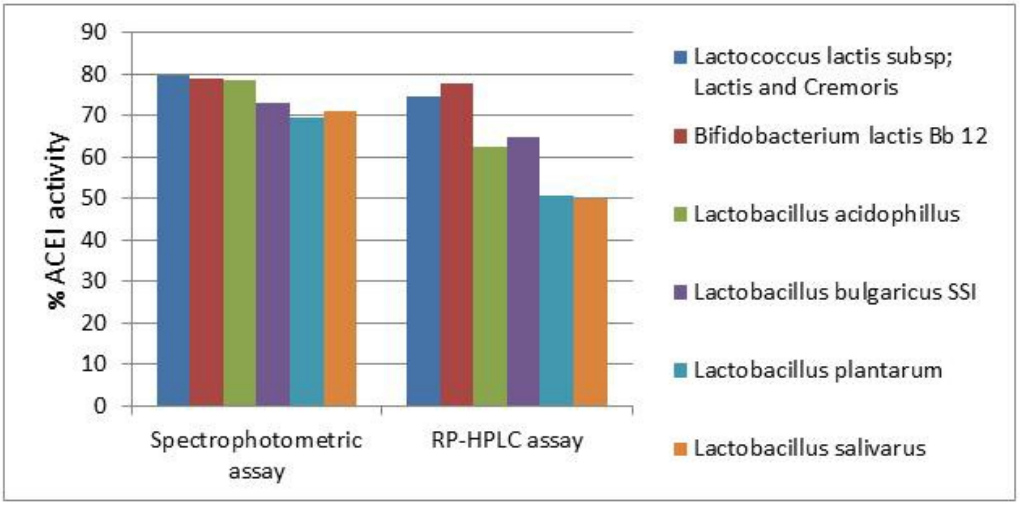

Figure 1: Percentage (%) ACEI activity between different strains assayed by spectrophotometer and HPLC.

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79. Chemical Properties and Acceptability of Yoghurt Made from Camel-Sheep Milk

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Introduction

The lactating she-camel is a very valuable animal for the nutrition of the camel herder's in the arid regions. Camel milk has certain properties which enable it be kept for longer periods than cow's milk. Traditionally, the most common forms of consumption of camel milk are either fresh or fermented (Farah *et al.*, 2007). However during the lactic fermentation process, dromedary milk showed behavior different from that of bovine milk at the microbiological, biochemical and structural levels that are certainly due to intrinsic factors (Attia *et al.*, 2001). In fact the coagulation caused by lactic fermentation did not produce a curd but simply flakes that lack firmness and that were unable to undergo further technological treatment (Abu- Tarbouch, 1994). Because sheep is reared together with camel and it is well documented that its milk is of high compositional contents, the present study is a trial to improve camel fermentation by incorporating different ratio of sheep milk.

Material and Methods

In this study, camel and sheep milk (15 L each) were obtained from local farmers. Mixtures of camel and sheep milk were prepared where camel milk was used as 100%, 75%, 50%, 25% and 0%. Milk samples were collected from each group for chemical analysis by Lactoscan before processing. Milk was pasteurized at 63º C for 30 minutes (Attia *et al.*, 2001) then cooled to 43ºC before adding 2.5% starter culture (*Streptococcus thermophilus* and *Lactobacillus delbruckii subsp. bulgaricus* (YO-mix 532, DANISCO, Denmark), after which milk was incubated at 42ºC. The produced yoghurt was chemically analyzed to determine the percentage of fat, protein total solids and ash according to Bradley *et al.* (1992). The acidity of the product was determined by titration (Bradley *et al.*, 1992). Sensory evaluation including appearance, texture, flavor, color and acidity was also done. The data were statistically analyzed using SPSS (Version 13).

Results and Discussion

The comparison of the compositional contents of milk showed variations between camel and sheep milk (Figure 1). Pure camel milk yoghurt had significantly ($P<0.05$) lower content of SNF, fat and protein compared to sheep and the camel-sheep yoghurt mixtures (Table 1) as well as watery texture and high acidity (Table 2). However the composition and texture were improved by increasing the level of sheep milk. This supported El Zubeir and Shueip (2009) findings on the propriety of yoghurts made from camel and sheep milk. The rate of change in the acidity was slow at the beginning which supported El Zubeir and Ibrahium (2009) findings Attia *et al*. (2001) concluded that dromedary milk appear less favorable for the lactic fermentation because the activity of the inoculated lactic starter was lower in camel milk than in bovine milk.

The present study concluded that the addition of sheep milk to that of camel would improve the quality of fermented milk. This indicated the possibilities of processing and marketing it as the health benefits of camel milk and fermented products are well known. Small scale mobile processing units may established to make use of the valuable camel milk. This may be a solution for proper utilization of resources which could improve food security and enhancing rural development.

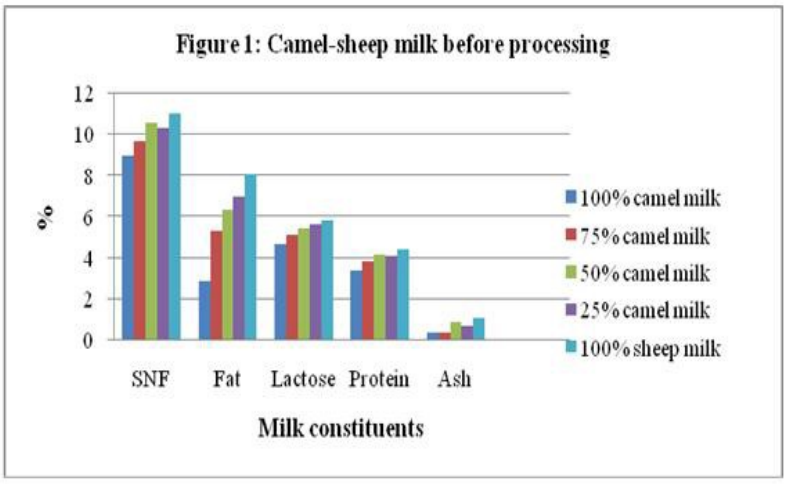

Table 1: Composition of camel- sheep yoghurts

Camel-sheep milk ratio	**Total solids%**	**Fat%**	**Protein%**
100% camel milk	9.6^{d}	2.7^{c}	3.39^{c}
75% camel milk	12.85^{c}	4.45^{b}	6.25^{b}
50% camel milk	15.15^{b}	$4.6a^{b}$	6.71^{ab}
25% camel milk	15.62^{b}	4.75^{ab}	6.78^{ab}
100% sheep milk	19.22^{a}	4.85^{a}	7.14^{a}

Different subscripts within the same column in this and the following table are significantly different ($p<0.5$)

Table 2: Sensory evaluation for camel- sheep yoghurts

Milk mixture	Appearance	Texture	Flavor	Color	Acidity
100% camel milk	1.125^{b}	1.375^{b}	1.750^{b}	2.500^{a}	3.500^{a}
75% camel milk	2.875^{a}	2.625^{a}	3.25^{a}	3.375^{a}	2.500^{bc}
50% camel milk	2.625^{a}	2.875^{a}	3.125^{a}	3.125^{a}	3.000^{ab}
25% camel milk	3.25^{a}	3.125^{a}	2.875^{a}	3.375^{a}	2.125^{c}
100% sheep milk	2.875^{a}	3.250^{a}	2.375^{ab}	3.000^{a}	2.500^{bc}
SE	0.304	0.343	0.38	0.351	0.273

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80. Effect of Pasteurization on the Keeping Quality of Camel Milk

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Introduction

The shelf life of camel milk is longer than that from other animals because it contain antibacterial agents (Wernery *et al*., 2005). However raw camel milk may contain microorganisms, which are potential pathogens (Younan *et al*., 2001; Sheuip *et al*., 2007). Pasteurized camel milk can last for more than 10 days at 4°C (Wernery, 2008). Hassan *et al*. (2006) found that pasteurization of camel milk before fermentation improved the microbial content and increased the shelf life of the product. In the present study the microbial loads and shelf life of camel milk were estimated using low temperature long time (LTLT) and high temperature short time (HTST) pasteurization methods.

Materials and Methods

Camel milk samples were obtained from Camel Research Center, University of Khartoum. Milk samples were collected in sterile bottles and immediately transferred after milking to dairy microbiology laboratory in Faculty of Animal Production, University of Khartoum. The herd is managed under semi-intensive system.

Raw milk samples (5 liter/ 5 batch) were divided into three portions; one was kept as control and the 2 other were heat treated in glass containers, using water bath temperature adjusted heat treatment at 63°C for 30 min (Low temperature long time, LTLT) and 72°C for 15 sec (High temperature short time, HTST). Then the samples were cooled immediately and stored at refrigerated. The microbiological examinations, acidity and clot on boiling were done daily to assess the shelf life of milk. Titratable acidity and colt on boiling test were done according to AOAC (1990). The camel milk samples (raw and pasteurized milk) were examined for total bacterial count (TBC), coliform count, psychrotrophic bacterial count, thermophilic bacterial count, thermoduric bacterial count and yeast and moulds counts were done according to Marshall (1992). The analysis of the data was conducted using SPSS version13.

Results and Discussion

There was no significant variations between the two procedures of pasteurization for the measurements which is supported by Attia *et al*. (2001) that more heat and time are required for camel milk. The pasteurized (two methods) camel milk samples had longer keeping quality, since the shelf life of the pasteurized samples extended up to 20 days under refrigeration temperature. When comparing the shelf life of raw camel milk samples that showed a shelf life of 7 days at refrigeration temperature. The variations in the shelf life of raw and pasteurized milk might be due to the presence of antimicrobial and antibacterial agents in the camel‘s milk (Wernery *et al*., 2005). The non complete destruction of organisms after pasteurization was reported by Hassan *et al*. (2006).

There was a decrease in the means values of microbial measurements (total bacteria, coliforms, total yeast and mould, psychrotrophic bacteria, and thermoduric bacteria) after pasteurization of camel milk (Table 1). The total bacterial and coliform counts of raw camel milk were higher than that reported by Shuiep *et al*. (2007). The high total counts and coliform count indicate low quality of some raw camel milk, which may be due to milking procedures (Shuiep *et al*., 2007 ; Semereab and Molla (2001). High coliform count may be due to contamination with feacal material, improper sanitation, and/or mastitis (Murphy and Boor, 2000). The yeast and moulds counts of raw camel milk samples were higher than that reported by Shuiep *et al*. (2007). The results of psychrotrophic bacteria were high, however Shuiep *et al*. (2007) did not reported psychrotrophic bacteria and he concluded that this might be due to the lack of cooling facilities for camel owners.

Table 1: Comparison between some microbiological quality tests of raw and pasteurized camel milk

Parameters (cfu/ml)	Treatments		
	Raw milk	LTLT pasteurized milk	HTST pasteurized milk
Total bacterial count	$1.2\times10^{10b}\pm1.2\times10^{8}$	$2.004\times10^{7a}\pm1.2\times10^{7}$	$2.004\times10^{7a}\pm1.2\times10^{7}$
Coliform count	$1.3\times10^{7b}\pm8.1\times10^{4}$	$9.4\times10^{5a}\pm5.1\times10^{4}$	$8.1\times10^{5a}\pm5.1\times10^{4}$
Thermodric count	$1.5\times10^{9b}\pm7.7\times10^{7}$	$1.3\times10^{6a}\pm4.8\times10^{7}$	$1.3\times10^{6a}\pm4.8\times10^{7}$
Yeast and moulds counts	$5.6\times10^{5b}\pm1.2\times10^{7}$	$3.6\times10^{4a}\pm1.2\times10^{4}$	$3.9\times10^{4a}\pm1.2\times10^{4}$
Psychrotrophic count	$1.9\times10^{9b}\pm1.2\times10^{7}$	$1.4\times10^{6a}\pm1.2\times10^{7}$	$1.4\times10^{6a}\pm1.2\times10^{7}$
Thrmophilic count	_	_	_

The same superscript letter in the raw indicate non significant differences (P> 0.05)

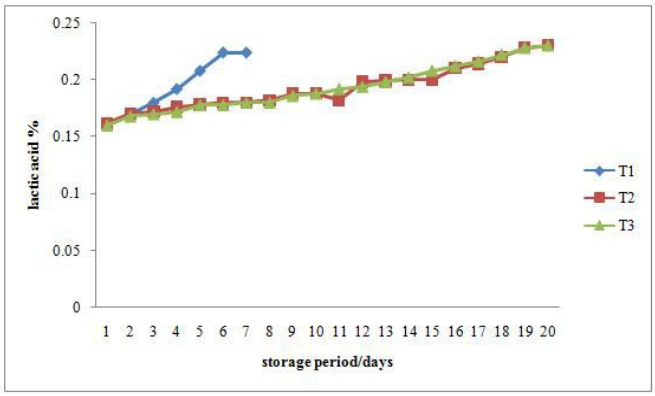

Figure 6: Effect of pasteurization and storage period on the acidity (lactic acid %) of camel milk

The present results of acidity were significantly affected (P< 0.001) by storage conditions (Figure 1). Higher level of camel milk acidity was found during the present study than that reported by Shuiep *et al*. (2007). The increase in acidity level was gradually at the beginning of storage period and this might be due to presence of the antimicrobial agents in the camel milk (Wernery *et al*., 2005).

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81. Thermographic Study of the Dairy Camel (*Camelus dromedarius* L.) Mammary Gland Before and After Machine Milking

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Introduction

Much research work has been done on the milking management of dairy cattle, sheep and goat, but comparatively few research data is available on camels. As results of market demand, intensive camel dairy farms using machine milking, have been recently established in Saudi Arabia for commercial milk production. Machine milking routines can affect the udder temperature and udder health (Vegricht *et al*., 2007). The teat is the most stressed part of the udder during milking (Hillerton al., 2002). Information on skin temperature may be of interest for detecting teat over milking and intramammary infections (Colak *et al*., 2008). Infrared thermography (IRT) is a non-contact and non-invasive technique that detects surface heat emitted as infrared radiation. This technology was previously used for measuring udder temperatures in goats (Caruolo *et al*., 1990), cows (Kunc *et al*., 2000) and ewes (Stelletta *et al*., 2007). As far as we know, infrared thermography has not been used before in camels. The aim of this study was to explore the effect of machine milking on udder and teat skin surface temperature of two breeds of dairy camels raised in Saudi Arabia.

Materials and Methods

Twelve multiparous dairy camels (6 *Majahiem* and 6 *Maghatier)* averaging 135 ± 21 DIM and 9.14 ± 1.07 L/d of milk yield (mean ± SD), were used. She camels were housed together at Al-Watania Agri FarmStock intensive industrial system (Al-Jouf district, Kingdom of Saudi Arabia), electronically identified and fed twice a day before milking with alfalfa hay and concentrate; water was freely available. Machine milking (45 kPa, 60 pulses/min, and 60:40 ratio) was done twice daily (0500 and 1700 h). Left side IRT images for udder body and front and rear teat surface were obtained immediately before (Figure 1), without udder preparation, and immediately after milking using an infrared vision camera (VisIR-Ti200, Thermoteknix Systems, Cambridge, UK) placed perpendicularly and at 50 cm from camel‘s udder. Climatic measurements were recorded using data loggers and temperature-humidity index (THI) calculated (West, 1994). Milk yield and milking time were recorded at each milking. Data was were analyzed by the Proc Mixed procedure of SAS (SAS version 9.2, SAS Inst. Inc., Cary, NC).

Results

Daily THI values ranged from 60 to 83 during the study period. No differences were observed in udder and teat surface temperature according to camel breed ($P > 0.05$) and between front and rear teats ($P > 0.05$). Milking time was 8.50 ± 0.31 min/camel for a milk yield of 4.60 ± 1.12 L, on average. Udder and teat surface temperatures before milking were higher ($P < 0.05$) at p.m. (36.07 ± 0.19 and 35.35 ± 0.17^{O}C, respectively) than at a.m. (34.80 ± 0.25and 33.93 ± 0.23^{O}C, respectively). Regarding temperature changes after milking no differences ($P > 0.05$) were observed in udder temperature after a.m. and p.m. milkings, while teat surface temperature decreased only after the p.m. milking (from 35.35 ± 0.17 to 34.26 ± 0.17^{O}C; $P<0.01$).

a)

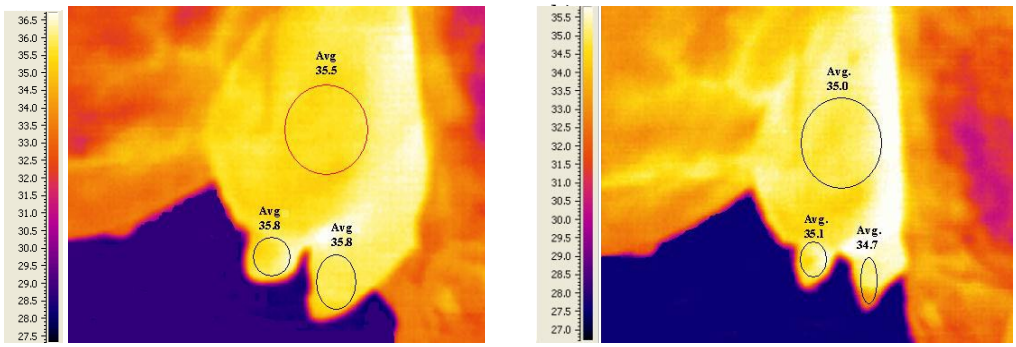

Figure 1. Thermograms of the udder of dairy camels a) before and b) after milking.

Discussion

To the best of our knowledge, no IRT images and THI have been used previously in dairy camels. Morning and evening milkings coincided with the overall means of daily minimum and maximum THI. According to Hahn *et al*. (1998), our camels were not under heat stress conditions. Observed decrease of teat temperature (–1.1^{O}C) after p.m. milking in camels disagree with that reported in dairy cows, where teat temperature increased (+2.6^{O}C) after milking (Kunc *et al*., 2000), while agreed with results in dairy ewes in which teat temperature decreased (–1.0^{O}C) after milking (Stelletta *et al*., 2007). Milking time, machine milking management (with or without udder preparation) and teat vasculatization differences could explain the discrepancy between these studies. IRT may be a suitable tool for evaluating the effect of milking technique on teat and udders of dairy camels. However, further research should be done for taking profit of the use of IRT for monitoring the effects of machine milking in dairy camels.

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82. Thermal Characteristics of Different Components of Camel Milk

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Introduction

There is a large quantity and variety of materials produced industrially in powder form and there is a need for information about their handling and processing characteristics. Thermal properties aid in product process control, prediction of storage characteristics and in alimentation. Differential Scanning Calorimetry (DSC) is used widely to characterize biological materials for its thermal properties. Typical observed transitions include the glass transition of the amorphous phase, melting and crystallization processes, denaturation, free and bound water, onset of oxidation, and heat capacity (Roos,2002 & Jouppila).

The milk composition of dairy animals has been widely studied throughout the world and thousands of references are available especially with regard to milk consumed by humans. The literature data mainly concerns cow milk, which represents 85% of the milk consumed in the world and, to a lesser extent, goat and sheep milk. Studies on other dairy animals (buffalo, yak, mare, and camel) are rather scarce, in spite of their nutritional interest and medicinal properties. In addition, unlike other milk-producing animals, camels can thrive under extreme hostile conditions of temperature, drought, and lack of pasture, and still produce milk (Yagil and Etzion, 1980). For that in this context, thermal characteristic of camel milk and cow milk need to be further investigated in order to have more information about the biological value of heat-treated camel milk.

Materials and Methods

Milk cream and fat were separated according to the method described by KARRAY *et al*, 2004, casein and whey were separated according to the procedure described by Wangoha, 1998 and lactose was separated according to the method described by Bund and Pandit (2007). All obtained samples were freeze-dried and kept at -20^{o}C.

Differential scanning calorimetry with and without modulation (DSC Q10, MDSC Q1000, TA Instruments, New Castle, Delware) were used to measure the glass transition and meting of freeze-dried whole camel and cow milk powders, and other components of camel milk (fat, cream, casein, whey protein and lactose). The procedures were similar as discussed by Rahman, 2010. All analyses were done in 3-6 replicates.

Results and Discussion

Milk is a multi component mixture containing mainly water, protein, fat, lactose and other minor constituents, thus it is a challenge to trace different state and phase changes from its complex thermogram as measured by Differential Scanning Calorimetry (DSC). In the literature, negligible research works are reported on the thermal characteristics of camel milk power, especially for different components of camel milk. This is mainly due to the complex interactions between different types of complex components present in the milk. Thermal characteristics of freeze-dried whole and skimmed camel milk were measured by DSC. The thermogram showed three endothermic peaks (two for fat-melting and other for non-fat solids-melting) and three shifts. Two shifts at low temperature could be related to the glass transitions. However, it was difficult to identify which components in the milk were providing these transitions. The shift at higher temperature after melting of non-fat solids could be related to structure ordering in the milk. However, it was difficult to trace the glass transitions of each component in the milk due to the complex interactions of the components' phases. For this reason, different components of the camel milk (fat, cream, casein, whey protein, and lactose) were separated and then measured its thermal characteristics. The thermogram of camel milk fat showed two endothermic peaks, one wide and the other sharp. The wide peak at low temperature was due to the melting of different fractions of fatty acid and the sharp peak indicated melting of a significant amount of specific fatty acid. The melting of fat started at -5^{O}C and ended at 52^{O}C, respectively. The melting of fat in cream started at lower temperature -l2^{O}C as compared to the pure fat at -5^{O}C. This decrease in melting temperature could be due to the effects of protein content in the

cream.

Casein showed one endothermic peak due to non-fat solids-melting and two shifts in the thermogram line indicating two glass transitions. The first glass transition started at 38^{O}C, second glass transition started at 77^{O}C and melting onset at 95^{O}C, respectively. Similarly whey protein precipitated by ammonium sulfate and ethanol also showed two glass transitions and one melting endotherm. In the cases of all types of protein, the second glass transition was observed just before melting of nonfat solids. In the case of first scan of lactose, only two endothermic melting peaks were observed without any trace -of glass transition. However, the second scan with annealing showed two glass transitions and two endothermic peaks. The onset of the first and second glass transitions were at 56 and 114^{O}C, respectively. Similarly the onsets of first and second melting endotherms were at 145 and 213^{O}C, respectively.

In case of commercial lactose, the glass transition could not be traced, however two similar melting endotherms were observed, first one at 141^{O}C and second one at 215^{O}C, respectively.

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83. Synergic Effect of Nutrition on Work Performance of Indian Camels

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Introduction

Camel belong to the family camelidae in the suborder Tylopoda of the order Artidactyla. The genus camels has 2 spicier viz. *camelus dromedarius* (Single humped) having habitat in dry hot arid lands of Africa and Asia and *camelus bactrianus* (double humped or bactrian) habitat of cold arid lands of central palaeretic. The camel (*camelus dromedarius*) is an important component of the desert ecosystem. The camel possesses many unique qualities, which make it distinitly superior to other domenticated animals in the hot and arid desert ecosystem. Camels is the only draught animal which has survived in adverse environmental conditions of desert. Moth straw, (*Phaseolus acovtifolius Jacq.)*, Guar straw (*cympsis tetragonaloba*) and groundnut straw (*Arechis hypogea*) is the most common fodder for draught camels. Not much work has been done to assess the feeding value of these feeds in draught camels. Therefore, the present study was undertaken to study the synergic effect of feeding leguminous straw with concentrate mixture on draught performance, physiological responses in camels.

Materials and Methods

Nine draught camels of 6 to 10 years of age and body weight ranging from 525 to 615 kg were selected and randomly divided in to three groups on the basis of their body weight and fed on 3 dietary treatments. The animals were offered ad lib. moth straw, groundnut straw and guar straw supplemented with the concentrate mixture. The concentrate mixture was fed as per requirements of draught camels (ICAR, 1985). The camels was fed three dietary treatments i.e. moth straw (T_1), groundnut straw (T_2) and guar straw (T_3), respectively along with concentrate mixture. The camels were housed in a well ventilated shed having sandy floor, asbestos roofing and provision for manger for individual feeding. All camels were offered fresh water once at 5 pm daily and refusal of water, if any, was also recorded to know the actual voluntary water intake. The quantity of water received by the animals through feed and fodder were also calculated to know the total water intake by the camel. The leguminous straw was fed to each camel as a sole diet between 5 to 6 pm. The daily allowance of concentrate mixture was offered to all camels at 2.7 kg pm/camel. All other management practices were kept the same for all the groups. After a preliminary feeding of 54 days, a six days experimental trial was conducted on all the draught camel. The refusal of straw, if any was also recorded to know the actual intake of feed and total faecal out put in 24 hrs was collected by harnessing faecal bags to individual camels. The representative samples of feeding and faeces were pooled and analyzed for proximate principles (AOAC 1995).

A 2 wheeled camel cart was used as a loading device for applying the load cell (Dynometer of 540 kg Ecl, UK) between the body of the cart and the beam for meaning the draught. The cart was pulled on a sandy track to cover a distance of 25.5 km with 18% pay load in 4 to 5 hrs. The camels were allowed to pull payload including the weight of the cart and the driver in such a way the experimental camels could exert an average draught of 18% of their body weight.

The physiological response such as respiration rate (flank movement), pulse rate (coccygeal palpation), body temperature and body weight of the camels were recorded before and after the carting. The data obtained from the trial was evaluated statistically as per the procedure (Snedecor and Cochran, 1980).

Results and Discussion

The leguminous kharib straw contained 88.15 to 89% DM, 10.10 to 14.11 CP, 12.0 to 18.50% DV, 1.20 to 2.12 % BE, 39.85 to 58.67% NRE and 8.25 to 11.85% TA on dry matter basis (Nagpal and Jabbar, 2005). The DCP and TDN values observed in the present investigation were 7.23 to 8.28 and 60.75 to 63.88 respectively for T_1 T_2 and T_3. The difference of DCP and TDN values was significantly ($P<0.05$) between T_1 and T_3 but there was a non-significant difference between T_1 and T_2. The mean daily dry matter intake (kg/day) in T_1 T_2 and T_3 was 11.50, 12.66 band 13.40 kg/day

respectively which was significantly ($P<0.05$) higher in T_3 followed by T_2 and T_1. The values of DCP1 and TDN1 (kg/day) were significantly higher in T_3 (927.50) followed by T_2 (812.22) and T_1 9730.23) which is in accordance with the findings of Nagpal *et al* (1996). The average daily gain (g/day) was significantly ($P<0.05$) higher in T_3 (310) over that of T_2 280) and T_1 (125.0). However, Nagpal and Jabbar (2005) reported average gaily gain of 227.30 g/day on feeding dry moth fodder in camels.

There was increased in body temperature, pulse rate and respiration rate in all the treatments after carting over the initial values. The camels fed with Guar straw exhibited less physiological stress during carting as compared to camels fed moth straw and ground nut straw. The result found in the present investigation an in close agreement with Nagpal *et al* (1996). Khanna and Rai (2000) and Chaudhary *et al* 2008 and Chaudhary & Tiwari, (2010).

When the camels were made to pull cart of a pay load of 2.8 kg/kg B W on Two wheeled cart, the average speed in T_1 T_2 and T_3 groups were 2.68, 2.92 and 3.21 kg/h respectively. The variation observed in power developed by different groups of draught camels was significantly higher ($P<0.05$) in T_3 group followed by T_2 and T_1. These results are in confirmation with the findings reported by Rai and Khanna, (1994).

In conclusion, ad libitun feeding of Guar straw with concentrate mixture resulted in improved in take of DM, DCP and TDN by draught camels. The average speed and power developed was significantly higher in T_3 as compared to T_1 and T_3. Further the camels tolerate the work stress without any apparent ill effort on physiological responses which fed on guar straw in the diet. Thus it may be recommended that draught camels preferred guar straw as compared to other leguminous straws.

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84. Diversity of the Arabian Camel (*Camelus dromedarius*) Foregut's Bacteria

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Introduction

Australia has the world second largest area of arid and semi-arid lands in the world (McKnight, 1969). The camel population increased significantly since the release of camels into the wild in 1920s to reach more than a million (Edwards *et al.*, 2004; Saalfeld and Edwards, 2008). Australia is now home to the largest herd of wild camels in the world. Arabian camels (dromedary) are unique animals due to their adaptability to harsh arid environment. When the sources of food become scarce, camels can utilise the abundance of low quality shrubs and trees, and contains high level of anti-nutritional compounds such as Mulga (*Acacia aneura*), Ironwood (*Acacia estophiolata*), and River Red Gum (*Eucalyptus camaldulensis*) growing along dry river beds (Philips *et al.*, 2001). The high content of lignocellulose compounds in the shrubs and trees aforementioned has limited other domesticated ruminant species from using these plants as a food source. Little is known about the bacterial community of the camel GI tract. This project was designed to investigate the bacterial community using independent molecular techniques based of the 16S rRNA gene sequence analysis.

Materials and Methods

The foregut contents were collected immediately after slaughter from 12 feral dromedary camels that were harvested from the central Australian desert. The animals were fed on native vegetation available abundantly in the central Australia desert region. This study was conducted according to the animal ethics guidelines set by The University of Queensland Animal Ethics Committee (AEC Approval Number: SAS/069/08/UQ). One ml of the digesta fluid was used to inoculate a pre-reduced culture tubes containing different fibre type, namely filter paper (FP) (Mann, 1986), cotton thread (CT), and neutral detergent fibre (NDF) as a carbon source to study the effect of cellulose type on the bacterial community in the foregut of the dromedary camels. Genomic DNA was extracted from the foregut content and from the enrichment media. The DNA was PCR amplified using bacterial universal primer set (27f/1492r), cloned and sequenced.The derived sequences were aligned and their nearest-neighbour for each sequences were identified. The cell number of general bacteria community, *F. succinogenes* and *R. flavefaciens* in the foregut of the dromedary camel were quantified using real-time PCR.

Result

The study of the bacterial community in the foregut of the dromedary camel revealed a total of 267 near-complete 16S rRNA clones, with 151 operational taxonomic units (OTUs) identified at a 99% species-level identity cut-off criterion. The prediction of actual diversity in the foregut of the dromedary camel, using the Chao1's approach, was 238 OTUs, while the richness and evenness of the diversity estimated, using Shannon's index, was 4.84. The majority of clone bacteria in the current study were affiliated with the bacterial phyla Firmicutes (67% of total clones) and Bacteroidetes (25%). Meanwhile, a total of 283 near-complete 16S rRNA gene sequences derived from the three fibre-enrichment media (CT, FP, NDF) were examined. At the phylum the Firmicutes was the most abundant phylum present in both FP and CT enrichment media, while the phylum Proteobacteria was prevalent in the NDF media. Fourty-two OTUs were predicted by the Chao1, and the richness of the diversity estimated using the Shannon's index was 2.82 from the combined clone libraries. LIBSHUFF analysis of the 16S rRNA clone libraries derived from enriched media revealed significant differences across all of them. Using an absolute quantification method, the numbers for total bacteria was highest in CT media with $2.7x10^9$ cell ml^{-1}. *F. succinogenes* has the highest cell number in the FP media with $2.2x10^5$ cell ml^{-1} and *R. flavefaciens* was found to be high NDF media with $3.5x10^4$ cell ml^{-1}. The bacterial cell density of *F. succinogenes* and *R. flavefaciens* in the foregut

of the feral dromedary camel estimated using real-time PCR were lower than other domesticated ruminants.

Discussion

Sequence data from the present study represent novel bacterial sequences representing new species, several new genera and likely, a new family. The use of molecular approaches to study microorganisms‘ diversity, based on analyses of DNA, has allowed for the possibility of exploring the rumen bacteria niche widely and eliminated the complexity involved in the isolation and enumeration of fibre-digesting bacteria, which tightly adhere to the substrate. A very low number of clones of predominant fibre-degrading bacteria were detected using genomic DNA. The dynamics of the fibrolytic rumen bacteria is highly influenced by the type of fibre supplied in the cultured media as a substrate. The presence of plant secondary metabolites in the rumen content of dromedary camels has reduced the population of the fibre-degrading bacterial community. In summary, despite camels having a low population density in the rumen samples compared to domesticated ruminants, the data presented here would help to develop feeding regimes for dromedary camels since they do not share a common interest with domesticated livestock in the forage each consumes, especially during drought seasons.

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85. Fibrolytic Bacteria in the Foregut of the Feral Arabian Camel (*Camelus dromedarius*)

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Introduction

Australia has the world's second largest area of arid and semi-arid lands (McKnight, 1969). It is here that the camel population has increased significantly since their release into the wild in the 1920s to numbering more than one million animals (Edwards *et al.*, 2004; Saalfeld and Edwards, 2008). As a result, Australia is now home to the largest herd of wild camels in the world. Arabian camels (dromedary) are unique animals due to their adaptability to harsh arid environment. Camels feed on range of trees and shrubs that are found in the Australian desert. The Mulga (*Acacia aneura*), Ironwood (*Acacia estophiolata*), and River Red Gum (*Eucalyptus camaldulensis*) are among those mostly preferred by camels (Philips *et al.*, 2001). The high contents of lignocellulose and tannins in these shrubs and trees have limited domesticated ruminant and other herbivore species from feeding on them. It is well acknowledged that fermentation of feedstuffs in the foregut of the camels occurs in the same fashion as that in cattle. However, little is known about the bacterial community of the camel's foregut. This project was designed to investigate the bacterial community using independent molecular techniques based of the 16S rRNA gene sequence analysis and to study the effect of cellulose type on the bacterial community.

Materials and Methods

The foregut contents were collected immediately after slaughter from 12 feral dromedary camels that were harvested from the central Australian desert. The animals were fed on native vegetation available abundantly in the central Australia desert region. This study was conducted according to the animal ethics guidelines set by The University of Queensland Animal Ethics Committee (AEC Approval Number: SAS/069/08/UQ). Samples of foregut contents were collected immediately after post mortem, strained through four-layer cheesecloth, kept under carbon dioxide in a pre-warmed bottle until processed. One ml of the strained forestomach fluid was used to inoculate a pre-reduced media containing either filter paper (FP) (Mann, 1986), cotton thread (CT), or neutral detergent fibre (NDF) as the only carbon source. The cultures were incubated anaerobically at 39 ^{0}C for two weeks. Genomic DNA was extracted from the foregut content and from the enrichment media. The DNA was PCR amplified using bacterial universal primer set (27f/1492r), cloned and sequenced.The derived sequences were aligned and their nearest-neighbour for each sequences were identified. The density of the general bacteria community, *F. succinogenes* and *R. flavefaciens* in the foregut of the dromedary camel were quantified using real-time PCR.

Result

A total of 267 near-complete 16S rRNA clones were assigned to 151 operational taxonomic units (OTUs), based upon a 99% species-level identity criterion. The prediction of actual diversity in the foregut of the dromedary camel, using the Chao1's approach, was 238 OTUs, while the richness and evenness of the diversity estimated, using Shannon's index, was 4.84. The majority of clone bacteria in the current study were affiliated with the bacterial phyla Firmicutes (67% of total clones) and Bacteroidetes (25%). Meanwhile, a total of 283 near-complete 16S rRNA gene sequences derived from the three fibre-enrichment media were also examined. At the phylum level, the Firmicutes was the most abundant phylum present in both FP and CT enrichment media, while the phylum Proteobacteria was prevalent in the NDF media. Forty-two OTUs were predicted by the Chao1, and the richness of the diversity estimated using the Shannon's index was 2.82 from the combined clone libraries. LIBSHUFF analysis of the 16S rRNA clone libraries derived from enriched media revealed significant differences across all of them. Using an absolute quantification method, the numbers for total bacteria was highest in CT media ($2.7x10^9$ cell ml^{-1}). *Fibrobacter succinogenes* had the highest

cell numbers in the FP media with $2.2x10^5$ cell ml^{-1} and *R. flavefaciens* was found to be higher in the NDF media with $3.5x10^4$ cell ml^{-1}. The bacterial cell density of *F. succinogenes* and *R. flavefaciens* in the foregut of the feral dromedary camel estimated using real-time PCR were lower than estimates reported in other domesticated ruminants.

Discussion

Sequence data from the present study represent novel bacterial sequences representing new species, several new genera and, likely, a new family. The use of molecular approaches to study microorganisms' diversity, based on analyses of DNA, has allowed for the possibility of exploring the rumen bacteria niche widely and eliminated the complexity involved in the isolation and enumeration of fibre-digesting bacteria, which tightly adhere to the substrate. A very low number of clones of predominant fibre-degrading bacteria were detected using genomic DNA. The dynamics of the fibrolytic rumen bacteria is highly influenced by the type of fibre supplied in the cultured media as a substrate. The presence of plant secondary metabolites in the rumen content of dromedary camels has reduced the population of the fibre-degrading bacterial community. In summary, despite camels having a low population density in the forestomach samples compared to domesticated ruminants, the data presented here provide an insight into different consortia of bacteria that may play the same role under different conditions.

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86. Organic Matter Digestibility and Gas Production Characteristics of Some Camel Feeds in Butana Area-Sudan

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Introduction

The rumen is the largest stomach compartment in ruminants, where millions of bacteria grow under anaerobic conditions. These bacteria are responsible for the digestion of fiber (cellulose) and are the reason why ruminants can consume a wide variety of byproduct feedstuffs derived from the processing of plants for human food. The rumen contains a very well adapted microbial population in order to utilize cellulosic materials that will be later used by the host animal. The motility pattern of the compound stomach of the camel differs from that of true ruminants (Engelhardt *et al*., 1988). A continuous separation of solid feed particles from fluids and solutes seems to occur throughout the motility cycle, there by retaining larger feed particles in the rumen. The objective of this study was to assess the organic matter digestibity and gas production characteristics of some pasture grasses, forbs, trees, concentrates and agricultural by-products from Butana area using camel rumen fluids.

Materials and Methods

In vitro gas production was undertaken according to the procedure described by (Menke and Steingass, 1988). Rumen fluid was collected by a manually operated vacuum pump from two slaughtered she camels at Wadelbashir Slaughter House (western Khartoum State) into a pre-wormed thermos flask and immediately transferred to the laboratory. The rumen fluid was filtered and flushed with Co_2. The Co_2 flushed rumen fluid was added to the buffered mineral solution (1:2 v/v), which was maintained in a water bath at 39^{o}C. Samples (200 mg) of the air-dry feedstuffs were carefully weighted into syringes fitted with plungers. Buffered rumen fluid (30 ml) is pipetted into each syringe, containing the feed samples, and the syringes were immediately placed into the water bath at 39^{o}C. Pistons were lubricated with vaseline and inserted into the syringes. Two syringes with only buffered rumen fluid were incubated and considered as blanks. Each incubation was completed using (12) individual feedstuffs with each run repeated. The syringes were gently shaken every 2–4 h. The incubation terminated after recording the 96 h gas volume. The gas production was recorded after 3, 6, 12, 24, 48, 72 and 96 h of incubation. Total gas values were corrected for the blank incubation and reported gas values are expressed per 200 mg DM. The metabolizable energy (MJ/kg DM) content of feeds were calculated using equations of (Menke and Steingass, 1988) as: ME (MJ/kg DM) = 2.20 + 0.136 GP + 0.057 CP + 0.0029 CF^2. The organic matter digestibility percent (OMD) % of feeds was calculated using equations of (Menke and steingsss, 1988) as OMD% = 14.88 + 0.889GP + 0.45CP + Ash content. Where GP is 24 net gas production (ml/20 mg DM); CP, CF and CA are crude protein, crude fat, and crude ash (% DM), respectively. Data were subjected to analysis of variance following the completely randomized design

Results and Discussion

The incubated samples showed a fast initial gas production without lag time in all investigated feedstuffs Table 1. This was likely due to the micro-organism which takes a longer period of time to be growing and dividing. Sorgum grain and *Clitoria ternata* showed highly significant differences values of gas compared to the other plants during (3 - 96h). A study by Cone *et al*., (1997) showed that gas production could be divided into three phases, representing gas production caused by fermentation of the water-soluble fraction, the non-soluble fraction and microbial turnover. Generally, there was considerable differences in cumulative gas production profiles between different incubated individual feedstuffs.

The parameters of gas production are presented in Table 2. *Ipomoea- cordofana, Sonchus-oleraceus, Clitoria- ternata and Plepharis- edulis* had significantly ($p<0.05$) more a-values compared

to the rest feedstuffs. This shows that the soluble fraction in these plant species was degraded or released faster than the others. (Stefanon *et al*., 1996) and (Schofield and Pell, 1995). The presence of soluble but not digestible materials may be a factor which contributed to low gas production. Only *Acacia- seyal* which had significantly ($p<0.05$) higher (a) and (a+b) values than other plant species. It would appear that the insoluble material of *Acacia seyal* was less fermentable when incubated. There could be one explanation for this result, is the greatest concentration of antinutritional factors in *Acacia- seyal*. *Convolulus- fatmensis*, *Ipomoea- cordofana*, *Sonchus- oleraceus*, *Acacia- seyal*, *Sorghum bicolor* and sesame cake had significantly ($p<0.05$) highest c-values. There were considerable differences among the feedstuffs in terms of a, b, a+b, and c values.

Baggasse and *Acacia- seyal* together had significantly ($p<0.05$) lower values of ME (Table 4). Guerouali *et al*., (1992) concluded that camels require less comparative energy for maintenance than sheep or cattle. Wardeh (1990) reported that the contents of energy releasing entities of such plants were high enough to meet the maintenance and certain production requirements. The organic matter digestibility (OMD) % of individual feedstuffs incubated ranged between (31.33 – 71.07%). The OMD % was significantly ($p<0.05$) higher in sesame cake, while, *Acacia- seyal* and baggasse had significantly ($p<0.05$) lower values. There were considerable variations in metabolizable energy contents and organic matter digestibility values of investigated feedstuffs. The results are in agreement with Elshami, (1985), Bhattacharya *et al.* (1985) and Gihad *et al.* (1988) who stated that camels digest dry matter and crude fibre of range plants more efficiently than ruminants.

Table 1 Camel gas production volumes (3 – 96 h)

Species	**3**	**6**	**12**	**24**	**48**	**72**	**96**
Convolulus fat mensis	1.00^{ghi}	4.50^{hijk}	13.66^{fghi}	24.33^{efgh}	30.66^{efg}	42.66^{c}	43.66^{ef}
Ipomoea cordofana	2.33^{ghi}	8.50^{defgh}	17.66^{cdefg}	24.16^{efgh}	31.50^{ef}	36.16^{de}	37.16^{gh}
Sondus deraceus	7.66^{bcd}	16.00^{b}	26.00^{ab}	33.33^{abcd}	37.83^{cd}	43.83^{c}	44.83^{de}
Sesbania sesabon	7.00^{bcd}	11.83^{bcd}	16.16^{defgh}	27.16^{defgh}	33.83^{de}	35.50^{def}	37.50^{fgh}
Clitoria ternate	14.33^{a}	22.83^{a}	30.33^{a}	39.16^{a}	44.16^{b}	51.83^{ab}	52.83^{bc}
Plepharis edulis	3.8^{efg}	9.83^{def}	22.33^{bc}	35.83^{ab}	42.16^{bc}	57.50^{a}	58.16^{ab}
Leucaena glauca	5.5^{def}	10^{cdef}	15.50^{efghi}	21.16^{hij}	26^{fgh}	28.16^{ghi}	30.66^{ijk}
Acacia seyal	3.83^{efg}	5.83^{fghij}	10.33^{ij}	17.83^{ijk}	30.33^{efg}	32.83^{efgh}	35.50^{hij}
Sorghum grain	3.83^{efg}	7.50^{defgh}	18.50^{cdef}	39.16^{a}	53.66^{a}	57.66^{a}	60.66^{a}
Groundnut cake	9.00^{b}	14.33^{bc}	21.00^{bcd}	28.00^{defg}	30.00^{efg}	31.00^{efghi}	32.00^{hijk}
Sesame cake	8.66^{bc}	15.00^{b}	25.33^{ab}	35.16^{abc}	39.66^{bcd}	40.66^{cd}	42.16^{efg}
Baggase	1.66^{ghi}	2.83^{ijk}	4.66^{k}	14.00^{k}	25.50^{fghi}	31.16^{efghi}	32.50^{hijk}

^{abc} Mean on the same column with different superscripts differs significantly at $p<0.05$.SE: Standard Error

Table 2 *In vitro* gas production parameters by plant species (ml/200 ml/kg)

Species	**Camel**			
	A	**B**	**a + b**	**C**
Convolulus fat mensis	2.65^{fgh}	49.04^{cde}	46.39^{cd}	0.030^{hij}
Ipomoea cordofana	3.01^{ghi}	39.88^{ef}	36.87^{defgh}	0.056^{ef}
Sondus deraceus	1.093^{de}	41.25^{def}	43.18^{cd}	0.065^{de}
Sesbania sesabon	2.44^{cde}	34.97^{fghi}	37.40^{defgh}	0.047^{fg}
Clitoria ternate	10.95^{a}	41.14^{def}	52.10^{bc}	0.048^{fg}
Plepharis edulis	0.87^{efg}	60.63^{ab}	59.77^{ab}	0.035^{ghij}
Leucaena glauca	2.61^{cde}	27.02^{hij}	29.63^{ghi}	0.050^{fg}
Acacia sayal	0.05^{efg}	38.59^{fg}	38.54^{defg}	0.028^{ijk}
Sorghum grain	-6.64^{ij}	68.90^{a}	62.20^{a}	0.042^{fghi}
Groundnut cake	2.43^{cde}	28.81^{hij}	31.24^{gh}	0.088^{bc}
Sesame cake	-0.22	41.53^{def}	41.31^{def}	0.078^{bc}
Baggase	2.44^{fgh}	49.38^{def}	41.94^{de}	0.021^{jkl}

^{abc} Mean on the same column with different superscripts differ significantly at $p<0.05$. SE: Standard Error

Table 3: Metabolizable energy and organic matter digestibility from gas production:

Species	**ME/Mj/Kg/DM**	**OMD%**
Convolulus fat mensis	6.58^{fg}	63.91^{abcde}
Ipomoea cordofana	7.10^{def}	58.81^{def}
Sondus deraceus	7.70^{bcde}	67.09^{abc}
Sesbania sesabon	6.68^{efg}	61.21^{cde}
Clitoria ternate	8.64^{bac}	65.59^{abcd}

Plepharis edulis	7.57^{dcef}	63.58^{bcde}
Leucaena glauca	6.63^{efg}	60.64^{cde}
Acacia sayal	5.57^{g}	51.09^{f}
Sorghum grain	8.25^{bcd}	58.18^{ef}
Groundnut cake	8.69^{ab}	69.69^{ab}
Sesame cake	9.59^{a}	71.07^{a}
Baggase	4.12^{h}	31.33^{g}

[abc] Mean on the same column with different superscripts differ significantly at $p<0.05$. SE: Standard Error

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87. Effect of Replacing Organic With Inorganic Ingredients on the Efficacy of Mineral Supplements for Camels in the Arid Northern Kenya

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Introduction

The importance of camels in the arid areas of the world cannot be overemphasized. However, camels are hardly given supplemental feeds (Vittorio *et al.*, 1999) and therefore have to depend on the scarce natural forages for all their nutritional requirements including minerals (McDowell & Conrad, 1990). Previous studies by Kuria *et al* (2004), and Kuria *et al.*, (2006a, b) confirmed mineral deficiencies in Marsabit district located in northern Kenya. A mineral supplement was formulated using local material, tested with pastoralists camels and found to improve milk yield and calf growth by over 30%. The objective of the current study was to validate a modified version of this mineral supplement. The components of the original formulation were a) ground livestock bones mixed with b) locally available natural salt. In the revised formulation, the bone component was replaced with industrial general purpose chemicals. The validation was done on-station.

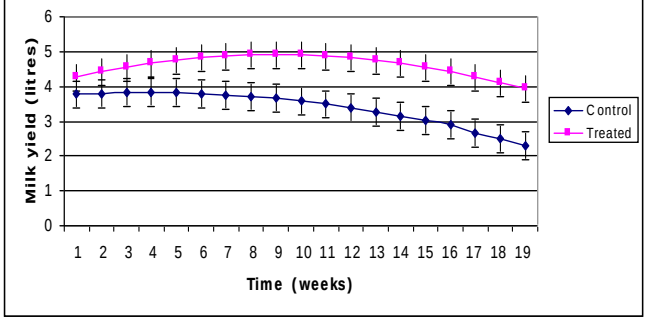
Materials and Methods

The experiment was carried out in KARI Gudas station from late October 2009 following the end of a severe drought to April 2010. Rainfall in the area comes in two peaks, that is, March-May and October-December and it ranges between 300 to 400mm. The temperature range recorded during the study was 21°c to 44°c. The experimental period was characterized by plenty of grazing resources for camels. The need to replace bones in the original formulation was necessitated by international concerns regarding the use of animal ingredients in the making of animal feeds due to health risks associated with mad cow disease. The mineral elements supplied by the bones in the original supplement i.e. calcium, phosphorus and magnesium were supplied through calcium carbonate, di-calcium phosphate and magnesium sulphate, respectively, in the revised supplement. These chemicals were mixed with naturally occurring salt collected from a local desert called Chalbi. Care was taken in calculating the mixing ratios so that as closely as possible maintain the original proportions of the various mineral elements in the revised supplement. The experimental camels were all of Somali breed whose parity ranged between 1 and 4 while the age ranged between 5 and 12 years. The stage of lactation was between 3 and 17 months. The experiment lasted about six months. The camels were randomly assigned the treatments such that a total of 27 camels were in the experiment with 15 treated and 12 controls. The experimental design was a Completely Randomized Design (CRD) with two treatments. Repeated measurements taken from each camel on weekly basis served as replicates. Each camel on treatment was given 200g of the mineral supplement every morning before releasing them for grazing. The milk measurements were repeatedly taken on weekly basis from each experimental camel. The milk yield was determined by milking one hind and one front teat (complete stripping) in the morning while the other two teats were left for the calf to suckle. To estimate yield from the four quarters i.e. whole udder, milk from the two teats was multiplied by two. This latter volume was further multiplied by two to get an estimate of the daily milk yield. Data relating to the number of parities, age and stage of lactation of the experimental dams was also recorded. The calves which were not receiving any supplement directly were weighed on weekly basis using a clock scale anchored on a tripod stand. Weekly weight gains ($kgwk^{-1}$) were computed by getting the difference between the readings for week two and week one, week three and week two and so on for each calf. Daily weight gain (gd^{-1}) for each calf was computed by dividing the weekly weight gains by 7. The data analysis was done using Statistical Analysis System (SAS, 2003). For the purpose of statistical analysis, the lactation stage (months) was categorized into four i.e. 1-3 months (A), 4-6 months (B), 7-9 months (C) and >9 months (D). Analysis of Variance (ANOVA) using the General Linear Model (GLM) procedure of SAS was done to test for treatment differences, effect of parity and stage of lactation on milk yield. The same procedure was used to analyze treatment effects on calf growth. In both analyses for milk yield and calf growth, age was entered as a covariate. Treatment means were separated using Least Significant Differences (LSD) at 95% level of confidence.

Results and Discussion

The mean daily milk yield for treated camels (4.4±0.2 ld^{-1}) was significantly higher ($p<0.0001$) than that of the controls (3.7±0.2 ld^{-1}). These figures were higher than those earlier reported by Kuria *et al.,* (2004) i.e. 2.7 to 3.4 ld^{-1}. The difference is attributable to variation in the breed of camel used in the experiment, the ones in the current study being of Somali breed while those used in the previous experiment were a mixture of Somali and Rendille breeds. In similar environmental and management situations, Somali camel breed produce more milk than the Rendille (Simpkin *et al.*, 1998). The quantity and quality of vegetation in Gudas where the current study was conducted was better than where the previous experiment had been conducted. This can also explain the difference in the observed responses to the supplementation. In the current study, the supplement increased milk yield of camels by 17.0% compared to 30% recorded with the original supplement. Digestibility and bioavailability of minerals in an animal body is a function of the source, among other factors. While the source of calcium, phosphorus and magnesium in the original formulation was organic in nature (livestock bones), the source of these minerals in the revised formulation was inorganic chemicals. Greater minerals bioavailability has been reported for organic sources than that observed for inorganic forms (Spears 1989, 2003; Wedekind *et al.*, 1992; Greene, 2000). The daily milk yield increased from lactation stage A to C and declined from C to D. This means the peak yield for the supplemented camels was attained between the 7th and 8th month of lactation. These results compares favorably with earlier reports by Kuria *et al,* (2004) who recorded peak production at between 5th and 7th month of lactation. Farah (1996), Simpkin (1998) and Yagil (2000) had earlier observed that most of the milk in camels was produced within the first 6 to 7 months of lactation. It is important to note that at commencement of the experiment, all the camels had lactated for over three months and appear to have already attained an early production peak (Figure 1).

Figure 1: Effect of the mineral supplement on the daily milk yield of camels

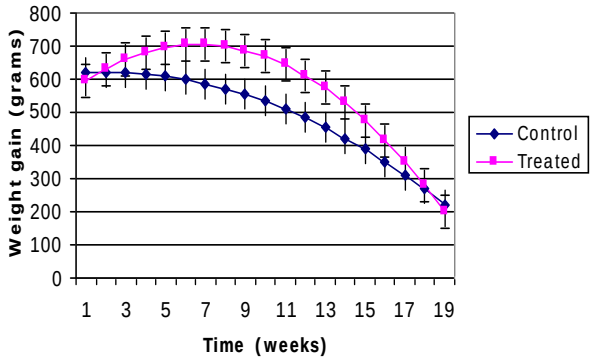


This early production peak may have been induced by feed and heat stress associated with severe drought conditions which prevailed when the camels were calving down. However, the supplementation increased persistence in milk yield with the normal peak production of almost 5 ld^{-1} a day being attained between two and three months later unlike the milk yield of the control camels which continued declining even with plenty of quality forage available during the period. Following the attainment of peak production by the supplemented camels, the daily milk yield declined steadily.

Camels in parity 2 produced significantly higher ($p<0.0001$) milk than those in parity 1. On the other hand, camels in parity 3 produced significantly less ($p<0.0001$) milk than those in parity 2 while those in parity 4 produced milk equal to ($p>0.05$) camels in parity 3. It was not immediately clear why camels in parity 3 produced less milk than those in parity 2 as this disagreed with previous reports (Bekele *et al.*, 2002; Hulsebusch *et al.*, 1994; Simpkin, 1996). Bekele *et al.*, (2002) observed that camels in the fourth parity showed the highest mean daily average off-take and showed a higher peak than other parities. Simpkin (1996) reported increasing mean daily milk yields from parity 1 through 2, peaking at parity 3 with a decline from parity 4. Simpkin (1996) results were in agreement with those of Hulsebusch *et al.,* (1994).

The mean daily weight gain for calves from supplemented dams (561.7±36.3) was significantly higher ($p<0.0001$) than that of calves from the control dams (448.9±37.7). The supplement increased the calf growth rate by 25.1% compared to 48% recorded with the original supplement (Kuria *et al.*, 2004).

Figure 2: Effect of the mineral supplement on the daily weight gain of camel calves



The superior performance of camels on the original supplement may be attributed to higher bioavailability of mineral elements due to the organic nature of the source. This explanation agrees with Greene (2000) who observed that there is usually considerable difference in bioavailability of minerals from different sources noting that organic sources (bones in this case) are more bio-available than inorganic sources (the case in the revised supplement).At the beginning of the experiment, the calves appear to have already attained the maximum growth rate of about 600gd$^{-1.}$ The control camel calves maintained this growth rate for the first four weeks of the experiment.However, the calves whose mothers were supplemented steadily gained weight,

attaining the maximum growth of 700gd^{-1} at the 6th week of the experiment (about four a half months of age) and maintaining it for the following three weeks. Thereafter, the calves whose mothers were supplemented continued gaining weight at a declining rate that was higher than for the controls.

In conclusion, the original supplement exhibited more profound influence on milk yield and calf growth compared to the modified one. However, responses registered with the modified supplement were significant. It is recommended that the modified supplement is commercially produced and promoted among camel pastoralists of northern Kenya in order to address mineral deficiencies facing camels in the area.

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88. Feed Intake, Digestibility and Milk Production in Mid Lactation of Tunisian Maghrebi Camels Fed Alfalfa-Based Diet

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Introduction

It is well documented that dry matter intake is important in nutrition of dairy species. It determine the amount of nutrients available to an animal for health and production. Dry matter intake is important for the formulation of diets to prevent underfeeding or overfeeding of nutrients and to promote efficient nutrient use.

Intensive camel dairy farms have been recently established in Southern Tunisia (Hammadi *et al*., 2006; Hammadi *et al*., 2010). Durability of these farms is strongly related to their profitability which depends to the produced milk. Milk yield potential depends on genetic traits and environmental factors such as feed intake and digestibility. Legumes provide a major source of proteins for dairy animals. Studies on intake and digestibility of Mediterranean legumes such as alfalfa in camels are absent. This study aimed to investigate: (1) the ingestion and digestion of alfalfa *(Medicago sativa)* based diet and (2) performance in mid lactation of Tunisian Maghrebi dairy camels.

Materials and Methods

The present study was conducted at the experimental station of the Arid Regions Institute in Chenchou (E9°53‘21‖, N33°53‘12‖). Six healthy Maghrebi camels (9.0 ± 4.0 yr of age; 464 ± 4 kg BW) at the 5th month of lactation were used. Dams were individually fed and water was offered daily. They received *ad libitum* alfalfa hay (90% DM, 15% CP and 42% NDF), 6 kg of green alfalfa (47% DM, 16% CP and 47% NDF) and 2 kg of concentrate (90%DM, 15%CP and 33%NDF). Dams were hand-milked twice a day (08:00 and 16:00). Milk production and feed ingestion intake were daily recorded. Digestibility was calculated using the indirect AIA technique. After adaptation period, representative samples of distributed and remained diets were collected daily and a small sample of feces was collected from rectum. Feed, refusals and feces were analyzed for neutral detergent fibre (NDF; Van Soest, 1973), dry matter, nitrogen and ash (AOAC, 2000). Samples were also subjected of acid insoluble acid (AIA) analysis according to Van Keulen and Young (1977). Coefficients of apparent digestibility for dry matter, organic matter, crude protein and neutral detergent fibre were calculated following the internal marker method. Data are presented as mean ± standard error means (SEM)

Results and Discussion

Feed intake and digestibility are given in Table 1. Compared to most of literature response (Khorchani *et al*., 1992; Ben Arfa, 2004), daily dry matter intake in this study was high but remains within the range of data (7 to 14 kg DM / d) by Le-Houérou (1995) in camels raised on pasture. Dry matter intake in camel is related to the quality of the diet. Under the range conditions, daily dry matter intake varied between 10.8 kg in dry season to 11.3 kg in rainy season. Expressed per kg metabolic weight, the amount of dry matter intake in our study was higher than that (56.6 g DM/kg $^{0.75}$) reported by Al-Motairy (1991) in camels fed wheat straw and concentrate. Dry matter digestibility of the alfalfa-based diet was 69.3 ± 1.4%. In cows, Llano and DePeters (1985) reported dry matter digestibility of 60.8% for alfalfa hay mixed with 30% concentrate. Similarly organic matter and crude protein digestibilities of diet were higher than reported (66.3% and 63.6%, respectively) for camel fed peanut hay and concentrate (Mohamed *et al*., 2009).

Table 1. Feed intake and apparent digestibility of the alfalfa-based diet in dairy camel

	n	Min	Max	Mean
Feed intake				
Dry matter				
- kg/day	36	11.1	16.0	13.5 ± 0.2
- kg/ 100 kg BW	36	2.2	3.5	2.8 ± 0.1
- g/kg $BW^{0.75}$	36	107	158	136.0 ± 2.0
Organic matter				
- kg/day	36	9.5	13.8	11.7 ± 0.2
- kg/ 100 kg BW	36	1.9	3.0	2.5 ± 0.1
- g/kg $BW^{0.75}$	36	92	139	118 ± 0.2
Digestibility (%)				
- dry matter	36	50.6	83.0	69.3 ± 1.4
- organic matter	36	51.1	84.8	71.8 ± 1.4
- crude protein	36	63.5	87.7	77.1 ± 1.0
- NDF	36	22.7	80.3	62.0 ± 2.1

Daily milk production ranged from 5.16 to 10.80 L and averaged 7.72 ± 0.27 L. This value was slightly higher than that (6.5 L/day) reported by Hammadi *et al*. (2006) for dairy camels. Milk secretion rate in the camel udders was 410 ml/h during 8 hours milking interval and 278 ml/h during 16 hours milking interval.

Conclusion

Intake and digestibility obtained in this study demonstrate high values of digestible dry matter intake, digestible organic matter intake and digestible crude protein intake. Alfalfa-based diet provides enough nutrients to produce milk in camel.

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89. Nutrient Utilization and Performance of Pregnant Camels Kept on Different Levels of Energy

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Introduction

The energy requirements for pregnant female animals are well described in most of domestic animals, and the requirements of farm animals are widely published. However, there are few references concerning energy requirements for pregnant female camels. The present study was carried out to investigate the response of pregnant female camel's performance to change dietary energy levels.

Materials and Methods

Twenty-eight female camels (*Camelus dromedarius*) (555±33kg body weight, with parities 1-3) in late stage of pregnancy (in the 11thmonth in pregnancy) were used to study the effect of four levels of dietary metabolizable energy 100, 120, 140 and 160 Kcal/kg$^{0.75}$ for G1, G2, G3 and G4 respectively on the performance of pregnant camels keeping similar CP (9.5%). Experimental period lasted 90 days. At the start of the 12th month of pregnancy 4 animals under each feeding regimen were placed in individual metabolic cages to calculate digestibility trial. Data were statistically analyzed using the method of least squares analysis of variance using software SPSS for windows (SPSS, 1999).

Results and Discussion

Difference in DMI /h/d and g/kg$^{0.75}$ were significant (P<0.05) among the experimental camel groups during the late pregnancy stage. Previously, research studies indicated that the daily dry matter intake of pregnant camels was 7.5 kg / day/ head (Seboussi *et al*., 2009). Although, these results of DMI values are lesser than the values 8.44 - 9 kg/h/d for 550-600 kg which were reported by (Wardeh, 2004). Increasing the energy level caused significant ascending effect (P<0.05) on the metabolizable energy intake (MEI) (kcal /kg$^{0.75}$). The present values of MEI are lower than (Wardeh, 2004). Total water intake (TWI) expressed as ml /kg$^{0.82}$ showed no significant difference between the experimental pregnant camel groups. At the same trend Shawket and Ahmed (2001) reported that the amounts of free water intake (ml/d/kgw$^{0.82}$) were not affected significantly by changing the level of energy supplementation.

The nutritive value as ME Mcal significantly increased (P<0.05) by increasing ration energy level. Mosaad *et al.* (2003), showed that high energy diet improved the condition of camels, by increasing the utilization of the nutrients.

Nitrogen retention (NR) as g/day or as percent of nitrogen intake (NR/NI %) did not differ significantly among the experimental four groups. These results confirmed the early findings of Gihad and Sooud (1989) who reported better retained N% and N intake with all animal species (camels, sheep and goats) with increasing the ration energy level.

The difference in total and daily body weight were significant (P<0.05) among the camel groups. The present total and daily body gain of the pregnant camel groups was less than that reported by Negpal (2007) which ranged from 124 kg/head to 177 kg/head for total gain and ranged from 1.01 to 1.44 kg/day in 123 days before parturition for Indian pregnant heavy camels breed. Loss in body weight at calving were not significant (P<0.05) among the experimental groups. Hammadi *et al.* (2001) reported that the values of weight loss of pregnant camels at parturition were 11-13% of the pre-calving weight. The difference in birth weight of camel calves was not significant among the four groups, our values of birth weight are close to the average values which were recorded by Shawket *et al*. (2010)

Results of this study indicated that the ration G1 providing energy level 100 kcal ME/kg$^{0.75}$, wa sufficient to cover the energy requirements needs for the pregnant dromedary female camels in late pregnancy stage.

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Table 1: Effect of level of the energy on dry matter intake, metabolizable energy intake (MEI), total water intake, nutritive value, nitrogen retention, total and average body weight, loss in body weight at calving and calves birth weight of pregnant female camels (Mean ± SE)

Items	Experimental rations			
	G1	G2	G3	G4
DMI, kg/h/day	6.24±0.36^{a}	6.85±0.38^{a}	6.88±0.22^{a}	8.39±0.38^{b}
DMI, g/kg$^{0.75}$	52.38±0.81^{a}	60.06±1.75^{b}	58.32±1.03^{b}	70.37±0.47^{c}
MEI kcal/kg$^{0.75}$	98.69±1.52^{a}	119.72±3.5^{ab}	119.82±2.12^{b}	154.70±1.05^{c}
Total water intake	111.44±13.09	121.39±13.34	113.41±6.90	137.62±6.23
Nutritive Value ME Mcal	1.88±0.054^{a}	1.99±0.03^{ab}	2.05±0.03^{bc}	2.20±0.04^{c}
Nitrogen Retention g/d	11.01±2.65	14.37±2.85	16.26±3.91	17.42±7.30
Nitrogen Retention NI%	11.49±2.89	14.06±2.20	14.39±3.86	14.79±5.46
Total body weight changes (kg)	45.25±14.93^{a}	88.00±12.59^{b}	88.50±6.91^{b}	82.38±6.85^{b}
Average body weight changes g/d	433.20±0.14^{a}	967.50±0.14^{b}	1056.0±0.18^{b}	1014.0±0.11^{b}
Loss in body weight (kg)	59.75±3.97	71.75±3.28	64.86±6.47	81.60±13.68
loss% of pre-calving weight	9.97±.92	11.90±0.83	10.37±0.83	12.96±2.24
Calves Birth weight (kg)	32.32±1.67	35.32±3.38	33.23±0.42	32.45±1.90

*****G1 = 1.89 Mcal, ME satisfy (100kcal/kg$^{0.75}$)
G2 = 2.08 Mcal, ME satisfy (120kcal/kg$^{0.75}$).
G3 = 2.33 Mcal, ME satisfy (140kcal/kg$^{0.75}$)
G4 = 2.37 Mcal, ME satisfy (160kcal/kg$^{0.75}$)

90. Feeding Preferences of One-Humped Camels (*Camelus dromedarius*) on a Semi-Arid Thornbush Savannah in East Africa. Adaptive Advantages in View of Increasing Aridity of the Environment

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Introduction

During the past 40 years there has been an increasing frequency of droughts in East Africa, and more noticeable in the past two decades, a decline in annual rainfall. NASA data suggest a decline by 15 % since the late 1980s (NASA 2008). As a result pastoral livestock production encounters higher risks and lower productivity mainly in the Ethiopian lowlands, Somalia, Kenya and Northern Tanzania. During the same time period camel numbers have been increasing in the area (FAO 2011), camel herds have been spreading southwards into Northern Tanzania, and traditional cattle keepers like the Samburu and Maasai pastoralists have successfully embraced camel production. Revisiting data collected by the authors in the early 1990s showed that camels owe this positive development to a large extent to their superior harvesting ability and their distinct feed preferences, which allow them to select high quality diets on degraded and drought affected rangelands where cattle and small ruminants are under severe nutritional stress.

Materials and Methods

A comparative study of feed preferences of camels, cattle, sheep, goats and donkeys was carried on a semi-arid thornbush savannah in Isiolo District, Kenya, approximately 250 km north of the equator. Only the results on camels are reported here. The study area includedannual grassland, dwarf shrub land and semi-deciduous Acacia spec. dominated thornbush of medium density; the annual rainfall was approximately 500 mm in a bimodal pattern. The study comprised of three major components.

Direct feeding observations were carried out using six adult male castrated dromedaries within a free ranging herd of close to 100 animals. Each of the six animals was observed for two 10-minute intervals during the morning grazing period. Feeding time per forage species was recorded to the nearest five seconds, feeding stations were counted. Height of feeding above ground was likewise recorded. The observations were repeated every two weeks for 32 months amounting to a total of 768 10-minute records. Parallel to this activity samples of five dominant forage species for each of the 64 observation events were taken for chemical analysis to estimate the approximate nutritive value of the ingested diet. Larger samples were taken to be processed for measuring in-vivo digestibility with the ―nylon bag‖ technique. The latter measurements were carried out within one month of the sample collection using four other camels fitted with fore-stomach fistulas. The animals were regularly herded with the aforementioned herd on the same pastures. Data processing and descriptive statistics were done with the STATISTICA 6.5 software.

In a separate but related activity a botanical inventory of the study pastures was established listing close to 350 plant species and containing information on spatial and seasonal occurrence as well as ground cover and density of the more important forage species (Schwartz and Schultka, 1995). This information was used to calculate relative dietary preferences, i.e. a selectivity index for individual forage plant species and taxonomic groups.

Results

The dromedaries fed regularly on 74 plant species out of the total inventory. During a single observation event any individual animal would utilise between 3 and 12 different species, the group of six would utilise between 10 and 25. Overall 44.2 % of the total observation time was spent feeding. The animals showed a distinct absolute preference for bushes, trees and dwarf shrubs with 37.9 %, 29.2 % and 27.6 % respectively of the total feeding time observed. Grasses, forbs and others together accounted for only 5.3 %. Average feeding height above ground was 1.6 m; maximum feeding height was 3.6 m.

The five most preferred forage species represented 32.4 % of the total intake time. All were woody species, two dwarf shrubs, one large bush, and two trees. One dwarf shrub and one tree are semi-deciduous legumes, the large bush and one tree are evergreen and fleshy leaved, the remaining dwarf shrub is semi-deciduous.

Table 1: Observed feeding time by species and selected mean quality parameters for the five most preferred forage species

Plant name	% feed time	NDF %	ADF %	ADL %	CP %	DMDR* 24	DMDR 48
Cadaba farinosa	7,6	28.4	18.5	8.9	27.0	81.7	79.9
Indigofera spinosa	6,7	49.7	38.1	9.6	13.7	36.9	42.4
Vernonia cinerascens	6,4	44.2	30.0	9.0	18.5	49.5	53.0
Maerua crassifolia	6,0	28.3	16.9	5.4	22.7	67.1	72.2
Acacia tortilis	5,7	35.9	25.0	8.1	18.9	57.3	63.5

*DMDR = Dry matter disappearance rate

Calculation of preferences relative to the supply on the pasture (selectivity index) showed high positive values (0.94 to 0.98) for the five most preferred species, indicating that the displayed preference was not a function of abundant supply.

Discussion

The results showed that feed preference was related to forage quality, in particular to protein content and digestibility, as the five most preferred species were also the five most nutritious of all species recorded in the camels‘ diet. Several factors contribute to this. Camels prefer woody plants which are usually much deeper rooted than the herblayer and have better access to soil water reserves. Therefore they often bear green foliage even in the dry season or highly nutritious flowers or fruits like most of the Acacia specs. Many of the larger woody species are evergreen and the foliage is of high quality throughout the seasons. Among the woody species a larger number are legumes, which are particularly rich in protein. Of the pastoral livestock camels are best suited to exploit the woody vegetation. The ability to feed up to heights of 3.5 m or more above ground gives them a substantial niche without competition from other domestic livestock. The prehensile lips allow camels to selectively harvest very small feed items such as Acacia leaves from between large thorns and the positioning of the canine teeth and the canine shaped premolars allows sideways leaf-stripping as an efficient harvesting technique for larger and fleshy leaves of evergreen trees and bushes.

Due to their feed preferences and harvesting ability camels are efficient users of rangelands with a drought affected or degraded herblayer or those suffering from bush encroachment. Consequently they are less prone to drought related nutritional stress and related reduced productivity and/or increased mortality. Pastoralists traditionally keeping cattle like the Samburu of Kenya and the Waarush group of Maasai in Tanzania have, in the recent past, adopted and still are adopting camels to replace the drought susceptible cattle with good results, retaining the traditional multiple use character of production of milk, blood, meat and transport capacity.

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POSTERS

Genetics and Biotechnology

1. Phenotypic Characteristics of Two Sudanese Camel Ecotypes *(Camelus dromedarius*) Raised in Butana Area

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Introduction

The population of Sudan camels was estimated to be 3.908 millions contributing to about 11% of country's animal biomass. These figures also represent about 20% of the world's camel population which ranks Sudan second to Somalia (30%), between them they owns more than half of the world's- camels. In eastern Sudan, camels (*Camelus dromedarius*) are mainly raised in the Butana region and the Red Sea coast. In the former, the camel population was estimated around 750.000 head representing more than 25% of total Sudan camel herd population (Darosa, 2005). The main camel keeping tribes in the Butana region are the *Lahawiyin*, *Kawahla*, *Shukriya*, *Rashaida*, *Bija* and *Bawadra.* There are two distinguished types of camels in Sudan, the slow heavy pack or baggage type and the fast light riding or racing camels. The objective of this study was to characterize the two Sudanese ecotypes in the Butana region according to their phenotypic measurements.

Material and Methods

Body measurement data were collected from 256 camels from two Sudanese ecotypes, the Arabi breedwhich is known as pack or baggage type and Anaffi breed which is identified as racing or riding type. These data were collected from central of Butana plain. A measuring tape was used for all measures with the exception of height at withers and height at hump tip which were measured with a calibrated stick. The body weights of animals were estimated according to (Boue, 1949) formula. Basic information such as sex, age and breed were recorded for each camel. The age of camel was classified into in to five groups. Phenotypic measurements data were subjected to analysis of variance (ANOVA) using the general linear model (GLM). The statistical model used was:

$$\mathbf{Y}_{ijkl} = \boldsymbol{\mu} + B_i + \mathbf{S}_j + \mathbf{A}_k + (\mathbf{B}\times\mathbf{S})_{ij} + (\mathbf{B}\times\mathbf{A})_{ik} + (\mathbf{S}\times\mathbf{A})_{jk} + \mathbf{e}_{ijkl}$$

Where $\mathbf{Y}_{ijkl}$ is the individual observation for each trait of the animal;$\boldsymbol{\mu}$ is the general mean of each trait; $\mathbf{B}_i$: is the fixed effect of the *i*th ecotype, $\mathbf{S}_j$is the fixed effect of *j*thesex; $\mathbf{A}_k$ is the fixed effect of *k*theage group;$(\mathbf{B}\times\mathbf{S})_{ji}$is the effect of the interaction between sex and ecotype; $(\mathbf{B}\times\mathbf{A})_{ik}$ is the effect of the interaction between ecotype and age group; $(\mathbf{S}\times\mathbf{A})_{jk}$ is the effect of the interaction between sex and age group and $\mathbf{e}_{ijkl}$ is the random error effect associated to the $_{ijkl}$observations.

Results and Discussion

Table 1 showed the influence of breed, sex and age group on the studied body measurements of Butana plain camels. The breed of camel had significant ($P<0.05$) effect on barrel circumference, heart circumference and body weight, while it had no significant ($P>0.05$) influence on height at wither, body length and height at hump. The Arabi camel had significantly ($P<0.05$) higher values of barrel circumference, heart circumference and body weight compared to the Anafi camel. The body measurements obtained in this study for Arabi and Anafi breed were lower than that reported by Ishag *et al*. (2010), Ishag *et al*. (2011a) and Ishag *et al*. (2011b). On the other hand, the body weight of Anafi camel in this study was different from the findings of Wardeh (1989), Khouri (2000) and Wardeh (2004). The sex of camel significantly ($P<0.05$) affected heart circumference, height at withers and body weight, but it did not influence barrel circumference, body length and height at hump. The male camels had higher body measurements than the females, which was similar to that reported by Dioli *et al.* (1992) and Mehari *et al*. (2007), Ishag *et al*. (2010), Ishag *et al*. (2011b) who stated that there is quite distinctive sexual dimorphism in camels, i.e. the male camels is usually taller and of heavier than the female. These differences between males and females may reflect differences in the hormonal secretions and their activities in the two sexes. The age group had significantly influence on all studied measurements except height at hump was insignificantly affected. The all tested measurements had increasing trend from 1st age group (3-4 years) to 4th age group (9-10 years),

after which some measurements were slightly increased and other were slightly declined. This results was somewhat is agree with findings of Ishag *et al.* (2010) and Ishag *et al.* (2011b); who mentioned that the camels of Sudan reach maturity (growth peak) within 7 to 9 years; after which the different measurements decline. The interaction between breed and sex of camel had significant ($P<0.05$) effect only height at wither; the males of Arabi camel were higher than females, while there was no difference observed between males and females of Anafi camel. Also, the interaction between breed and age group was significantly affected only body length. On other hand; the interaction between sex and age group had significant influence on barrel circumference, heart circumference and body weight. The height at hump was only body measurement that not significantly affected by the studied factors.

Table (1) Means and standard errors of barrel circumference (BC), heart circumference (HC), height at wither (HW) and body weight (BW) for camel of Butana Plain.

Source of variation	N	BC (cm) mean ± SE	HC (cm) mean ± SE	HW (cm) mean ± SE	BW (kg) mean ± SE	BL (cm) mean ± SE	HH (cm) mean ± SE
Breed:		*	***	NS	**	NS	NS
Arabi	120	232.3^{a}± 2.4	175.6^{a}± 1.0	181.5^{a}± 1.0	390.1^{a}± 6.6	158.3^{a}± 1.2	188.2^{a}± 1.7
Anafi	136	222.3^{b}± 2.3	170.3^{b}± 0.9	179.1^{a}± 0.9	362.6^{b}± 6.4	155.8^{a}± 1.2	186.5^{a}± 1.6
Sex:		NS	*	*	*	NS	NS
Male	122	228.3^{a}± 2.5	174.7^{a}± 1.0	182.4^{a}± 1.0	385.5^{a}± 7.0	158.5^{a}± 1.3	188.2^{a} ± 1.8
Female	134	226.2^{a}± 2.3	171.2^{b}± 0.9	178.9^{b}± 0.9	367.2^{b}± 6.3	155.6^{a}± 1.1	186.5^{a} ± 1.6
Age groups:		***	***	**	***	***	NS
1^{st} (3-4 years)	66	209.3^{c}± 3.5	165.6^{c}± 1.5	177.6^{b}± 1.4	321.9^{d}± 9.8	150.0^{c}± 1.8	186.2^{ab}± 2.5
2^{nd} (5-6 years)	53	218.7^{b}± 3.4	168.1^{c}± 1.4	178.7^{b}± 1.4	350.2^{c}± 9.6	157.3^{b}± 1.7	185.8^{ab}± 2.4
3^{rd} (7-8 years)	49	237.5^{a}± 4.2	175.6^{b}± 1.7	178.9^{b}± 1.7	397.4^{b}±11.7	157.3^{b}± 2.1	185.4^{b}± 3.0
4^{th} (9-10 years)	36	238.5^{a}± 4.0	177.3^{ab}± 1.6	183.3^{a}± 1.6	409.1^{a}±11.2	159.2^{ab}±2.0	191.3^{a}± 2.9
5^{th} (≥ 11 years)	49	232.3^{a}± 3.7	178.0^{a}± 1.5	184.5^{a}± 1.5	403.2^{a}±10.3	161.4^{a}± 1.9	188.1^{ab}± 2.6
Breed*Sex		NS	NS	*	NS	NS	NS
Breed*Age group		NS	NS	NS	NS	*	NS
Sex*Age group		*	*	NS	*	NS	NS
Overall mean	**256**	**227.3 ± 1.7**	**172.9 ± 0.7**	**180.7 ± 0.7**	**376.4 ± 4.7**	**157.1 ± 0.8**	**187.3 ± 1.2**

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2. Factors Affecting the Performance of Racing Camels in the United Arab Emirates

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Inroduction

In the United Arab Emirates (UAE), camel racing has become a deeply appreciated and a valued tradition. Despite the many opportunities made available by the modern and diversified local economy, people in the UAE continue to breed, raise and train camels for racing. Camel owners in the UAE can identify three lines of origin that have provided the bulk of genetic pool for modern racing camels; namely Omani, Najdi and Sudanese origins (Camel Race Association, 2002).

Similar to the horses, the racing performance of camels is affected by both genetic and environmental factors (Ekiz *et al*., 2005; Orhan and Kaygisiz, 2010). Racing performance of camels is generally measured by racing time or finish rank for given distance and age group (Thiruvenkadan *et al*., 2009). Thus, it was reported that race finishing time is a direct measure of speed and is regarded as the proper method of evaluating race performance of horses (Burns, *et al*., 2004). Therefore, the objective of the present study was to identify environmental factors that affect racing performance of UAE race camels in order to contribute to a selection program aiming to improve the racing performance for this breed.

Materials and Methods

The data used in the present study were obtained from UAE Camel Race Association (CRA). As part of regulation, races should be filmed from two different views using two cameras run parallel to the inner fence of the racetrack. The photo finish video camera records the first tin winners and the winning time of the race. Finishing time data from 4000, 5000, 6000 and 8000 meters races belonging to year 2008 representing 250 race records were used in this study. One hundred ninety races of varying distances with 50 camels per race were studied.

Three linear models were used in the evaluation of environmental factors affecting the racing time and racing speed. In model-1, the fixed effect of age was included. Model 2 included the fixed effects of sex and breed as well the interaction between them. In model-3, race distance factor (4000, 5000, and 6000 m) was included for a four-year race camel. The following mathematical models were used in the analysis of the data:

$Y_{ij} = \mu + A_i + e_{ij}$ (Model-1)
$Y_{ijk} = \mu + S_i + B_j + SB_{ij} + e_{ijk}$ (Model-2)
$Y_{ij} = \mu + D_i + e_{ij}$ (Model-3)

Results And Discussion

The descriptive statistics of racing time and racing speed at the distances studied are shown in Table 1. Average speed of race camels in UAE was 10.6 m/s (SD=0.26; range: 9.2-11.79 m/s). The higher speed was observed ($P < 0.05$) at shorter distance compared with longer distances. Speed of race camels is much lower compared to the average speed of racehorses (Corrêa and Mota, 2007; Ekiz and Koçak, 2007; Schurink *et al*., 2009).

Table 1. Least square Means, coefficients of variation (CV), minimum maximum and values for the racing speed (m/s) and racing time (s) by distance

Distance (m)	Mean	S.E	C.V (%)	Minimum	Maximum	Mode
			Speed (m/s)			
4000	10.64[a]	0.01	1.83	9.21	11.07	10.64
5000	10.51[b]	0.02	1.85	9.67	11.79	10.55
6000	10.50[b]	0.01	1.52	9.81	10.88	10.33

8000	10.15[c]	0.04	2.12	9.75	10.40	-
			Time (s)			
4000	376.08	0.25	1.92	361.3	434.50	375.60
5000	475.8	0.72	1.83	424.20	517.00	473.60
6000	571.43	0.64	1.55	551.13	611.50	563.50
8000	788.29	3.26	2.12	768.70	820.30	-

Speed of race camels in UAE was significantly affected by age of the camel ($P < 0.05$) for the fastest three. The highest race speed was attained by the 3-year-old camels, while the lowest racing speed was obtained by the 6-year-old camels for the fastest three. The trend of camel's age effect on racing performance observed in the present study is different from those figures reported for horses. Females were significantly ($P < 0.05$) faster than males in other age groups for the fastest ten. These results in the present study are in contrast with most of the figures reported for horses in which males were superior to females in all types of races. Purebred camels showed a significant ($P < 0.05$) lower performance than crossbred camels for the fastest ten. Crossbred males tended to perform better than other animals. In conclusion, the results of the present study provide insight into the environmental factors affecting racing performance of race camels in UAE.

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3. Genetic Characterization of Local and Crossbred Racing Camels in the United Arab Emirate

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Introduction

Camel breeds are not as differentiated and classified as breeds in other livestock. Systematic selection for productive traits has never been done in camels, except for racing animals (Kappeler, 1998). Nevertheless, there are different breeds used for different purposes like riding, meat or milk production. The breed most common in the UAE is the _Al-Khawar' breed. It is mainly known for its racing performances but also bred for milk production (Fontainebleau, 2007).

In developing an effective animal selection program, estimates of the genetic characteristics and relationships is important for the identification of parents for the hybridization and for reducing the number of accessions needed to maintain a broad range of genetic reliability. With the development of molecular genetic techniques, it has become possible to establish a new class of genetic markers based on variability of DNA sequence level Chung *et al.* (1995). Previous genetic studies included the development of a microsatellite marker set for parentage and an identity verification test for dromedary racing camels (Sasse *et al.*, 2001). These studies employed microsatellites as markers. Besides analysis of microsatellite alleles, polymerase chain reaction and restriction fragment length polymorphism (PCR-RFLP) provide the possibility of the practical application of polymorphic genetic markers to livestock improvement Soller and Beckmann, (1982). The use of information on genetic markers is expected to increase genetic progress through increasing accuracy of selection, reduction of generation interval and increasing selection differentials (Meuwissen and Van Arendonk, 1992). Therefore, the objective of this study was to characterize genetic diversity and relationship between local, crossbred racing and lactating camels in UAE based on molecular markers.

Materials and Methods

Camel blood samples were collected from 28 Camels, namely, 6 females, 6 males local and 6 female, 6 males crossbred and 4 lactating camel as control. In addition, samples were collected separately from 3 lactating females to serve as controls and also to examine variability between them. Samples were taken directly from 3 racing camels representing each group of competition after finishing the race from Ned Al Sheba Camel Racetrack. Genomic DNA was extracted from blood samples using DNease Blood & Tissue Kit (Promega, UAS) according to the manufacturer procedures.

The primers used in this study were utilized in several studies to examine Arabian Camel (*Camelus dromedarius*), (Mehta *et al.*, 2006 and Al-Swailem *et al.*, 2007). In addition, one primer (OPA-04) has been previously used with milk camels in Biotechnology Lab at Faculty of Food& Agriculture system UAEUniversity where they proved polymorphic. Genomic DNA of camel with same sex and breed were examined with each primer. Each primer was examined with individual samples.

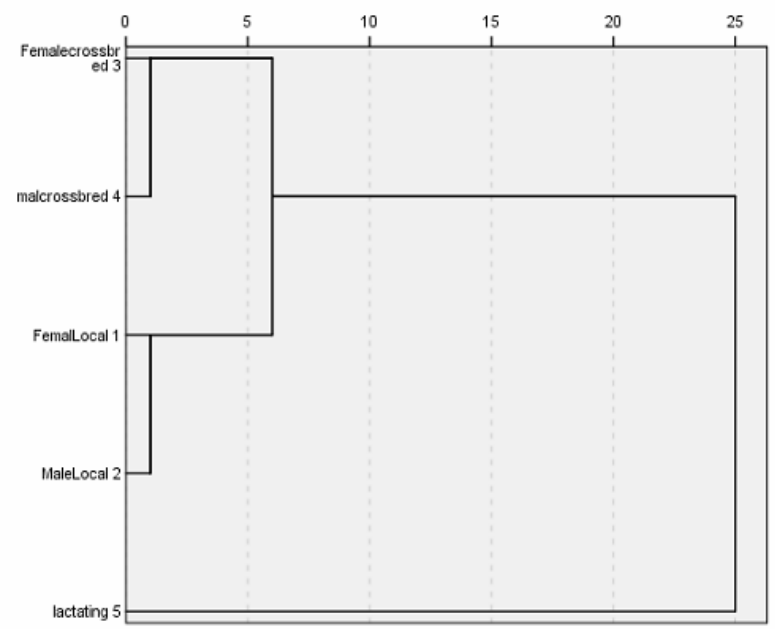
Comparisons of DNA profiles generated from each pooled group were performed by Gel Documentation data software. Fingerprint similarities values were based on the presence or absence of bands. Data were then computed and subjected to statistical analysis with SPSS computer software program, Diversity Database Fingerprinting Software, to produce a genetic distance matrix using the Jacart Value which assesses the similarity between any two populations on the basis of the number of generated bands as reported by Nei (1978).

Results and Discussion

The primers examined resulted in a reproducible DNA-based fingerprints for the three major camel groups and lactating camel group as control under investigation, namely, Local, Crossbred, and lactating. Also the samples were assigned as males and females. With the pooled DNA samples,

certain primers amplified similar DNA fragments for all samples per primer. On the other hand, the other primers revealed diversity between the different groups which allowed the possibility of assigning certain molecular markers to specific racing or lactating groups as well as distinguishing local from crossbred camels. In addition, number of bands and the degree of polymorphism were different between breeds as well as primers. The Dendrogram (Fig. 1) indicated that the five groups can be distinguished from one another and resulted in two clusters based on the RAPD assay.

Figure 1. Dendrogram Average Linkage (Between Groups) Rescaled Distance Cluster Combine.



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Physiology Biochemistry Pharmacology and Immunology

4. Antimicrobial Activity of Camel's Colostrum Against *Listeria innocua*

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Introduction

For all mammals, colostrum is considered as a vital food of newborn within the first days after birth. It protects the newborn against infectious diseases, due to its combined action of a high concentration of transfer-immunity factors and nonspecific inhibitory system (lactoferrin, lactoperoxydase and xanthin oxidase) present in this biological fluids. Several investigators (Elagamy *et al*., 1992; Kappeler *et al*., 2004 ; El Hatmi *et al*., 2007) have studied the concentration of antimicrobial factors in camel's milk. No such work, to our knowledge, has been carried out on antimicrobial activity of camel's colostrum. The present study aimed to evaluate the natural protection of camel's colostrum against *Listeria innocua LRGIA01*.

Material and Methods

From experimental herd of camels in Livestock and Wildlife Laboratory, Arid Lands Institute, we collected colostrum within the first 2 days of parturition in clean bottles. Samples were immediately stored at –20°C until use. Samples were then centrifuged at (20000 g, 4°C, 20 min). The pH of supernatant obtained is decreased at pH= 4.2 by HCL (1M), recentrifuged and neutralized by NaOH (1M). Finally, serocolostrum obtained is dialyzed against 3 days at 4°C and freeze-dried.

The target strain is stored in Broth Heart Infusion (BHI, Biokar, France) contained 25 % of glycerol at – 20 °C. Before experimental use, strains were activated by two successive transfers in their appropriate broth and incubated overnight at 30 °C.

The freeze-dried camel's colostrum resuspended at a concentration of 20 and 40 mg /ml indistilled water were sterilized with filter-syringe 0.2 µm. The antimicrobial activity was determined using a semi-automatic unit with spectrophotometric monitoring of microbial cultures in liquid medium in microplates Bioscreen (ThermoFisher, Illkirch, France). For this purpose, 30 µl of *Listeria innocua LRGIA 01* (10^6 CFU / mL) was inoculated into 270 µl of medium (BHI) supplemented with different concentrations of colostrum in the microplate wells incubated with stirring for 24 hours at 30 ° C. The growth of *L. innocua LRGIA 01* was followed at 600 nm. Positive controls (medium supplemented with 2400 IU / mL nisin) and negative (BHI medium without colostrum) were also performed.

Results and Discussion

L. innocua is a Gram-positive rod that occurs individually or forms short chains. *Listeria innocua* is widely distributed throughout the environment, but primary habitats are considered to be soil and decaying vegetable matter, living as a saprophyte. *Listeria* can also survive in many extreme conditions, such as high salt concentrations, high pH, and high temperature. Both pathogenic and innocuous forms of *Listeria* have this ability. *Listeria* species also form biofilms, which allow them to attach to solid surfaces where they proliferate and become extremely difficult to remove (Howard *et al*., (1992).

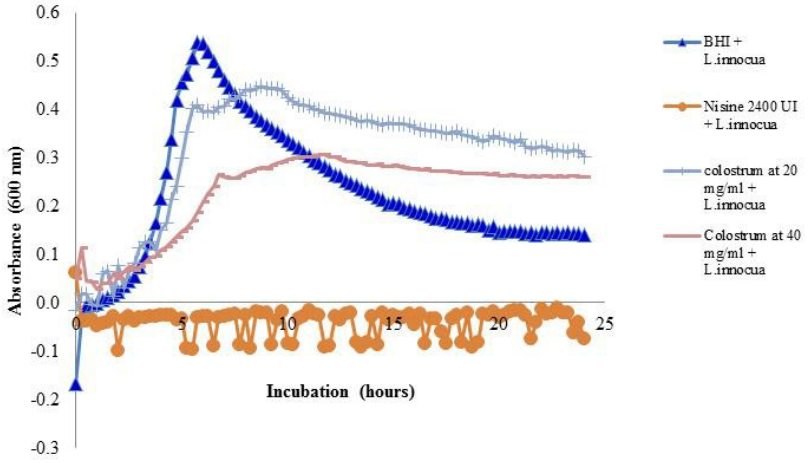

Figure 1: Growth curves (optical density, O.D, at 600 nm) of *Listeria innocua LRGIA 01* at different concentrations (0; 20 and 40 mg/ml) of camel's colostrum and Nisine 2400 UI.

No difference during the lag phase for the first 2-3 h was observed between the positive control and the samples. After 4 h, in the early exponential phase, clear differences in the growth of *L. innocua* were observed with a dose dependent effect (20 and 40 mg/ml). The lowest concentration (20 mg/ml) of camel's colostrum samples inhibited slightly the bacterial growth between incubation times 5- 8 h. Therefore, a significantly inhibition of growth of *L.innocua* is observed at the concentration (40 mg/ml) of colostrum samples in the exponential phase and first hours of stationary phase. The two concentration of camel's colostrum showed stimulation of microbial's growth, after 10 h and in subsequent hours of stationary phase.

Conclusion

This antimicrobial activity in camels' colostrum might be partially due to lactoferrin and immunoglobulins, El Hatmi *et al*. (2007) showed that colostrum contains a large quantity of immunoglobulins.

A large number of studies have demonstrated bactericidal and bacteriostatic effect of lactoferrin from colostrum of different species other than camel. In conclusion, this study has highlighted that camels' colostrum contains different protective antimicrobial factors, including peptides released during the digestion process that can exert a beneficial impact on gut health, particularly for the low immune defense system of children, elderly and the convalescent.

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5. Production and Application of Camelid Antibodies

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Introduction

The application of hyperimmune serum in diseased animals or humans is an efficient short-term prophylactic method to save lives of humans and animals alike. This method especially works well in acute cases through neutralization of circulating toxins. These antitoxins will circulate for more than 20 days in the animal's body after application and can also be used as a therapeutic tool in case of urgent operations or castrations. In sheep, for example, the administration of the *Clostridium perfringens* epsilon antitoxin, 20 IU/kg body weight will save the animal's life.

Dromedaries are excellent antibody producers for 2 reasons. Firstly, an adult animal possess more than 30 L of blood and secondly, they have also a considerable fraction of heavy-chain antibodies (HCAbs) circulating in their blood which are composed of a heavy-chain homodimer. These unique HCAbs may account for the reported thermostability and long shelf life. Camelid IgG is less immunogenic and less likely to activate complement than most mammalian IgG (Cook *et al*., 2010).

Results

We report here the production and the application of camelid hyperimmune immunoglobulin for *Clostridium perfringens* alpha-toxoid and for anti- snake venom development. For the production of hyperimmune serum against *Clostridium perfringens* alpha-toxoid, vaccination of two dromedaries was carried out according to the recommendation of the vaccine producer (IBT, Dessau, Germany) (Wernery *et al*., 2009). Two dromedaries were vaccinated thrice with 10ml of vaccine subcutaneously. Antibody levels were tested using a competitive ELISA kit, BIO-X Diagnostics ELISA BIO K221. When the antibody response was at the peak, six liters of blood were taken from the jugular vein of each camel, blood was allowed to clot at room temperature (RT), centrifuged and sera collected and stored at -20ºC.

For anti-venom development, five dromedaries were immunized with a mixture of venom to prepare polyspecific anti-venom. Three additional camels were immunized with venom from a single snake species to prepare three distinct monospecific anti-venoms. A total of 13 immunisations were administered with an equal amount of adjuvant, over a period of 64 weeks. After the 7th immunization, six liters of blood were taken from each camel and sera were stored at -20ºC (Cook *et al*., 2010).

Hyperimmune sera were subjected to a series of processes, which included, solvent-detergent extraction that effectively inactivates the lipid-enveloped viruses. Serum proteins of the extract were precipitated by caprilic acid (octanoic acid) without loss of yield and purity. Subsequent filtrations and chromatographic separations resulted in highly purified IgGs.

For *Clostridium perfringens* alpha-toxoid, the purified IgGs were then further concentrated to 14g/L and filled in 50 -100ml sterile transfer bags (Compoflex, Fresenius Kabi AG, Germany). It is available at CVRL for animal applications. While camelid IgG anti-venom were concentrated to 50g/L and stored for human clinical studies.

Applications

Anti-toxins are especially very effective in acute cases. Intravenous application of *Clostridum perfringens* alpha-toxoid immunoglobulins to camels suffering from acute clostridial enterotoxaemia, showed significant improvement and thus saved the animals. Symptomatic gazelles, antelopes and sheep were also treated effectively without any side effects.

The results of the different preclinical assays in laboratory animals showed that purified camelid IgG anti-venom have venom-neutralizing capability. It also showed that camelid anti-venom

can drastically reduce the venom induced haemorrhagic effect of some snake venoms at the bite. We have not conducted yet a clinical trial in humans, but it is anticipated to start very soon.

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6. Humoral Immune Response in the Dromedary: Kinetic of the Production of Immunoglobulins and their Physicochemical Characteristics

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Introduction

It has always been thought that the structure of immunoglobulins is restricted to a tetramer of two heavy chains and two light chains. in 1993 Hamers-Casterman *et al*. (Hamers-Casterman *et al*., 1993) discovered that besides producing conventional tetrameric IgGs, camelids (camel, dromedary, llama, alpaca, guanaco and vicuña) produce functional homodimeric IgGslacking light chains and are therefore constituted only of two identical heavy chains (Hamers-Casterman *et al*., 1993, Maass *et al*., 2007).

Three subclasses of IgG were identified in the dromedary serum and classified according to their decreasing MW of the H-chain; IgG1, IgG2 and IgG3. IgG1 has the conventional IgG structure, a tetramer of two Heavy chains and two light chains with a molecular weight of 150 kDa and binds to proteins A and G in affinity chromatography. The IgG2 and IgG3 are HCAbs with an apparent molecular weight of about 100 kDa. IgG2 binds only to protein A, whereas IgG3 binds to protein A and protein G but it elutes at higher pH than IgG1. The differential affinities allow the purification of these subclasses by fast protein liquid chromatography.

The unique structure of HCAbs is made possible due to some modifications in the sequence of the antibodies. Moreover, tetrameric and homodimeric IgGs differ in their V regions, VH and VHH regions respectively, which are encoded by a distinct set of V genes (Nguyen *et al*., 2000). Homodimeric IgG chainslack the CH1 domain due to a point mutationon the donor-splicing site (Nguyen *et al*., 1999).

Although genetics of immunoglobulins is well characterized, little is known about the development of an HCAb immune response. The aim of this study is to determine the kinetic of production of antibodies in response to the immunization with HSA.

Material and Methods

Four male dromedaries aged one year from the local herd in the arid lands institute (Medenine, Tunisia) were immunized 4 times (j0, j7, j21 and j35) with 1 mg of HSA, the first injection with the complete Freund's adjuvant and the others with the incomplete adjuvant.

The animals were bled at j0, j2, j4, j7, j9, j14, j21, j28, j35, j42 and j52 and serum recuperated by centrifugation after blood coagulation. One ml of serum was passed over the protein G column previously equilibrated with phosphate buffer pH 7. Only IgG1 and IgG3 are retained by the G protein and other serum proteins including IgG2 eluted from the column. The IgG3 are eluted first with buffer 0.15 M NaCl, 0.58% acetic acid pH3.5. The IgG1 are then eluted with a solution of 0.1 M glycine buffer pH2.7.

The antigen (HSA) was dissolved in a carbonate-bicarbonate buffer to obtain the working concentration of 5 µg/ ml. This antigen solution was distributed in the 96-wells plate at a rate of 100µl per well. The purified antibodies were deposited in the wells after a 1/1000 dilution. Then, the wells were incubated with a rabbit anti-camel IgG antibody that we developed by immunizing a rabbit with purified IgG1 and IgG3. The final step is the incubation with the anti-rabbit-HRP conjugate (Promega) at a dilution of 1/10000. The substrate used was OPD, the plate is incubated in the dark at room temperature for 30 minutes, the reaction is then stopped by inhibiting the enzyme by adding 50 µl of a solution of 3M HCl and the plate is read at 492 nm.

Thermostability was evaluated by incubating the purified antibodies at 65°C and 80°C at different times ; 10, 20 and 30 minutes. The residual activity was evaluated by ELISA (as previously described) and compared with the activity at 37°C. For pH resistance, antibodies were incubated at pH 3, 5, 7 and 8 and activity evaluated by ELISA. For ethanol tolerance, antibodies were incubated with 10%, 30%, 50% and 70% of ethanol.

Results and Discussion

Following immunization, the body develops a so-called primary response with the production of IgM. After a few days, the IgG response develops; it is the secondary response that is specific to the antigen. This delay reflects the time required for the activation and proliferation of cells producing specific antibody to the antigen.

In the four camels there are two different profiles in terms of their secondary response that is taking place from day 21 for all animals. Thus, in animals 809 and 817 the curves have a sigmoidal profile mounting a rapid increase in the response between J21 and J35, followed by a plateau between J35 and J52. By contrast, in 808 and 812 there is a gradual evolution of the production of antibodies J21 and J52 which shows a response that is taking place gradually (Figure 1). These results show tha the immune response can be supported by conventional antibodies or by both conventional and HCAbs.

Our results show that HCAbs, especially IgG3 isotype are more thermostable than conventional antibodies. At 65°C and 30min which correspond to the temperature of pasteurization IgG3 loses less than 10% of its activity at 37°C while IgG1 loses about 60% (Figure 2).

At acidic pH, IgG3 loses about 50% of its activity at pH 7 while IgG1 loses about 75% (Figure 3).

The HCAbs are less affected by the presence of high concentration of ethanol in the solution than the IgG1.

These results can be explained by the dimeric structure of the HCAbs which is more resistant than the tetrameric one of conventional antibodies and demonstrate the HCAbs can constitute an interesting alternative to rabbits or mice antibodies commonly used in biotechnology.

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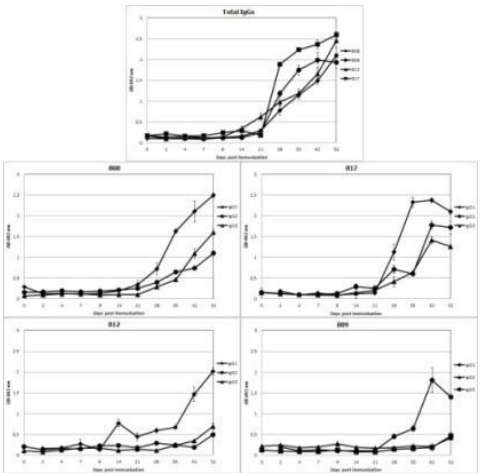

Figure 1: kinetic of the production of antibodies to HSA

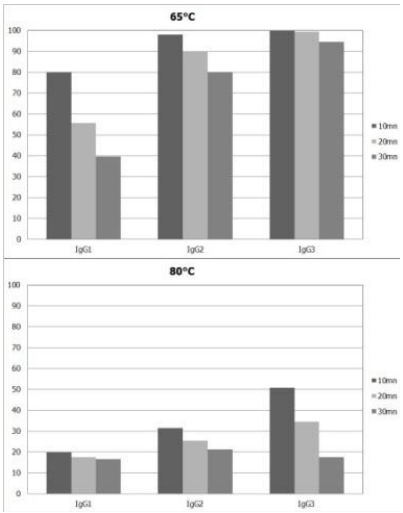

Figure 2: thermostability of the different IgG (residual activity relative to 26°C(at 54°C and 74°C at different times

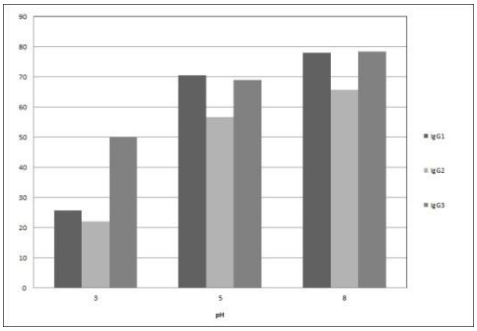

Figure 3: pH stability of the different IgG (residual activity relative to pH7) at pH 3, 5and 8

7. Trypaonocidal Effect of *Cannabis Sativa* on Experimental Camel Trypanosomiasis

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Introduction

Camel trypanosomosis is caused by *Trypanosoma evansi* and the disease is referred to as surra (FAO,1988). Surra is of great economic importance in Africa, where thousands of animals die each year (Stephen, 1986). The disease is transmitted by the blood biting fly Tabanids. Control of Camel trypanosomosis is based mainly on treatment by trypanocidal drugs. The extensive use of these drugs resulted in the appearance of drug-resistant trypanosomes (El Rayah, 1999). The situation was made worth by the slow development of new tryapanocidal drugs. This why an ethnobotanical approach collaboration with traditional healers remides may prove to be a rich source of drug discovery (Fornsworth *et al*, 1985). Herbal medicine is a common practice all over the world. Sirelkhatim, (2011) studied the cytotoxicity and biological activity of many Sudanese medicinal plants. In this study *Cannabis sativa* is selected upon its use in many countries for the treatment of, constipation, gout, malaria and absent-madness (Marijuana, 1975). Identifying bioactive compounds and establishing their health effects are active areas of scientific enquiry (Etherton *et al*., 2004).

Material and Methods

White albino rats were used in the present study, They were obtained from the central veterinary research laboratory, Soba. They were housed in laboratory cages, fed with pellets and were watered ad libitum. The parasite was isolated from naturally infected camels at Alshowak, Algadarif estate. *Cannabis sativa* is a member of the family *Cannabinaceae.* It was obtained from Niala, South Darfur, Sudan. The powder of *Cannabis sativa* whole plant obtained was successively extracted with methanol for 4 hrs, using a soxhelt apparatus. The extract was occasionally shaken during the first four hours and was then filtrated. The filtrate was evaporated under vacuum, and the residue is brownish in color. The aqueous extract was extracted by dissolving in distilled water and then put in water bath for half an hour.

Results

Trypacide was used as a standard drug in this experiment at a dose rate of 10 mg/kg BW. It was found that that drug cured the parasite on the third day of treatment but relapses occurred after ten days of treatment. With the plant, it was clear that there was an immediate cure as from the second day of treatment when the methanolic extract was given at both doses. All the rats either given 125 or 250 mg/kg BW became aparasitaemic till day 48 when the parasite appeared with clearance percentage 100%. There was death in the group that given 125 mg/kg BW together with the standard drug, and the percentage rate was found to be 90%. There was death associated with the untreated group with percentage rate 50%. The results were shown in table 1,fig 1&2. The best result was obtained with methanolic extract.

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Table 1: Antitrypanosomal activity of *Cannabis sativa* extracts compared to Trypacide

Group No.	Treatment	Dose used	Initial trypanosomes clearance	Relapse	Percentage of Death
Group 1	Infected untreated control		None		50 % between day 40-45
Group 2	Treated with Trypacide	10 mg/kg BW	Day 4	Day 11	20% between 30-45 day
Group 3	Treated with (M) extract	125 mg/kg	Day 2	Day 48	none
Group 4	Treated with (M) extract	250 mg/kg	Day 2	Day 48	none
Group 5	Treated with (A) extract + trypacide	125 mg/kg + 10 mg	_		50 % On Day 2
Group 6	Treated with (A) extract + trypacide	250 mg/kg	Day 8	Day 18	90%

Each group was composed of 6 rats each. The parasite was given at a dose rate of 5x105
(M) represents Methanolic extract . (A) represents Aquous extract

8. Assessment of Changes in Body Surface Temperature Associated with Ambient Temperature Using Infrared Thermography in Camels (*Camelus dromedarius*)

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Introduction

Controlling surface temperature is an important mechanism in temperature regulation of homeotherms (Philips and Health, 1992). Vasomotor tone of peripheral blood vessels in specialized heat exchanger regions depends on the surrounding T_a (Tattersall *et al*., 2009). The major mechanism of sensible heat loss is the cutaneous vasodilatation in specialized body regions that serve as heat exchanger with the environment. Such specialized regions are characterized by high surface to volume ratio, absence of fur, dense network of blood vessels and the presence of arteriovenous anastomoses (Mauck *et al*., 2003). The term "thermal window" is applied to describe these regions (Klir and Health, 1992). Recently, thermal window has been defined as a restricted surface area which is visible as hot spot in a thermal vision and differ by more than 5°C from its adjacent regions (Weissenbock *et al*., 2010). Exchanging body heat with the surrounding environment through thermal windows is achieved by modifying blood flow in these regions via controlling vasomotor tone (Sumbera *et al*., 2007). Camel's skin has numerous arteriovenous anastomoses which could facilitate heat dissipation via high cutanoeus blood flow. However, it is still questionable which regions of camel's body are engaged in dissipation of excess body heat. Therefore, this study was designed to investigate the regional variations in surface temperature and to visualize body thermal windows responsible for the dissipation of excess body heat in dromedary camels.

Materials and Methods

This study was conducted during summer season on five dromedary camels of native breed (Majaheem) with mean body weight of 450±20.5 kg and 2 year of age. Animals were housed individually in shaded pens, fed twice a day at 07:00 am and 04:00 pm, and had free access to clean tap water. Ambient temperature (T_a), relative humidity (RH), sweating rate (SR), and body surface temperatures ($T_{surface}$) were measured every 3 hours for 2 successive days. Seven body regions (head, neck, shoulder, axillaries, hump, flank, and hip) were shaved and used as sites for measurements of sweating rate and body surface temperature. Sweating rate was determined according to the method modified by Pereira *et al*. (2010). Different body regions surface temperature were recorded using infrared thermal camera model Ti200/40 (Thermoteknix Systems Ltd., Cambridge, England). The collected data were analyzed using Proc GLM; the general linear models (GLM) procedure for analysis of variance (ANOVA) of Statistical Analysis System (SAS).

Results

Circadian variation in body surface temperature (Fig. 1) was greatest in the hump region (18.8 °C) and lowest in the axillary and flank regions (6.9 and 5.8 °C, respectively). However, daily variation in thermal gradient between camel's body surface and the surrounding environment was lowest in the hump region and highest in flank and axillary regions. The correlation of sweating rate versus body surface temperatures revealed moderate correlation ($r = 0.57$; $p<0.001$).

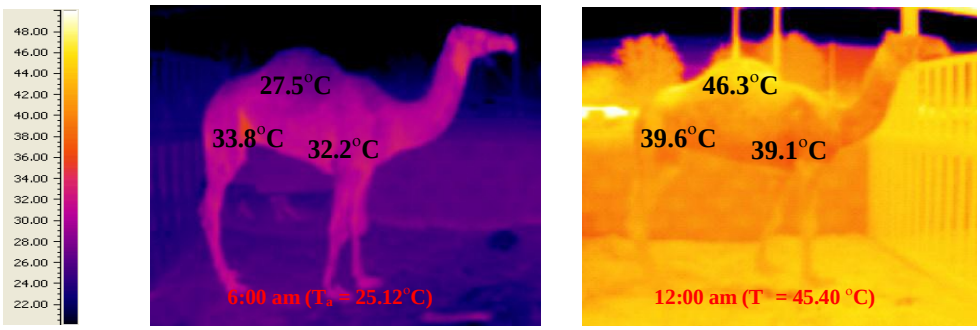

Figure 1: Variation in body surface temperature at different ambient temperature.

Discussion

It is still unclear which regions of camel's body function as the main avenues for the dissipation of excess body heat? Therefore, infrared thermal vision was taken every 3 hours throughout the day, and the daily variation in thermal gradient between camel's body surface and the surrounding environment has been monitored during the present study. The thermal vision showed that body surface temperature was higher at high T_a and lower at low T_a. However, the variation in the body surface temperature was lowest in the flank and axillary regions. The flank and axillary regions showed lower thermal gradients at higher T_a (during the day) and higher thermal gradients at lower T_a (during the night). This indicates that flank and axillary regions might work as thermal windows dissipating heat during the night. This observation support the previous reports on guanaco which demonstrated that axillay and flank regions with very short and sparse pelage are potentially more effective in heat dissipation (Morrison, 1966). Furthermore, this observation confirms the earlier report that heat gained during the hot day is dissipated during the cool night as water economy mechanism in camels (Lee and Schmidt-Nielsen, 1962). Correlation of sweating rate versus body surface temperatures revealed moderate correlation ($r = 0.57$). This indicates that body surface temperature might work as potential thermal driver of sweating in camels. Similar results have been reported for lactating cows (Berman, 1971) and ox (Whittow, 1962). However, thermal modulation of sweating in camels needs more research.

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9. Pharmacopathological Effect of Cymelarsan and Oxytetracycline Interaction in Camels Infected Naturally with *Trypanaosoma Evansi*

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Introduction

In Sudan, the one-humped camel (*Camelus dromedarius*) plays an important role in the national income and constitutes a major proportion of foreign currency revenue. Sudanese camels are affected by three major diseases, namely mange (Jereb), internal helminthiasis especially haemonchosis (Holaa), and trypanosomosis (Guffar). The latter is the most important health problem of all (Wilson, 1984).

Since 1961 no additional drugs for use against animal trypanosomosis have gone beyond the experimental stage. Drug resistance between diamidines and isometamidium group seems to exist.

Treatment in camels is dependent on one of two drugs suramin and quinapyramine (Bujon, 1990). However, suramin has become less effective (Gad-el Mwla and Fayed, 1979). It is well known that drug combinations are used mainly to overcome resistance or any undesirable side effects. Drugs are often given in combination with potentially beneficial or adverse effect results.

Materials and Methods

Twenty-five one-humped camels (*Camelus dromedarius*) 1–3 year-old, of both sexes weighing 250-300 kg were obtained from El Gadarif State and were stabled in Elmewelh Market pens (Omdurman-Khartoum State).

Animals were divided randomly into groups, each group consisted of 5 camels, kept for 14 days before commencement of the study for acclimatization. General health examinations were done daily and samples of urine; faeces, blood and serum were taken for determination of normal base-line data.

Trypanosoma evansi (*T.evansi*)

Drug

1- Cymelarsan® 0.25mg/kg(Rhône – Mérieux – France).
2- Oxyteracycline (Remacyline®) 20mg/kg(Coophavet – France).

Each camel in group 3 was given single intramuscular dose of Cymelarsan^R at the rate of 0.250mg/ kg (therapeutic dose) followed by 20 mg/ kg of oxytetracycline, (therapeutic dose) while animals in group 4 were given a single intramuscular dose of Cymelarsan® at 0.125 mg/ kg (half therapeutic dose) followed by oxytetracycline at 50 mg/ kg (two and half therapeutic dose). A single dose of Cymelarsan® at 0.125 mg/ kg (half-therapeutic dose) followed by a single intramuscular dose of oxytetracycline at 100mg/ kg (five therapeutic) were given to each camel in the groups.
Camels in group 1 were used as un- infected-untreated (control negative), while camels in group 2 were infected-untreated (control positive).

Animals were bled from the jugular vein (at the first day after infection, and then three days post infection, 1 hour, 3 hours, 24 hours, 3 days, 7, 14, 21, 28, 35, 42 and/or 49 days post-treatment. Two plain vaccutainer test tubes were used (Becton and sons- France) the tube containing no anticoagulant was left to clot, centrifuged at 3000 rpm and serum was collected and kept at -20^{o}C until analyzed for the activity.

The haematological methods and serobiochemistry were measured. All data were computerized using MSTAT-C program (Michigan State University), for the analysis of variance and for mean separation.

Results

The parasitaemia post infection and post treatment was examined, also clinical signs, gross findings, the histopathological findings, the histophathological findings, haematological changes and the Serobiochemical changes. The combination treated groups recorded a normal data in all parameters.

Discussion

In single dosages the parasite was found in the liver at 25-50% after period of relapse for approximately two weeks post treatment, the combination cleared the blood and the liver from the parasite without death when given to camels naturally infected with *T. evansi*. This seems to be in agreement with previous findings (Anosa, 1988a; Losos and Ikede *et al.*, 1972,Baltz *et al*., 1989 and Youssif, (2005). The death in the daily treatment combination program is attributed to the toxic effects of these drugs although the blood and the liver are free of the parasites.

A good health improvement as judged by clinical signs, pathological findings and haematological and serum biochemical result, was observed in camels which received the combination. The half recommended therapeutic dose of Cymelarsan with single or two and half recommended therapeutic dose of OTC-LA at the recommended therapeutic dose twice a week for two weeks or in treated camels, indicated that the combination was toleratable and successful to overcome the infection.

Combination preparation, may act by complementary mechanisms at different sites, or one of the drug may potentiate the clinical efficacy of the other by altering its distribution, biotransformation or excretion. (Baggot, 2001).

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10.Relationship Between Copper and Ceruloplasmine in Camels (*Camelus dromedarius*)

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Introduction

The current study was initiated to asses the relationship between copper and its indicator-ceruloplasmine. Ceruloplasmine is a carrier protein for copper; it contains more than 90% of the circulating copper in normal animals, so ceruloplasmine is usually well correlated with copper. In the camels, it appears that ceruloplasmine is also correlated with copper and can be a useful indicator of nutritional copper status as indicated in cattle and sheep (Blackley and Hamilton, 1985), but a copper sub deficient situation (plasma copper concentration below (50µg /dl),the ceruloplasmine doesn't allow one to assess the deficiency status level . Most of the camels in these two localities are not receiving any mineral supplements and their feeding resources are generally scattered and poor.

Indeed, trace elements in the camel are believed to have biological roles similar to that described in other ruminants. In this study, copper was assessed directly by measuring its concentration in the blood of camel and indirectly by measuring its related indicator-ceruloplasmine.

The area selected for this study was north and South Kordofan and sex and age were considered in the study.

Material And Methods

The survey was conducted, during the period from October 2004 to September 2005.

The survey covered two states (North Kordfan State and South Kordfan State), Camels *(Camelus dromedarius)* in different sexes and ages were used in this study. All animals grazed freely in opened system (Nomadic system). A total of 500 serum and blood samples were collected from both North and South Kordfan.

Blood in plain vacutainers tube was taken from the Jugular vein by veni-puncture, the serum was separated by centrifugation and stored at -20^{o}C for analysis.

Serum copper was determined according to the method of Butrimovitz and Purdy (1977).

The method of Houchin (1958) was used for the determination of plasma ceruloplasmine activity using a Jenway 6505 Uv/Vis. Spectrophotometer.

Results

Statistical methods have revealed that none of the three factors employed in this study have any impact on copper levels as well as on ceruloplasmine. Results show that both copper and ceruloplasmine were below the normal values reported in the literature. Also, a non significant positive correlation exist between copper and ceruloplasmine.

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11. Effect of Sex Factor on Macrominerals Profile in Vital Organs of Dromedary Camels in Western Darfur, Sudan

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Introduction

Generally in tropical areas, animal do not receive mineral supplements and are dependent on pasture for their needs (Mcdowell *et al*., 1995). Otherwise, mineral deficiencies decrease livestock production efficiency, prevent forage digestibility and herbage intake, often associated with alterations in many metabolic processes and cause various kinds of diseases, (Bureau *et al*., 2008). Whereas, the mineral content in soils is highly variable. Usually, camels depend on salt plants (halophytes), salty soils (*kuro*) and sometimes commercial salt supplements to cover mineral needs (Macdowell; 1995). Minerals status can be determined by the analysis of serum, tissues (liver, kidney and spleen) and feed or plants species (Scheideler *et al*; 1994). The physiological variations of mineral concentration in camel plasma and sometimes liver show the peculiarities of mineral metabolism and include increasing of the absorption capacity, tolerance for minerals in excess and maintenance of enzymatic activity in deficient periods (Faye *et al* 2006). The main objective of this paper was to examine the macrominerals status of local camels in western Darfur by measuring the levels of Ca, P and Mg in vital organs of both matured male and female camels.

Materials and Methods

The study has been carried out on herd of mature camels (5-10 years). They were slaughtered at a Traditional abattoir of AlGenana town in west Darfur state. The camels were grazing on free pasture without any supplementary feeding. The 10 samples of liver, spleen and kidney from each male and female camel were collected from abattoir in December 2010 then kept under frozen condition for latter laboratory analysis. The samples were dried, digested and dissolved. A flame atomic absorption spectrophotometer (AAS) was used for the analyses. For comparing the mean concentrations of different macrominerals in different tissues for both male and female camel, the data of research were analyzed using the student t-test were used SSPS version 11 and the correlation coefficient of Macrominerals in organs has be done.

Result and Discussion

In the current study calcium, phosphorus and magnesium levels in kidney are shown in Figure 1. The phosphorus content of the male kidney is high than the mean level of phosphorus in kidneys of female camels. Moreover, the phosphorus level in camel kidney is higher than other macrominerals level; because kidney is considering the main filter in body, therefore high minerals were deposited. Significant correlation between macrominerals in camel kidneys. The female kidney magnesium level was lower the male camel.

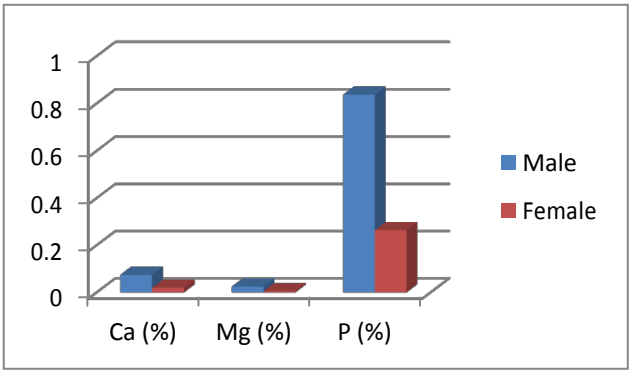

Figure 1. Macrominerals percentage level in kidney of Male and Female Camel.

The current result of macrominerals content in camel liver has been observed in Figure 2. The concentration of Mg, Ca and P in liver of male camel are high than those in female camel. The data in current study are agreed with findings by Rashed (2002) in camel meat in semi-arid region. The P level in liver of female camel is highest than that P level in kidney or spleen because liver is consider the main site of almost physiological processes in the body. The concentration of Ca and Mg in spleen is highest rather liver and kidney either in male or female camel, that have shown in Figure 3. Therefore, the concentrations of Ca and Mg in camel organs are response to effect of sex factor whereas; P concentrations in camel organs have been variable.

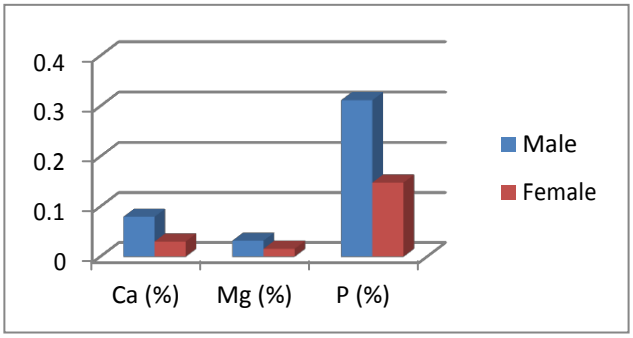

Figure 3. Macrominerals percentage level in spleen of Male and Female Camel

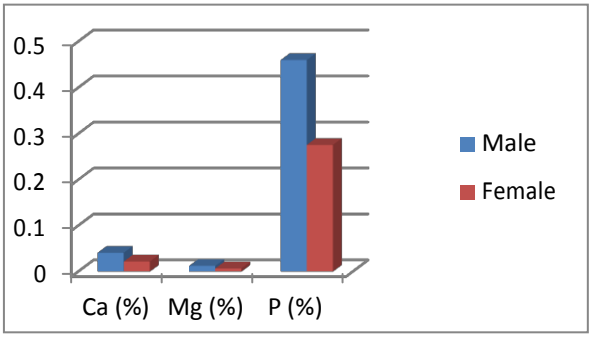

Figure 2. Macrominerals percentage level in liver of Male and Female Camel

Conclusion and Recommendation

The chemical analysis of different organs of male and female camels from west Darfur state reveals that organs contain high concentrations of P in male or female camels compared to Ca and Mg concentrations. while the kidney contains high level of P rather than liver and spleen. These results may relate to the presence of these elements in high concentrations in the plants of free pasture and also, to the ability of the camel tissues to concentrate these elements as they have a biological role in camel metabolism. The future studies should be done to cover all belts of camel should be appreciated to document baseline of minerals to monitor any risk of imbalance and deficiencies of minerals in camel.

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12.Use of Exogenous Creatinine to Evaluate Kidney Function in Hydration and Dehydration Conditions of Camels

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Introduction

The dromedary camel is an animal well adapted to extreme temperature conditions and osmotic fluctuations (Yagil, 1986). Camel adaptation to dehydration is the consequence of its anatomic and physiologic particularities (Bengoumi *et* Faye, 2002). It has been shown, that dromedary camel kidney function is one of the most important factors of its ability to adapt to extreme conditions of osmotic stress and additional water needs as during milking periods (Yagil, 1993, Bengoumi *et al*., 1993).

Objectives

This trial aims to study kidney function in camel dromedary under normal hydration and dehydration conditions *via* follow up of glomerular filtration using exogenous creatinine as marker.

Materials and Methods

This trial was carried out at the Hassan II Agronomic and Veterinary Institute (IAV Hassan II in Rabat-Morocco) on six 7-10 year old females; animals were fed before and during this experiment with concentrated feed (MARAA) at 2kg/animal/day which contains very little water. In addition, they received one bale of wheat straw (18kg) once per day in the morning and water was given *ad libitum* during normal hydration period. Body weights were assessed on experiment day using barymetric measurements (Schwartz *et al*., 1992).

Experimental Protocol

1st Phase:

Product and doses used

To prepare the solution to be injected to dromedaries at 8g/100ml (8%), 40g creatinine (anhydrous powder) was progressively dissolved in 500 ml of distilled water, and sterilized by filtration using 0.22 µm paper filter. The prepared solution was injected to animals at16 mg/kg of body weight corresponding to 20 ml of the solution/kg of body weight. Volume injected to each animal was calculated on the basis of body weight assessed on the same day.

Bloodsampling and plasma processing

Blood samplings (8-10 ml) were performed on right jugular vein in a vacuum tube with anticoagulant at times T_0 (just before injection), 2 ; 6 ; 10 ; 20 ; 40 ; 60 and 90 min and 2 ; 4 ; 6 ; 8 ; 12 ; 18 and 24 h after injection. T_0 blood sampling was performed to determine basal blood creatinine. Blood samples were centriguged for 30-45 min (3000g/min during 15 min) and plasma was stored at -20°C until creatinine dosage. Hematocrit, density and total proteins were performed on whole blood. To establish RCN, Nebauer cells counter was used

Phase 2: Dehydration during 34 days

Dehydration began the next day after completion of blood samplings which was spread over 24 hours. Camels were deprived from water intake and kept in stable where night and diurnal temperature conditions are under control (20°C-23°C). For animal welfare, camels dromedaries were examined every day to take body temperature and to observe their reactivity state to ovoid possibly apathy and pain. Blood samplings were carried out at the beginning of this stage and every week to determine total proteins, hematocrit, density, Red Cells Number (RCN) and Mean Cell Volume (MCV) which were used as indicators of the camels dehydration status. At 34th day post water deprivation, dromedaries were subject to the same experimental protocol previously described, during hydration period, to follow up creatinine kinetics during a period of 24 hours.

Creatinine determination

Plasma creatinine was analyzed using the Jaffe method.

Data analysis

All parameters measured on the 6 dromedaries were used for data base conception in Excel and analyzed then as follows:

Comparisons of studied parameters means, in hydration and dehydration states were realized by Excel software, using matched means comparison function with p=0.05 to consider the test significant. Results are expressed as mean±standard error.

Pharmacokinetic analyses were performed by WinNonlin Software (Version 5.2, Build 200701231637 Core version 18 Sept 2006) using non compartmental approach.

Results and Discussion

To compare parameters studied on camels, corresponding to normal hydration and dehydration periods (34 days of thermic and hydric stress), paired means comparison tests were used. Equality esperances test for paired observations in Excel offers the possibility to compare means with Student test; p=0.05 was retained as meaning threshold test. Pharmacokinetic data analysis were performed using non compartmental approach, considered to be more suitable especially when sampling period is 24 hours, because it doesn‘t need specific mathematic modeling. Laroute *et al.,* (1999) reported also that lonely parameter required is AUC which is then easy to calculate and extrapolated party of AUC should not exceed 15% of total AUC. In the present study, at the moment of GFR calculation in normally hydrated and dehydrated states, extrapolated party of curve has as mean respectively 9.3 ± 6.3% and 11.2 ± 4.9%.

Camels dromedaries of the present study showed a body weight decrease of 15% following 34 days dehydration, which can be interpreted as adaptation to lack of water. These results are different from Bengoumi (1993) who reported that 14 days water deprivation caused body weight decrease of 35%. This difference can be linked to ambient temperature (45°C) and dehydration severity. According to Djegham and Belhadj (1986), camel dromedary resistance to water deprivation is due to its ability to mobilise its water storage and to transfer it from one to another compartment. Thus, camel dromedary is able to lose up to 25% of its total body water without any dehydration symptoms. Hematocrit mean values in the six dromedaries (27±1 % in normal hydration state and 28±2 % in dehydration state) are included in the interval of usual hematocrit mean values [20-33%] as described by Yagil *et al.(*1974) and are lower than those reported by Bengoumi (1993) with values of 30% in hydration state and 38% in dehydration state, but still compared to those of Yagil *et al.* (1974) with 28.5±0.82% in summer and 32±1.02% in winter. Differences between these values can be explained by season and hydration status which affect directly this parameter. So then, it‘s important to know conditions of normal values in dromedary camel (Yagil *et al.,* 1974). Hematocrit mean values in dromedary camels in normal hydration and dehydration states did not show any significant difference. This can be explained by individual variations that should mask this effect or because dehydration state was not so severe to influence this parameter. Thus, this parameter can be considered as later parameter to detect hydration state in the dromedary camel. RCN in this trial (8.6±1.4×106/mm3) is included in physiologic values interval as reported by Yagil *et al,* (1974) (3.8×10^6/mm^3 and 12.6×10^6 /mm^3). Dehydration caused a significant decrease in RCN which is in agreement with data reported by Yagil *et al.,* (1974) as hematocrit and RCN follow same evolution. MCV was influenced by dehydration. It has been significantly increased (from $31.9\pm4.6\times10^{-7}$ mm^3 to $48.2\pm7.3\times10^{-7}$ mm^3) after 34 days of water deprivation. Results of this study showed significant plasma creatinine increase with rate of 30% with dehydration, except for camel A (from 1.18±0.28 mg/dl (104±25 µmol/l) to 1.53±0.14 mg/dl (135±12 µmol/l)). These results agree with Bengoumi‘s work (1993). Plasma creatinine values in dromedaries seem to be higher than those reported in other species (Soliman et Shaker, 1967). In our study, 34 days of water deprivation in camels induced significant GFR diminution (from 1.33±0.22 ml/min/Kg to 1.06±0.21 ml/min/kg) which presents a decrease of 20%. These results are in agreement with those of Bengoumi (1993) who found GFR decrease of 60% after 13 days of water deprivation and then it increased after rehydration. Explanation of these phenomena can be attributed to hormonal factors.

Conclusions and Recommandations

Significant decrease of body weight in camel dromedary in dehydration conditions is an adaptation way to water restriction and RCN and MCV can be used as dehydration state indicators. The role of the kidney to minimize water loss is the result of both anatomic and hormonal factors

controlling glomerular filtration. Indeed, GFR is lower than that reported in other animal species and has significantly decreased under effect of dehydration. These results should be taken into account during drugs administration. In this effect, this animal should be considered as a model for studies of dehydration effect on hormones and enzymes implicated in water metabolism regulation.

Use of exogenous creatinine in *bolus* for kidney function evaluation in camel dromedary is a practical method, reliable, quick, not expensive and has less risks for animals compared to other methods based on urine collection. Nevertheless, other investigations are necessary in large number of animals to study creatinine tubular secretion, particularly in dehydration conditions and according to the sex. Fifteen blood samplings during 24 hours is a tedious work in routine practice. So then, it‘s very interesting to draw up limited strategy for blood samplings in order to determinate blood samplings number and best time with minima risks errors.

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13. Comparative Assessment of Some Trace Minerals Level in Camel Tissues From West Darfur State, Sudan

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Introduction

West Darfur is located on Sudan's western border with Chad and the Central African Republic. The people practice farming, herding and the acute geographical changes with recurrent famines that is brought the region to the conflicts over pasture and land between farmers and Nomadic herders, (Transitional Darfur Regional Authority, 2008).

Generally, in tropical areas animal do not receive mineral supplements and depend on pastures for their needs. They consume a considerable amount of earth. However, the mineral contents of soils are highly variable. Usually, camels depend on salt plants (halophytes) and salty soils (*kuro*). Minerals status can be determined by the analysis of serum, liver and feed or plants species (Scheideler, *et al*., 1994). It was the intention of this paper to assess the level of iron, zinc, copper and manganese in serum and liver in male and female camel from West Darfur State.

Materials and Methods

This study was carried out in Western Darfur state, Sudan on camels over four years of age. They were slaughtered at a traditional abattoir. The camels were grazing on natural pasture without any supplementary feeding. The camel‘s liver and blood samples were collected in November and December 2010.

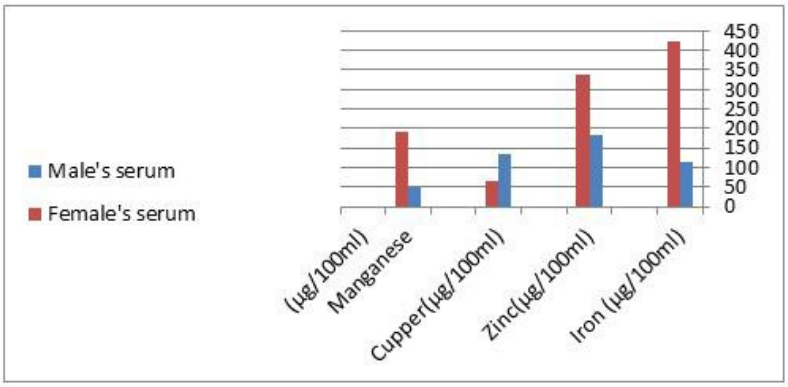
The fresh liver and blood serum samples were obtained from mature clinically healthy animals. A total of 5 samples of liver and serum were obtained from each male and female camel at different ages. The samples of blood serum were collected from camels by jugular veni-puncture and the serum was separated. Liver samples were maintained in formalin until undergoing laboratory analysis. All samples were analyzed by Atomic Absorption Analytical Methods, Perkin-Emer (1982). A student t.test was applied to assess the difference between treatments.

Results and Discussion

This study was carried out to assess the level of trace elements (Iron, Zinc, Copper and Manganese) in blood serum, liver of camel from West Darfur-Sudan. In the present study, Figure 1 shows the results of iron, zinc, copper and manganese level of serum. The iron level in the serum of female camel is higher than in male camels. Also is highest than 169.3 $\pm$ 209.9 µg/dl reported by Mustafa (2007). While, the mean level of serum zinc in this study in female camel is higher than male camel and those values is high than 104.8+9.5 µg/dl and 24.5 $\pm$ 15.8 µg/dl found by Abu Damira (1993) and Mustafa (2007) in Eastern Sudan camels.

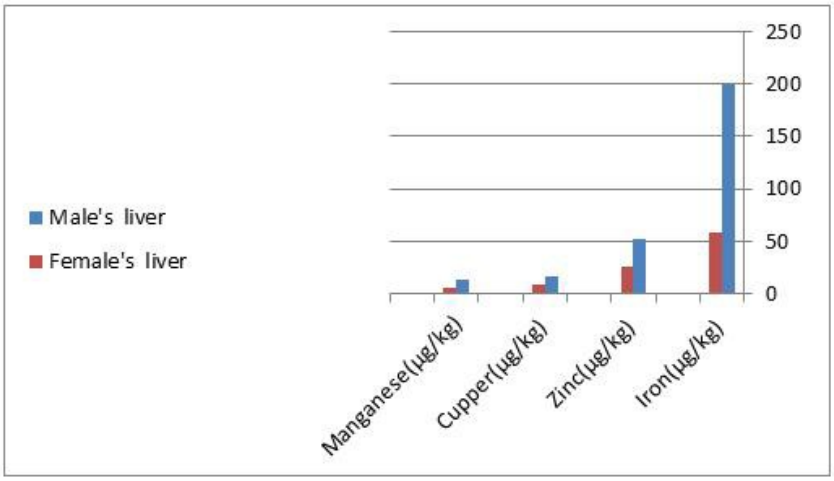
The copper level of male camel sero was higher than in females and also higher than in camels raised at different sites under nomadic conditions which was 59±1.98 µg/dl in Nuba Mountains, 70±1.14 µg/dl in Darfur and 67±1.37 µg/dl in Egyptian camels by Espinosa *et al*; (1982) and higher than 60.74$\pm$20.6 µg/dl in adult camel in Buttana area, Mustafa (2007). Whereas, the mean manganese level in serum of female camels was higher than in male camels. Unfortunately, there were no previous studies done on the manganese status in blood of camel.

Figure 1: Shows the trace mineral level µg/dl (Iron, Zinc, Cu and Mn) in the Serum of male and female camel.



The results obtained in the current study of iron, zinc, copper and manganese levels of liver have been shown in Figure 2. The mean level of iron in male liver is higher than in female and lower than the range 287.1 – 317.3mg/kg on dry basis reported by Abu Damir *et al*; (1993). While, meanlevel of liver zinc in male is high than in female camel and lower than 143±4.8mg/kg reported by Awad and Breschneider (1977). The level of liver copper in the female is lower than in male, moreover, the both levels are lower than 64.86±46.80 mg/kg copper level of liver of local slaughtered adult camels in Butana region by Mustafa (2007). Xin *et al*; (1993) confirmed that, the copper concentration in liver is affected by physiological needs. (Mc Dowell *et al*; 1993) confirmed that, the concentration of copper in liver of ruminants is correlated to bioavailability of copper in feed. In this study it observed the mean concentration of iron in the liver of both male and females is higher compared to the concentration of copper. This observation is the same as reported by the Tartour (1969) He found the correlation between iron and copper content in liver of camel is a negative. Whereas, the mean level of liver manganese in female is lower than in male camel. However, the mean level of manganese in liver of female camel is seem to agree with the findings in Bactrian camel was 6.9±1.9mg/kg, Liu Zongping (2004).

Figure 2. Shows the concentration of trace mineral level mg/kg (Iron, Zinc, Copper and Manganese) in the liver of male and female camel.



Conclusions

Poor concentration of copper in liver and serum of camel that was appeared in the results of the current study may be correlated with the elements shortage in natural pasture of camel. therefore in order to improve the camel productivity, serious consideration of supplying supplementary copper providing by injectable preparations, oral dosing with copper oxide needles or provide mineral licks containing elements should be given. Results shows that Fe, Zn, Cu, Mn concentration in liver of male was higher than in female camel.

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14. Erythrocyte Osmotic Fragility Curve of Male and Female Camels (*Camelus dromedarius*)

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Introduction

Camels (*Camelus dromedarius*) have an exceptional ability to rapidly replace water lost during prolonged periods of dehydration within a few minutes of access to drinking water (Schmidt-Nielsen *et al*., 1956). The camel erythrocytes are highly resistant to osmotic haemolysis, being able to expand to 240% of their original volume without rupturing in hypotonic solutions (Perk, 1966). The oval shape of camel erythrocytes (Jain and Keeton, 1974) and the composition of its membrane (Al-Qarawi and Mousa, 2004), partly make camel erythrocytes less susceptible to osmotic haemolysis than other mammalian. In addition to that, the erythrocytes of the dehydrated camel were more resistant to hypotonic saline solutions than those of hydrated camels (Yagil *et al*., 1974). This work was designed to investigate whether sex had an effect on the erythrocytes osmotic fragility curve of camels.

Materials and Methods

This study was carried out in southern Darfur state, Sudan (Latitudes 8° and 13° North, Longitudes 22° and 28° East). It was conducted during the dry season in camels' summer habitat (Masaif), the camel herds were naturally ranging and have had access to water every 5 to 9 days. The blood samples were collected from adult camels (5-12 years) using capped and heparinized tubes (Medical Disposable Industrial Complex, MDIC), and transported in an ice-cooler to the laboratory. The erythrocyte osmotic fragility test was measured by subjecting it to decreasing concentrations of sodium chloride (NaCl) solution (0.9-0.1%) according to Jain (1986). The statistical analysis was performed using windows based SPSS (Version 10.0, 1999) using Student *t*- test to evaluate the effect of sex on the erythrocytes osmotic fragility of the camels. The data are presented as mean ± SD and $P < 0.05$ was considered significant.

Results and Discussion

The curve of osmotic fragility of camel's erythrocytes is shown in Figure 1. The pattern of the erythrocytes response to haemolysis was basically increased with decreasing concentration of saline solution (0.9% NaCl). Haemolysis started at 0.4% NaCl for males (3.86 ± 6.37%) and females (3.71 ± 3.95%). The maximum haemolysis occurred at 0.2% NaCl showed a percentage of 96.09 ± 4.02 and 95.05 ± 6.41 % for males and females, respectively. In both sex, 0.1% NaCl resulted in 100% haemolysis. In the present study the curve of both sexes of camels started haemolysis at 0.4% NaCl , which demonstrates that camels have more resistant erythrocytes than that of sheep, cattle and humans which commence haemolysis at 0.85%, 0.70% and 0.55% NaCl, respectively (Arikan, 2003). The higher concentration of phospholipids, cholesterol and proteins in the erythrocytes membranes of camels that are not altered by dehydration or starvation may have a role in the stability of the camel erythrocytes (Al-Qarawi and Mousa, 2004).

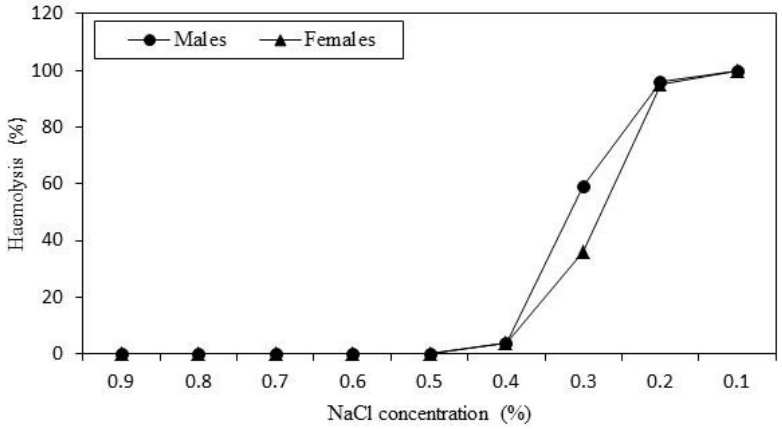

Figure. 1: Erythrocytes osmotic fragility curve of males and females camels (*Camelus dromedarius*).

The study shows that camel erythrocytes of males were osmotically more fragile than those of females at 0.3% NaCl that shifted the osmotic fragility curve to the left in males compared to females. It has been established that erythrocytes of males are more susceptible to haemolysis than those of females in domestic fowl (March *et al*., 1966; Oyewale and Durotoye, 1988) and cattle (Olayemi, 2007).

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15. Effect of Disease and Physiological Conditions on Drug Pharmacokinetcs in Animals

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In veterinary medicine, the drug‘s pharmacokinetic (PK) parameters are generally based upon data that are derived from studies on small groups of young healthy animals, often of a single breed. It is rare to find all information that can influence drug exposure characteristics. Therefore, it is important to recognize some of the factors that can alter the outcome of PK studies and therefore potentially alter the pharmacological response. Some of these factors are easily identified, such as breed, gender, age, and body weight. Others are less obvious, such as disease, heritable traits, and environmental factors. Failure to identify appropriate conditions can lead to substantial errors when predicting the dose-exposure relationship within a population. Such information is rarely available because of the difficulty in collecting blood samples from the animal patient under clinical conditions of use. Furthermore, while new human drug applications are required to contain PK data (21 CFR 320), no corresponding regulatory requirements are associated with applications for new veterinary drug approvals. Although the very limited number of subjects in veterinary clinical trials and PK and safety studies challenges the identification of conditions or subpopulations, such factors can influence the safety and effectiveness of veterinary therapeutics.

16. Serum Protein Electrophoresis of Dromedary Camels in Tunisia: Early Tool for Prediction and Diagnosis in *Trypanaosoma evansi* Infections

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Introduction

At present, efforts are made to save the camel in Tunisia in particular and improve the knowledge both of the breeding behavior, physiology and in pathology. In this context we have undertaken this work to determine normal values of serum protein and different protein fractions in camels clinically healthy and to study their variations in a pathological situation as the case of trypanosomiasis.

Materials and Methods

One hundred and twenty-five male camels, from southern Tunisia were used. Marked with numbered collars, these animals between 4 and 7 years, underwent clinical examination allowing us to divide them into three different lots, the first batch of 45 healthy camels with negative serology for trypanosomiasis, second batch of 54 apparently healthy but infected camels based on the IFI test and final batch of 26 camels clinically ill and seropositive by IFI.

After local antiseptise, the samples were taken by puncture of the jugular vein. Blood was collected vacutainer tubes and centrifuged at 3000 g per minute within two hours after collection. The sera were then separated, divided into two aliquots of 2 ml, then frozen at minus 20°C until analysis within no more than a month.

The serum total protein was assayed by the reaction of Biuret with a kit Biomaghreb ref 20161. Measurements of absorbance were performed using a spectrophotometre UV-Visible SCHIMADZU. The serum protein electrophoresis was performed on a base of cellulose acetate at pH 8.6 in veronal buffer and powered by 175 volts (generator HELENA) for 13 minutes. After Ponceau staining, the electrograms were quantization using hydrometer HELENA PROCESS u-24, at 520 nm.

Indirect immunofluorescence was performed by the technique adopted by Katende *et al*. (8). By setting the dilution 1/100 for the conjugate and Evans blue. The antigens consist of freeze-dried trypanosomes diluted 1/4 as recommended by the ILRAD in Nairobi and the reading was made using an immunofluorescence microscope LEITZ type. The positivity threshold was set at 1/80.

Statistical calculations were performed on Macintosh computer using the software Stat View The statistical distribution was first displayed graphically and normality was assessed by the Kolmogorov Smirnov (KS) Statistical analysis of the various results was performed with ANOVA The test was considered significant for $p < 0.05$.

Results

The distribution of values of total serum protein concentration in camels healthy and seronegative for trypanosomiasis is shown in Figure 1 with a Gaussian distribution.All the results obtained are given respectively in Table 1 for numerical values and in Tables 2 and 3 aspects of the profiles in animals and sick animals are shown. The statistical analysis shown in Table II showed significant differences between healthy animals and animals infected by *Trypanosoma evansi*.

Discussion

It appears that in the south of Tunisia, total serum protein in camels healthy, male sex and age between 4 and 7 years was 61.1 g / l on average. The electrophoretic profile "normal" camel is characterized by the existence of five fractions shown in Figure 2. The average frequency for each fraction was 50% for albumin, 3% for α1, 5% for α2, 13% for β and 30% for γ globulins. Thus constituted, the electrophoretic profile of the camel is reminiscent of dogs, humans and goats. It also presents differences with that of cattle and horses (1, 7, 8, 9, 10). Observed values at the end of our work are generally consistent with the literature under similar conditions such as age, physiological status, diet and season greatly affects the camel herd (6, 7, 9).

In camels with positive serology for *Trypanosoma evansi*, there was a maked increase in sero protiens with or without clinical signs of the disease. For all parameters studied, statistical analysis showed a significant increase ($p < 0.05$) in camels infected compared to healthy animals. In our work, the increase in serum protein was detected before the onset of symptoms and may thus be considered as a first diagnosis of trypanosomiasis.

Conclusion

During a trypanosomiasis, there was a marked increase in serum protein with essentially a hyper γ globulin reflecting primarily the immune response during disease.

All of our results allows to consider the application of serum protein electrophoresis as a tool for early diagnosis before the onset of symptoms and monitoring of trypanosomosis camelina by Trypanosoma evansi.

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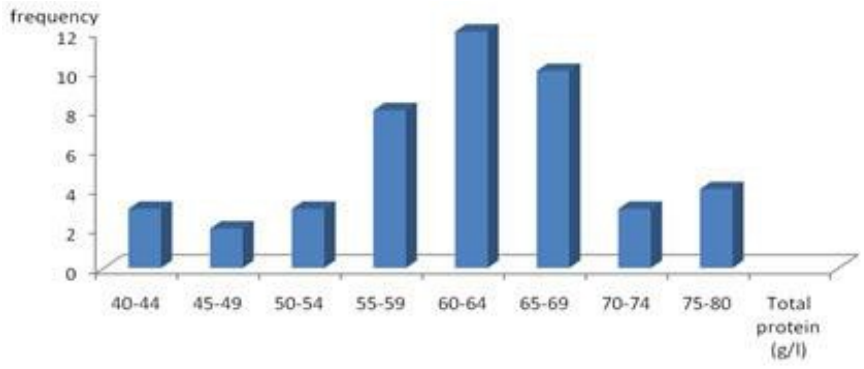
Figure 1 Histogram of total protein serum concentrations in 45 healthy camels



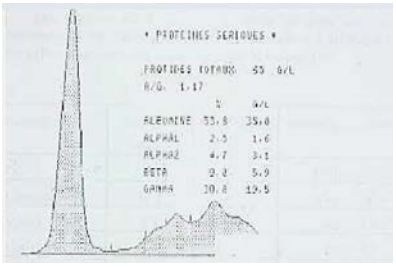


Figure 2 Appearance of the profile of electropherograms of serum proteins in camels healthy.

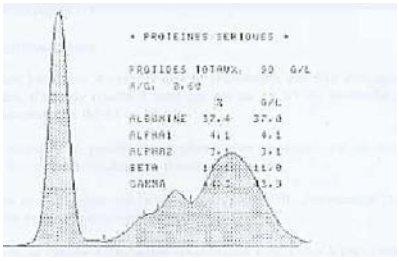


Figure 3 Aspect of the profile of electropherograms of serum proteins in camels suffering from trypanosomiasis to *Tyrpanosoma evansi.*

Table 1 Serum proteins and their fractions in the camel : variation in trypanosomiase to *Trypanosoma évansi*.

	Dromadary healthy (n=45)		Dromadary seropositive with no symptoms (apparently healthy) (n=54)		Dromadary seropositive with symptoms (ill) (n=26)	
PARAMETERS	**A (g/l)**	**SD**	**A (g/l)**	**SD**	**A (g/l)**	**SD**
Total Protein	61.1	9.0	104.6	18.2	103.2	18.7
Albumin	30.8	4.6	48.1	9.9	40.0	9.0
Alpha 1 Glob.	1.8	0.7	3.0	1.2	2.4	1.4
Alpha 2 Glob.	3.0	0.9	5.2	1.8	5.0	1.5
Beta Glob.	8.4	2.5	13.6	4.6	12.8	4.9
Gamma Glob.	17.1	3.9	34.6	8.4	43.1	8.4
Alb/Glob	1.1	0.2	0.9	0.2	0.7	0.2

Table 2 Serum proteins and their fractions in camels: mean difference (absolute values) between seropositive and seronegative in trypanosomiasis.

Mean difference	**Ill/Healthy**	**App.healthy/ Healthy**	**Ill/App.**
healthy			
Total Protein	42.1*	43.4*	1.4
Albumin	9.2*	17.3*	8.1*
Alpha 1 Glob.	0.5*	1.2*	0.7*
Alpha 2 Glob.	2.0*	2.2*	0.2
Beta Glob.	4.5*	5.3*	0.8
Gamma Glob.	26.0*	17.5*	8.4*
Alb/Glob	0.4*	0.2*	0.2*

*significant at 95%

17. *Mycobacterium Avian Subsp. Paratuberclosis* in Camels: An Epidemiological Study

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Introduction

Paratuberclosis (Johne's Disease JD) is a slow developing infectious disease that has been reported in ruminants in several countries around the world. However, the disease has been more recently reported as an important endemic disease in the Kingdom by camel owners, who called the disease locally as (Silag). The symptoms of the disease were mixed with other diseases showing the same symptoms. Accordingly, unsuccessful treatments were practiced by the Vets and the owners. The aim of this epidemiological study was to clarify prevalence of JD in camel herds in different regions of the Kingdom based on a survey of camel herds by analysis of fecal, blood samples and recording clinical symptoms exhibited by the camels.

Materials and Methods

A total of 15 herds with about 1500 camels in different regions in the Kingdom were visited, based on complaints from their owners, that their animals were showing specific clinical symptoms, mainly diarrhea and emaciation ending in higher mortalities. All the necessary information about the disease was collected, mainly clinical symptoms, age of animals and predisposing factors. Fecal and blood samples were collected from animals showing the symptoms and those exhibiting abnormal feeding behavior. The 62 Fecal samples were analyzed by ZN acid fast bacilli test,(Hamid Bushara, 2011), and 45 blood samples were analyzed by ELISA and PCR techniques at the Central Diagnostic Lab (IDAC). Those techniques could be used successfully to inform camel breeders of their herd's status in relation to the disease and also to screen camels prior to purchasing for restocking (Hamid Bushara, 2011). Al Hajiri and Al Hinawi, A. M. (2007), had also used ELISA & PCR in detecting subclinical paratuberclosis in Saudi Dairy herds. More information on prevalence of the disease was also collected from cases admitted to the clinic at the college of Veterinary Medicine, Gassim University. Screen tests were carried out for the herd if a camel exhibited the clinical symptoms and was tested +ve.

Results and Discussion

Results of the study indicated that Johne's disease affects camels and results of the analysis were highly significant indicating the importance of further investigation. Incidence of JDS in the 4 regions studied were 98 % confirmed +ve with clinical symptoms and 64 % confirmed carriers respectively. Camels infected exhibit specific symptoms and high percent were carriers. Clinical symptoms were mainly severe weight loss and persistent diarrhea, mainly in young camels (2-3 years). Similar symptoms were reported in other ruminants (Clarke, 1997). Sources of infection were introduction of infected animals to the herd, the habit of eating infected manure due to nutritional deficiencies, searching for undigested seeds in feces and milk from infected camels. Control of the disease in camels depends mainly on management including provision of well balanced diets. Early detection of the disease by regular screen testing the herd followed by culling the infected animals. Effective treatments were tried in ruminats, St-Jean, g. and Jernigan A,D. (1991), and Slocombe, R.E. (1982) in goats. Although treatment of infected animals are considered expensive in small ruminants, more studies in camels might be justified since the owners of expensive breeds are ready to pay the cost for the drugs. Production of a vaccine for controlling the disease is urgently needed to overcome the danger of spreading JD as the camel owners will not be willing to accept the culling strategies applied for other ruminants.

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18. Purification, Physico – Chemical and Bio-Chemical Characterization of the Major Camel Immunoglobulins (IgG, IgM and IgA)

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Isolation and purification of IgM, IgG and IgA from serum, colostrums and pulmonary lavage of the camel was done by precipitation, gel filtration and anion exchange chromatography. Immunoelectrophoresis and double diffusion were used to analyse the purified fractions and to assess the reliability of the separation procedures. Immunolobulin molecules were characterized on the basis of their electrophoretic mobilities, chromatographic behavior, antigenic inter-relationships and molecular weights. Their concentrations in camel serum were also determined.

Cellulose acetate strips electrophoresis coupled with immunoelectrophoresis distinguished slow, medium and fast IgG arcs that occupy the gamma region. The IgM and IgA arcs were identified according to their shape and their distribution in the beta and the alpha regions respectively. Immunoelectrophoretically, slow and medium IgG were eluted in the fall through in the form of twin peaks from DEAE (DE52) anion exchanger with 0.01 M phosphate buffer (PH 7.4) while the fast IgG and the IgA were eluted with 0.05 M and 0.06 M respectively. Camel IgM was readily obtained at the first peak of sepharose 6-B gel filtration.

Camel IgG, IgM and IgA shared common antigenic determinants. Spurs of partial antigenic identity were observed between slow IgG and medium IgG on one hand and fast IgG on the other. However complete antigenic identity was observed between colostral slow, medium and fast IgG and between slow and medium IgG from serum colostrums and pulmonary lavage.

The molecular weight of camel IgG was found to be 155×10^3 Daltons, and its heavy polypeptide chain was estimated as 57.0×10^3, 56.5×10^3 and 56.5×10^3 Daltons from slow, medium and fast respectively. The light polypeptide chain from the same IgG preparations had a molecular weight of 27.6×10^3, 27.5×10^3 and 27.65×10^3 Daltons respectively. Monomeric IgA had a molecular weight of 165×10^3 Daltons. The molecular weight of IgA secretory piece was found to be 73.5×10^3 Daltons. Estimated molecular weights of the heavy and light polypeptide chains of IgA molecule were found to be 65.0×10^3 and 27.5×10^3 Daltons respectively and those of IgM were estimated as 72.0×10^3 and 27.0×10^3 Daltons respectively.

It was observed that each of camel IgG (slow, medium and fast) IgM and IgA contained an additional polypeptide chain of similar molecular weight ($46.15\text{-}47.1 \times 10^3$ Daltons). An extra molecule was also found in reduced IgM and its molecular weight was determined as 56.2×10^3 Daltons.

Camel serum IgG, IgM and IgA, albumin and total proteins were quantitatively determined. IgG was the predominant immunoglobulin class in the serum (18.06-29.13 mg/ml) and accounting 25.6-41.4% of the total proteins. The concentration of IgA and IgM were found to be 5.27 and 1.71 mg/ml respectively.

Medicine
Infectious Disease
and
Health

19. A Note On Rabies in a Camel

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Introduction

Rabies (OIE List-'B' disease) is one of the most dreadful diseases and a major viral zoonosis. It is caused by RNA virus of family *Rhabdoviridae*, genus lyssa virus, which infects all warm-blooded animals and birds characterized by signs of abnormal behavior, nervous disturbances, impairment of consciousness, ascending paralysis and death. Although all mammalian species are believed to be susceptible to rabies virus, there are few reports of rabies in domestic Camelidae (Afzal *et al.*, 1993; Kumar and Jindal, 1997, El Mardi and Ali, 2001, Dongre and Joshi, 2006).

History and laboratory investigation:

A seven year old male camel of Border Security Force, Dantiwada of Gujarat state in India reported in the morning with sudden symptoms of hyper excitement with aggressive nature and abnormal behavior, yawning, tendency to attack and bite handler and other camels as well as inanimate objects and salivation. Death occurred 3 days after onset of symptoms. A detailed postmortem examination was conducted and brain was collected in 10% formalin for histopathology and also in 50 % glycerin phosphate buffered saline. Brain Impression smears were also prepared and sent to Central Disease Diagnostic Laboratory, Centre for Animal Disease Research and Diagnosis, Indian Veterinary Research Institute, Izatnagar, Bareilly, India.

Results and Discussion

The clinical signs as observed in the present case were also reported earlier in India by Kumar and Jindal, (1997) and Dongre and Joshi, (2006). Clinical signs of camel rabies reported by Afzal *et al*. (1993) included hyper-excitability, attacking inanimate objects, self-biting offorelimbs, salivation sternal recumbency, paralysis of hind legs anddeath within 3-7 days. Omer *et al*., (2005) reported rubbing, incoordination (Staggering gait), slight excessive salivation, recumbency, excitement, abnormal movement of the eye, laryngeal and pharyngeal paralysis and self biting of forelimbs in a camel in Sudan. The postmortem examination revealed no appreciable gross changes in any organ except moderate congestion of the brain. Histopathological changes were characterized by non suppurative perivascular cuffing, neuronophagia and presence of Negri bodies in neurons with non suppurative meningitis in H&E section of brain. Sellers stained impression smear showed inclusion bodies indistinguishable from Negri type. Fluorescent Antibody Technique (FAT) was applied on brain impression smear as well as on formalin fixed samples and was found positive for rabies. FAT is the most widely used method for diagnosing rabies infection in animals and humans and recommended by both WHO and OIE. In thepresent study, there was a history of wound on the hind limb, thus possibility of dog bite could not be ruled out.

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20. A Deadly Respiratory Camel Disease

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A highly contagious respiratory disease was first reported from Rakhshan region of Balochistan (July, 2010). The disease was frivolously taken as the results of dust storms and dry spells as the disease spread with the dust fill winds after a long drought period in Balochistan and adjoining areas of Iran and Afghanistan. The spread of the disease was very quick, after the introduction of infected camels, in a livestock fair (Sibi mela). The sign of disease were noticed in healthy camel six days after exposure. The disease is highly contageous and about 80% of the camel herd was affected. The symptoms of disease consist of white & sticky nasal discharge, nasal congestion, regurgitation, an ultimately the animal becomes inappetent. Treatment with amoxicillin trihydrate by local veterinarians and other practitioners was considered affective. A single injection resulted in recovery within 12 hour and all the physiological activity restored in 24 hours. Larynx of dead camels were swollen and the whole trachea lacerated. The lungs were filled with sticky exudates. There were black spots on the lungs and lungs were fused with the ribs.

According to the findings, Bacterium (Pasturrelle) was responsible for this disease, though other types of bacteria like Streptococci were also found in the samples (findings from the unpublished data from Central Veterinary Diagnostic Laboratory (CVDL), Sindh and Bahauddin Zakria University (BZU) Multan, Pakistan.

The disease exhibited similar signs as the disease reported by Abdelmalik I. Khalafalla from the Sudan, Ethiopia and Kenya (1996-2006) caused by PPR virus, a morbillivirus of the Paramyxoviridae. He advised to send swabs, lymph node and lungs samples to CIRAD or IAEA laboratories for lab diagnosis. Non infected camels may be vaccinated with sheep PPR vaccine..

21. Composition and Anti-Hypoglycemic Effect of Camel Milk

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Introduction

In the previous section it was shown that camels can produce an adequate amount of milk in drought areas where other domestic animals have very low production. Of prime importance for young camels, and especially for man, who drinks the milk, is the composition. However, data concerning the composition of camel milk vary greatly, this can be partly attributed to the inherited capabilities of the animal, but the stage of lactation, age, and the number of calvings.Of special significance to the quality of the produced milk are the feed and water quantity and quality.

Most camel milk isconsumed fresh, it can also be consumed when slightly sour or strongly soured. Normally it has a sweet and sharp taste, but some times it is salty, the change in taste are caused by the type of the fodder and the availability of drinking water.

Camel milk contains high levels of minerals such as potassium, iron, zinc, magnesium, cooper, sodium, and manganese.

However compared to cow‘s milk it has lower levels of sugar and lactose. Camel milk is lower cholesterol than cow and goad milk, and three times higher in vitamin C than cow's milk and ten times higher in iron. Its low protein and large concentration insulin has positive effect on immunity and the anti-diabetic action of camel milk can be attributed to the camel's choice grazing on natural vegetation in the desert, including medical plants such as neem and salts herbs. It is also high in unsaturated fated acids and vitamin B but less in vitamin A and B_2. Camel milk supposis supposedly can prevent ulcers. Regular intake of camel milk helps to control blood sugar levels. Camel milk also benefits infection such as tuberculosis, gastro-enteritis and cancer, and is supposed to be a new Viagra.

Material and Methods

Selected suitable healthy thirsty six albino rats, 8 weeks old weighting 130-150 gm were used. They were kept in the laboratory for not last than one week before use in the assay and maintained on adequate & controlled diet, with water available at all times except during the assay when they were fasted for 18-24 hours prior to the assays. They divided into four groups (Group 1, Group II, Group III and Group IV) with 8 rats each . Diabetes was induced of Group 1, Group II and Group III by injected intraperitonial with 60 mg/kg body weight of streptozotocin 60 mg/kg weight. Rats in group IV served as a control group. Fasting blood glucose levels of all these were estimated after there days of treatment. The animals in addition to the normal diet, were fed with camel milk (Group1) raw cow milk (Group II), water (Group III) and normal diet (Group IV). Rats of Group1 and Group II were administrated 250 ml of milk daily with watering bottle instead of water. Whereas rats in Group III and Group IV were given tap water. The plasma glucose level was measured daily spectrophotomatrically employing glucose oxidace methodology .

Results

The mean initial blood glucose of treated animals were 190.52 $\pm$7.36 mg/dl maintrace in case of untreated 80.5 $\pm$11.55 mg/dl .After three weeks of the treatment of Gruop1 the mean blood glueose levels markedly 98.0$\pm$3.5 and 85.71$\pm$12.8 mg/dl maintrance in Group II, it decreased at a lowering rat to 158.3$\pm$45.3, 132.8$\pm$23.49 and 101.1$\pm$8.98 mg/dl, and in Group III it dropped at still lower rate. 202.77$\pm$10.11, 162.8$\pm$8.43 and 125.3$\pm$24.22 mg/dl. Every time the mean blood glucose level in control group was within the normal range (70 to 80 mg/dl). The mean treatment of three weeks the blood glucose showed a significant decrease in Gruop1 animal which treated with camel milk, in comparezon to those gelling raw cattle milk. Three weeks of treatment blood glucose level in diabetic animals observed to be 210% and 114% in animal treated with raw camel milk and water .

Discussion

The finding of the present study confirmed the glycemic control in streptoztocin induced diabetic rats. High concentration of insulin of camel milk may be responsible of anti-diabetic effect (Agrawal *et al* 2003). Camel milk contains approx 52 units/litre insulin.

In conclusion, the present study showed a significant hypoglycemic effect of camel milk and maybe a scientific justification for drinking camel milk by certain diabetic patients.

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22. Health Considerations in Intensive Camel Dairy Farming Units: The Case of Southern Tunisia

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Introduction

In Southern Tunisia, almost all camel herds are fed on large areas of pasture over an extended period, depending to the extensive breeding system by exploiting large areas of pastures. In this system, milk production remains under-exploited by the camel breeders because of the difficulties of collection and transport to market. In recent years, attempts to install units for intensive breeding of lactating camels have led to improved production. The creation of these units requires the establishment of special facilities and mastering new techniques. Controlling of the health aspects plays a significant role in the success of any livestock. Indeed, health considerations must be taken into account at the beginning, during and at the end of the breeding period.

Material and Methods

Each year, since 2004, at the beginning of the lactation period, a group of 10 female calves were transferred from the herd of the Institute of Arid Regions, led in Médenine according to the semi-extensive system, to the experimental station of Chenchouin Gabes (oasis condition), in order to be conducted according to the method for intensive milk production. Each she-camel received daily 10 kg of hay of alfalfa or oats, 8 kg of fresh alfalfa and 2 kg of concentrate. Before weaning the young at 3 months, half the quantity of milk produced by the camel is milked by hand in the presence of calf suckling the two rights teats. The entire quantity of milk was milked with the milking machine after weaning; each female was milked twice a day at eight a.m and at four p.m. During the breeding period in intensivesystem, regular veterinary examinations are performed to diagnose and treat pathological cases. The CMT (*Californian Mastitis Test*) was done in a collective and periodic way for all she-camels and in an individual wayfor suspected mastitis.

Results and Discussion

Risks in intensive system

At the beginning of the breeding period, there is a risk of stress during the adaptation period especially for primiparous she-camels, as well as during initiation to machine-milking. Moreover, the probability of infestation by internal parasites such as tapeworms and gastrointestinal strongyles increases in relatively wet conditions of oases and especially owing to the fact that significant part of food is based on fresh forage (alfalfa) which can lodge parasitic eggs and larvae. Digestive disorders (enterotoxemia, colic, etc) related to sudden changes in farming conditions and diet can also be recorded.

During the period of lactation, clinical and sub-clinical mastitis are the most observed pathologies under intensive conditions (Table 1).

Table 1: Number and proportion of mastitis observed in Chenchou station

Mastitis	***Subclinical***	***Clinical****(n=14)*			
		Traumatic	*Septic*	*Gangrenous*	*General complications*
Number	4	9	5	2	2
Percent %	5.17	64.29	35.71	14.28	14.28

The acute clinical mastitis observed are characterized, in addition to the inflammatory and edema that develops in one or more quarters, by gradually changing of physical and chemical aspects of milk *e.g.*contain blood, pus or to become fully exudates. Clinical mastitisduring the seven years occurred in 14 cases on70 females bred. Nine cases were due to trauma which happened during the introduction of she-camels to machine milking and by congener‘s attacks. Indeed the teat canals of the she-camel udder appear to be more susceptible to internal abrasions than the penetration of germs because each teat has two narrow holes (Khanna, 1986, WERNERY, 2003). The Five septic mastitis

are observed during the last 3 months of lactation coinciding with the autumn season. Even if it is less frequent (two cases), more rapid and more serious evolution is noted for gangrenous mastitis caused by *Staphylococcus aureus*. Moreover, *Streptococcus spp*.and *S. aureus* with *Micrococcus spp*. seem to be the major pathogens of mastitis in camels (Woubit *et al*., 2001, Azmi *et al*., 2008, Abera *et al*., 2010). Despite of its low prevalence (5.12 %), the risk of subclinical mastitis is important since it poses a problem of detection and can usually progress to chronic mastitis.

At the end of the breeding period, there are risks of excessive fattening since female magherbi camels are more meat-oriented and therefore the possibility of health (ketosis, retained placenta) and fertility (absence of ovulation and difficulty in coitus) disorders are possible. In addition, the risk of enterotoxaemia in camel‘s transferred back to the rangelands may occur.

The health benefits of intensive system

Besides improving productivity, dairy farming in intensive system is a more controlled system allowing more effective health monitoring and reduces the risk of developing contagious diseases caused in extensive system by direct contact on rangelands and around watering points.

Strategy to adopt

First it is necessary to choose an aerated locality with an acceptable humidity to reduce stress on she-camels in an intensive system. Females must be in good health, free of udder discomfort and they should be vaccinated against enterotoxemia before being transferred to the intensive farming system. The animals must receive a preventive medication against internal parasites by oral or parenteralrootsand against external parasites by pulverization while respecting the withdrawal periods relating to the products used.Also during the period of adjustment to machine milking oxytocin (10 IU / camel) can be usedin order to induce milk ejection reflex for stressed females and especially for the primiparous.

During the breeding period, a permanent follow-up of the sanitary conditions of the she-camels should be performed and areas reserved to milking females should be cleaned, and breeding areas should be treated with acaricides and insecticides. A periodic stool examination for assessment and identification of helminth infection should be performed and serological examination should be made in case of need. Furthermore, before each milking, the udder and the first jets of milk must be examined in addition to periodic tests with CMT for early diagnosis especially of sub-clinical mastitis. The increase in somatic cells of camel milk is a good indication of inflammation (Barbour *et al*., 1985, Sargeant *et al*., 2001). The treatment of mastitis should be done by external massages of the udder and by parenteral route. However, the application of intramammary tubes designed for cattle is unsuitable for the dromedary udder because of the narrow diameter of the teat canal and orifices. A good practice of milking: whether it is manual (avoid excessive pressure on the teat canal) or mechanical (periodically check pulses and the level of vacuum in the milking machine) besides a regular disinfection before and after each milking of the pots and teats should be done.

At the end of lactation period, it is recommended to make vaccination against enterotoxemia and reduce energy intake to avoid fattening in order to reduce the risk of ketosis and infertility.

Conclusion

The market demand for camel milk requires the establishment of intensive livestock units that must follow good health practices to minimize losses and ensure a good quality of commercial milk. The prevalence of mastitis is relatively higher in intensive conditions. The camel population in the Tunisian southern is not a dairy breed, its exploitation in the production of milk requires extra efforts and more technical and health care throughout the period of intensive breeding.

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23. Molecular Characterization of Pseudocowpoxvirus (PCPV) Isolates from Indian Dromedarian Camels

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Introduction

The disease Camel Contagious Ecthyma (CCE) is widely recognized in camel-rearing regions of the world (Ali *et al*.,1991; Housawi *et al*., 2004). Recently, Pseudocowpoxvirus (PCPV) has been reported as the etiological agent of CCE (Abubakr *et al*., 2007; Nagarajan *et al*., 2010). In CCE, nodules appeared on the lips of affected animals followed in most cases with swelling of the face and sometimes the neck. Papules and vesicles appeared later and within a few days developed into thick scabs. Lesions occurred sometimes on the face, eyes and nares. Healing occurred within 20 to 30 days in most cases (Khalafalla, 1998). The important genes of PCPV isolates from the camels have yet to be characterized.

The objective of the present study was to amplify RNA binding protein (RBP) gene and virion core protein (VCP) gene of Pseudocowpoxvirus isolates from Indian dromedarian camels by PCR and subsequent cloning of the PCR amplified DNA fragmenst into the vector for sequence analysis and to find out its relatedness with the other parapoxviruses available in the NCBI database.

Materials and Methods

In the mid September 2010, Camel calves of below one year of age of either sex in the camel herd of NRC on Camel, Bikaner, Rajasthan ,India were showing symptoms of contagious ecthyma lesions around the facial region. Scab materials were collected from a total number of 15 severely affected animals.Total DNA was extracted from collected skin scabs using AxyPrep Multisource Genomic DNA Miniprep kit (Geneaxy Scientific Pvt. Ltd.) according to the manufacturer‘s instructions. For the amplification of RNA binding protein gene and Virion Core protein gene,nucleotide primers were designed based on the respective gene sequences of Pseudocowpoxvirus isolate from Finlnish reindeer (GenBank accession No.GQ329669) ;The primer pairs for RNA binding protein gene, forward (**RBPF)** 5‘tta gaa gct gat gcc gca g ttg tcg atg agg 3‘ , reverse (**RBPR)** 5‘atg gcc agc gac tgc gct tcc ctg atc ctc 3 and the primer pairs for virion core protein gene, forward (VCPF) 5‘ctagagcatg ccctcgtacg cgcgcg 3‘ and reverse (VCPR) 5‘atg gag gca att aac gtt ttt ctc gag acc 3‘. PCR amplification of the topoisomerase gene was performed using the following thermal profiles: initial denaturation at 94^0C for 5 min, followed by 35 cycles of denaturation at 94^0C for 1 min, annealing at 57^0C for 1 min, extension at 72^0C for 1 min, and final extension at 72^0C for 10 min. The PCR-amplified products were checked by electrophoresis in a 1.5% agarose gel. The amplified products using parapoxvirus-specific primers were cloned in pGEM-T Easy Vector (Promega) and used to transform Escherichia coli DH 5α [Sambrook *et al*., 1989]. Positive clones were identified by colony PCR using gene- specific primers and restriction analysis with EcoRI. Positive clones were sequenced in both directions using universal T7 and SP6 primers at the DNA sequencing facility of Delhi University (South Campus), Delhi and analysed with that of different parapoxviruses published earlier in the GenBank (Table 1 & 2) using computer software BIOEDIT Version 7.0.9. These sequences were compared in Clustal X (Thompson *et al*., 1997) and phylogenetic tree was constructed in Treeview 1.6.5 by neighbour joining method (Page, 1996).

Results

The disease was characterized by papules and then pustules on the lips-muzzle and eye lids of infected camels. Profuse salivation, foul mouth odour and facial edema were also observed. The pustules on the lips ruptured and became ulcerated. Those in the muzzle dried and became covered by grey or brown scabs. Infected animals were showing pruritis and intermittent rubbing against the wall of the corrals, which eventually led to the sloughing of the skin at the affected areas.

Total DNA was extracted from all the fifteen infected scabs and both RBP and VCP genes were amplified successfully. DNA fragments of RBP gene (555 bp) and VCP gene(415 bp) were

observed on agarose gel electrophoresis .There was no amplification in the PCR using the DNA isolated from the camelpox positive scab materials (negative control).

Confirmation of recombinants was done by restriction analysis and positive clones were sequenced. The nucleotide sequences of both RBP and VCP genes were submitted to GenBank, NCBI database, for which the assigned accession No.are JN712917 and JN712918,respectively**.** Phylogenetic trees constructed using nucleotide sequences of both RBP and VCP genes of various parapoxviruses revealed that the Indian PCPV clustered with different parapoxviruses published earlier, supported by high bootstrap values (Fig. 1 and Fig.2). The gene had a high G+C content (63.06%), consistent with the relatively high G + C content in the whole genome of parapoxviruses (Delhon, *et al*., 2004). We compared both RBP and VCP gene sequences of PCPV- camel with all other sequences representing ORFV, PCPV and BPSV available in the database The percent identitities of both RBP and VCP genes of PCPV-Camel with different parapoxviruses at nucleotide level were given in Table 1 and Table 2.

Discussion

The clinical signs of camelpox, camel contagious ecthyma and camel papillomatosis are similar and can be confused, especially in the generalized form (Munz *et al*., 1990) and so far can be distinguished only by virus identification in electron microscope. In addition to the complexity and high skills required to operate electron microscopy, this technique is not usually available for veterinarians in the field services. Therefore, with the advent of molecular tools such as PCR and gene sequencing, it is possible to detect even a few copies of viral DNA from the clinical samples and is found to be more efficient and specific for the epidemiological studies of contagious ecthyma in camels. The development of PCR methods for the molecular detection of parapox DNA has met the demands for specific and sensitive laboratory diagnosis (Mazur *et al*., 2000; Guo *et al*., 2004; Tryland *et al*., 2005).

Sequence analysis of RBP gene at nucleotide level revealed that Indian PCPV shared 91.1-91.35% sequence identity with PCPV reindeer. ORFV from different regions of the world shared 75.4-75.9 % sequence identity with PCPV camel. With BPSV, PCPV camel showed 91.7 % sequence identity As far as the nucleotide identity of VCP gene is concerned, PCPV- Camel has got almost equal relatedness with both PCPV- reindeer (97.1 -97.8 %) and ORFV (93.2 -95.1 %). High nucleotide sequence identity of VCP gene in ORFV and PCPV also reveals that the protein is well conserved in the members of the genus Parapoxvirus. For the first time, complete nucleotides sequences of both RBP and VCP genes of PCPV of camels were analyzed.

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Table 1. Percent nucleotide identity of RBP gene of PCPV –Camel with different parapoxviruses

Sl.No.	Virus isolate	Host	Country and year of isolation	NCBI Accession No.	Percent nucleotide identity
1	PCPV-Camel	Dromedarian Camel	India ,2010	JN712917	-
2	BPSV	Not available	USA,2003	AY278213	91.7
3	PCPV-Reindeer	Reindeer	Finland, 2010	GQ329669	91.1
4	PCPV-Reindeer	Reindeer	New Zealand,2010	GQ329670	91.3
5	PPV-Tillquist	Not available	USA,2003	AY278212	91.1
6	ORFV	Japanese Serow	Japan,2010	AB522803	75.9
7	ORFV	Japanese Serow	Japan,2010	AB522802	75.9
8	ORFV	Japanese Serow	Japan,2010	AB522801	75.9
9	ORFV	Japanese Serow	Japan,2010	AB522800	75.9
10	ORFV	Japanese Serow	Japan,2010	AB492086	75.9
11	ORFV	Not available	Mewe Zealand,2006	DQ184476	75.4
12	ORFV	Not available	USA,2004	AY386263	75.9

Table 2. Percent nucleotide identity of VCP gene of PCPV-Camel with different parapoxviruses

Sl.No.	Virus isolate	Host	Country and year of isolation	NCBI Accession No.	Percent nucleotide identity
1	PCPV-Camel	Dromedarian Camel	India ,2010	JN712918	-
2	PCPV-Reindeer	Reindeer	New Zealand,2010	GQ329670	97.8
3	PCPV-Reindeer	Reindeer	Finland, 2010	GQ329669	97.1
4	ORFV	Not available	USA,2004	AY386263	95.1
5	ORFV	Not available	New Zealand,2006	DQ184476	94.9
6	ORFV	Not available	USA,2006	FJ460506	94.6
7	ORFV	Not available	USA,2004	AY386264	94.6
8	ORFV	Not available	USA, 2006	FJ442820	94.4
9	ORFV	Sheep	Germany,2011	HM133903	93.7
10	ORFV	Not available	USA,2006	FJ460505	93.2

24. Study on the Incidence of Blood Parasites in Camels of Sistan and Bluchestan Province (South-East Iran)

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Introduction

Camel breeding is practiced in Iran and many tropical and subtropical regions of the world. The importance of this animal in transmission of some diseases to other ruminants is caused for many studies about it (Mirzai, 2007). Number of camels in Iran is almost 143000 that 36000 of them are in Sistan and Bluchestan province (Southeast Iran). One of the most important breed of camel in Iran is Bluchi camel that it finding this province and other areas including: Hormozegan, south of Khorasan and Southeast region of Iran and are used scattered for passenger and transportation (Eskandari, 2002). So, according to the number of camels in the country and its role in the transfer of pathogens especially as reservoir host, there was a need for this research.

Material and Methods

One hundred and thirteen blood samples of different areas of Sistan & Blouchestan province were taken and collected blood samples were studied. Samples were examined with three methods: A): 10 ml of blood mixed with anticoagulant and centrifuged for 15 minutes in microhematocrite tubes and was studied for *Trypanosoma evansi* in its buffy coat layer. B): 1 ml of blood was mixed with 9 ml of 2% formol (modified Knott's method) and after centrifuging, its precipitants were studied for microfiaria. C): Preparation of blood sample on the slide and staining with Gimsa for study on blood protozoa. Moreover, animal information including: age, and sex were recorded in prepared forms and relationship between them and infection were studied with chi square method.

Results and Discussion

Results showed that 30.09% of studied camels were infected to blood parasites and that the highest rate of the infection was with *Trypanosoma evansi* (19.47%) with *Theileria sp.* (6.20%), followed by *Babesia sp.* (3.54%) and microfilaria (0.88%) (Table 1). *Trypanosoma evansi* was shown in the blood of an infected camel (Fig. 1). The rate of infection in studied camels based on their sex was shown in Table 2 and statistical analyses did not show significant relationship between the infection with blood parasites and sex of camels ($p>0.05$). Also, relationship between infection and age of camels was not significant.

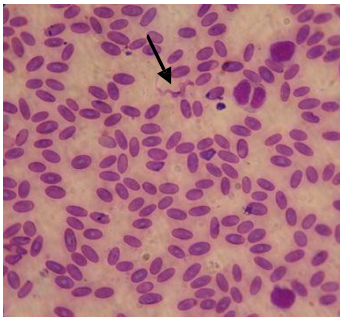
Table 1. The rate of infection to blood parasites in camels of Sistan & Bluchestan province

Total No. (%)	**Infected camels**				**Non-infected camels No. (%)**
	Trypanosoma evansi No. (%)	*Babesia sp* No. (%)	*Theileria sp* No. (%)	Blood microfilaria No. (%)	
113 (100)	22 (19.47)	4 (3.54)	7 (6.20)	1 (0.88)	*79 (69.91)*

Table 2. The rate of infection to blood parasites in camels of Sistan & Bluchestan province based on sex

Sex	**Infected camels No. (%)**	**Non-infected camels No. (%)**	**Total No. (%)**
Male	23 (20.35)	58 (51.33)	81 (71.68)
Female	11 (9.74)	21 (18.58)	32 (28.32)
Total	34 (30.09)	79 (69.91)	*100 (113)*

Figure 1. isolated *Trypanosoma evansi* in blood of camels in Sistan & Bluchestan province



Importance of this study is due to the presence of 143000 camels in different regions of Iran including Sistan & Bluchestan province, transmission of some diseases including parasites, other ruminant and even humans. *Trypanosoma evansi* was reported by some researcher in other areas of the world (Desquesnes *et al*., 2008). Also, other blood parasites were reported in other countries (Mazyad and Khalaf, 2002, Nassar, 1992). In Sudan, unknown sheathed microfilaria was isolated from blood of 7 camels (Elamin *et al*., 1993). In another study, *Onchocerca armilata* was isolated from 41% of studied camels (Awad *et al*., 1990). Therefore, with regard to presence of the infection with blood parasites in camels of Sistan & Bluchestan province, control of the infection is important for health of camels, other ruminants, and humans. It is possible by treatment of infected animals control of arthropods as main vector of blood parasites.

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25. Investigation of Occurrence and Persistence of Brucellosis in Chronically Infected Dromedary Dams (*Camelus dromedarius*) and Their Calves

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Introduction

Brucellosis is a major zoonotic disease induced by bacteria of *Brucella species.* It affects wild and domestic animals and often manifests as a sub – acute or chronic disease. Predominant clinical sign in animals is abortion. Many species including camels can become chronic carriers, which can lead to the intermittent shedding of *Brucella spp.* in milk during lactation and sets human consumers of dairy products at risk of an infection.

Results

At the beginning of this Master thesis (von Hieber, 2010), a comparative study of 221 dromedary serum samples from a brucellosis infected herd was performed to estimate the sensitivity of Rose Bengal Test (RBT) and competitive ELISA (cELISA). It revealed a 10.86% higher sensitivity of cELISA (87.33% cELISA vs. 76.47% RBT). The cause for this finding is, first the broader range of detectable immunoglobulin classes in cELISA, and secondly the spectro - photometric test evaluation, which is more precise than adspective evaluation. These findings show the superiority of cELISA over RBT for the brucellosis detection in dromedary camels.

The main focus of this study concentrated on an investigation of 118 dromedary dams for alterations in their brucellosis serological status over a period of two years. After purchase from Sudan in 2008, 88.13% (RBT) of the above mentioned dams were positive in the initial investigation. After 18 months, 116 dams gave birth to live calves. At that time, 82.20% of the dromedary dams were found positive RBT and 89.83% by cELISA. Six months later all dams were re–tested. The serological investigations revealed a significant decrease in sero–prevalence within six months after parturition, compared with the period of 18 months prior to parturition. The percentage of positive dams declined to 69.90% (RBT) and 82.52% (cELISA), respectively. In total, a decrease of brucellosis positive dams of 18.23 % (RBT) was observed over a period of 24 months, 5.93% (RBT) whereas a decrease was observed in the first 18 months after purchase and further 12.30 % (RBT) decrease within 6 months after parturition.

The reason for the higher reduction of positive dams after parturition is not clear, but presumably parturition and lactation have influenced the immune system of dromedaries to an unknown extent. The reason for the general decrease of positive found dams over two years is most probably the chronic state of brucellosis. It is not exactly known how long they have been infected since there were no data available of the time in Sudan. However, it can be assumed that they had already been infected several years before the purchase in 2008 and that the disease has turned into a chronic state. It is known that in chronic course of brucellosis, *Brucella* organisms can retreat into biological niches, mostly into lymph nodes, which would explain the decline in antibody levels.

Alarming was the observation of 4.84% of the studied dams whose serological status has changed from positive to negative to positive during the two years of investigations. It is therefore recommendable, that when ―stamping – out‖ methods are applied for the eradication of brucellosis formerly positive animals should be included in this programme.

All calves were screened serologically for the first time within 24 hours after birth. In these first investigations, 30.17% were found positive with RBT and 39.66% with cELISA. A second screening took place 6 months later and most of the calves were found serologically negative. Only 1.14% (RBT) and 15.91% (cELISA) positive calves were found at that time. Further elucidation of antibody development in cELISA of positive calves, showed a significant decline in the amount of immuno globulins compared with the immunoglobulin levels after birth. This is due to the continuous decrease in maternal antibody levels, which the calves have ingested with the colostrum after birth. Maternal antibodies in dromedary calves usually disappear within six to eight months post partum. Moreover, blood culture revealed no active brucellosis. Therefore, calves of chronically infected dams

seem not to be at risk to contract an acute brucellosis infection. However, for confirmation of this finding further investigations of the calves, when adult and/or pregnant, are recommendable.

Since the cultivation of *Brucella spp.* was experienced to be tedious, several trials were performed to improve the cultivation frame work for these bacteria, whereby the main aim was to focus on different culture media. Two typical media, Brain Heart Infusion (BHI) and Brucella specific medium (BSM), were compared. BSM medium was based on Farrel‘s medium and supplemented with a range of antibiotics, to suppress growth of non – *Brucella species*. In this specification, BSM has been used as the main culture medium for *Brucella spp.* in CVRL for 13 years. BHI medium supplemented with a range of antibiotics revealed its clear superiority over BSM in connection with the duration of incubation and the density of bacterial growth reached during incubation.

Along with bacteriological and serological investigations of the test herd, also tissue rt – PCR was performed on placentas, lymph nodes, lung, liver and spleen, which were all negative. Due to these results, the sensitivity of rt – PCR was tested by using either spiked tissue samples with *B. melitensis* or dilutions of *B. melitensis* colonies in several different solvents. The results showed that probably the presence of a high amount of non – target DNA interferes with the efficiency of the method. These findings emphasized the low sensitivity for the tissue – based rt – PCR, but have also shown the method‘s reliability in the amplification of pure target DNA in bacterial dilutions.

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26. Relevant Dromedary Parasites in the United Arab Emirates (UAE)

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Introduction, Material and Methods

Literature data showed that more than 80 different parasites can be found in Old World Camelids. However, since dromedaries and Bactrian camels are kept in countries with extreme climate conditions, the spectrum of economically important parasites is limited. Our knowledge on parasites of dromedaries in the UAE is based on a large number of parasitological examinations and necropsies carried out at CVRL in Dubai. Thus, over the past 10 years we carried out 1,500 camel necropsies and examined more than 80,000 camel samples for parasites.

Results and Discussion

The none-cyclically transmitted *T. evansi*is in general the most important parasite of camels. Due to the broad use of Cymelasan® in racing camels in the UAE and due to limited biotopes for horseflies as main vectors, camel trypanosomosis is less significant compared to the situation in other countries.

Contrary to other hosts, *Eimeria* coccidiosis is less frequent in camel calves. Coccidiosis is more often diagnosed in racing camels. Tissue stages (schizonts and gamonts) of up to 300 µm damage the intestinal mucosa and open the doors for secondary infection. Toltrazuril that is used in other farm animals for prophylactic purposes does not protect camels from infection (Gerlach, 2008). Hygienic measures and quarantine are important tools to prevent camel yards from eimeriosis.

Fatal cases of isosporosis caused by *Isospora orlowi* occur between December and March mainly in calves in an age group between 3 weeks and 3 months (Kinne *et al*., 2002). The infection source is unclear but it is suggested that there are tissue stages in dams that become activated in the perinatal period or even might be excreted with milk. Isosporosis was also diagnosed in adult camels in connection with bacterial lunginfections.

Single cases of cryptosporidiosis occur in 4 to 8 weeks old calves. Since *Cryptosporidium parvum* is not host specific, other farm animals can be considered as source of the infection. Cryptosporidiosis is an opportunistic infection and can be found when calves are weakened by other diseases.

A large variety of helminths has been described in camels but under authochthonous conditions only *Haemonchus longistipes*, *H. contortus*, *Trichostrongylus* spp., *Nematodirus* spp. and *Trichuris* were identified. The spectrum of adult cestodes consisted only of *Moniezia expansa* and *M. benedeni* while heavy burdens of *Stilesia vittata* were seen in dromedaries imported from Africa.

Due to the absence of dogs in camel breeding facilities and a proper disposal of carcasses of dead animals, hydatids of *Echinococcus granulosus* were not found in indigenous camels in the UAE and were only seen in old camels imported from other countries. For this reason also sarcosporidiosis is abscent in the UAE.

Mange due to *Sarcoptes scabies* is the most important arthropod infection in dromedaries. Deep skin scrapings need to be taken for diagnostic purposes. Treatment is done by washing with amitraz, phoxime or metrifonat. Macrocyclic lactones like ivermectin, doramectin and others are less effective in camelids (Kinne and Wernery, 2003). All the animals in the affected group have to be treated at least two times.

Hyalomma dromedarii is the only tick found on indigenous camels. *H. dromedarii* does not transmit blood parasites infective for camels but it is a host for equine piroplasms.

Only a few cases of myiasis caused by *Chrysomya bezziana* (Old world screwworm) and *Wohlfahrtia nuba* were seen in the past. Also nasopharyngeal bots (*Cephalopina titillator*) seem to be a rare parasite in the UAE.

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27. Diagnosis of Brucellosis Camels

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Camel, as the livestock industry, is widespread in the Central Asian republics and the countries of the Middle East. From this species of animals one receives milk, wool, meat and as well camels can be used as a transport. Of particular importance is the fact that the camels can grow in the zone of dry steppes, deserts and semi-deserts, where the development of other branches of animal husbandry is very difficult.

However, in the development of camel breeding the main obstacle is infectious diseases, among which occupies a special place brucellosis, representing danger to people, that can be infected with the use or processing of the products of sick camels.

Consumption of milk and dairy products from these animals and wide spread of brucellosis dictate the necessity for development of methods of research for products derived from camels.

We tested different methods of diagnostics of brucellosis in camels through the study of blood serum and milk.

Procedure of sedimentary reaction is as follows.

Color antigen, intended for setting the ring reactions of cow‘s milk is added to 2,0 cm3 of fresh camel milk. Mixture is shaken (and is placed in a thermostat for 2 hours or) and centrifuged with 3000-5000g for 15-20 minutes. After that the reaction is visually determined by the presence of agglutination at the bottom of the tube. The degree of agglutination is estimated by the four-point scale:

- the lack of agglutination, i.e. milk evenly painted in bluish colour, or sludge takes the form of a smooth surface "buttons". The result is negative;
+ agglutination expressed weakly, milk also has blue color. The result is doubtful;
++ a clear agglutination, milk slightly painted in blue color. The result is positive;
+++ clear agglutination with milk white. The result is positive.

When comparing the results of sedimentary reaction with the data of serological studies of the blood serum of camels (RBA, RSK) has noted, that with the help of sedimentary reaction in a disadvantageous brucellosis a herd of camels is revealed from 5 to 15 % of reacting animals. In the study of serum blood of the same herd of camels (136 heads) of the positive results obtained from 3 to 8% of the total number of the surveyed (RBA, RA, RAC). It is important to know the degree of epizootic hazard animals identified with the positive results of a sedimentary reaction. With this purpose we put bio probe in guinea pig with milk positively reacting camels (7 animals). Within 15 days after the introduction of the pathological material 5 guinea pigs, which provided the pathological material reacted positively to the diagnostic tests (allergies, RA, RAC). Thus has proved the specificity and activity of the sedimentary of the reaction.

In addition, 5 camels were killed for bacteriological study of organs (lymph nodes, heart, liver, spleen, kidney, bladder, right, and left inguinal, retropharyngeal, paraortic and bone marrow). As a result of the conducted research in four cases, the culture was located from the liver, the spleen and the pelvic lymph nodes.

During the epiziootiological survey, it was found that all the camels were in direct and indirect (in pasture) contact with disadvantaged sheeps.

We additionally examined with the help of sedimentary reaction shubat (fermented milk product) obtained from the same animal,we obtained 100%-matching results.

Moreover, we examined shubat (fermented milk product) from the same herd and 100% matching results were obtained.

The findings lead to the following conclusions:

1. The most effective method of diagnostics of brucellosis of camels in the study of blood serum is lamellar reaction agglutination test with rose bengal antigen (rose bengal test - RBA);

2. Milk of camels can be explored for brucellosis by the color antigen, designed for the circular reactions. The complex antigen+antibody forms a precipitate. The immunological test is sedimentary reaction;
3. The results of the sedimentation reaction in 95% of cases coincided with other serological tests. However, sedimentary reaction allows fro testing of milk at places where camels are kept.
4. Bacteriological studies of breast cancer show that the positive testimony of sedimentary reactions indicates the presence and the possible allocation of the causative agent of bovine brucellosis with milk.
5. Brucella isolated from milk belong to B. melitensis biotypes.
6. The sedimentation reaction developed by us for testing camel and goat milk is specific, sensitive and quick safety procedure.
7. Sedimentary reaction can be successfully applied in the study of sour camel's milk (shubat).

The use of the proposed test to study brucellosis of camel‘s milk will identify the most hazardous sick animals and prevent illness of people.

28. The Effectiveness of the Allergic Complex in the Diagnosis of Brucellosis in Camels

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Brucellosis among the camels is often found in places of their group content and is of great public health danger, especially when used in the food received from dairy products.

Brucellosis pathogens in camels can be Brucella abortus and Brucella melitensis depending on the type of poor livestock, with whom they have direct contact or through factors of transmission.

Diagnostics of brucellosis camels is one of the main links in the general complex of brucellosis event.

Serological (RA CFT) and allergic tests in the diagnosis of brucellosis in camels complement each other.

In epizootic outbreaks of brucellosis, the number of positively reacting to the specific, allergen camels often exceeds the same indicator of serological reactions (RA CFT)

Coincidence of the testimony of an allergic tests and serological reactions are observed in 47,0% of cases. The number of positively reacting only for allergy among spontaneously infected animals is 28% of the total number, and by serology this indicator is equal to 25%.

Most of the diagnostic value is allergen, prepared from the strains Brucella abortus 104-m and Brucella melitensis Rev-1.

The high efficiency of health-improving activities is achieved through an integrated allergic study and conduction of veterinary-sanitary measures for destruction of the pathogen in the external environment.

29. Experiences From a National Health Care Program in Swedish Camelids

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Camelid keeping has a short tradition in Sweden, and the experience and knowledge about management and diseases are limited among camelid keepers and veterinary practitioners. Imports of camelids from all over the world are common and the risk for spread of infectious diseases from camelids to Swedish livestock is a reality. Therefore, a national health care program for camelids was launched in 2008.

Due to the health care program, the knowledge about camelid management and diseases has increased among camelid keepers and veterinary practitioners. Several ―new‖ diseases in the Swedish camelid population have been diagnosed and reported, e.g. dicrocoelios and neosporos. Recommendations for camelid imports have been discussed and spread among keepers and veterinarians.

Information was gathered from reports from farm visits, lab reports, news letters to camelid keepers and articles in national veterinary journal.

Camelid keeping is new in Sweden. There is a lack of knowledge among camelid keepers and veterinary practitioners. Imports of camelids are common and pose a threat for spread of infectious diseases among Swedish livestock. Therefore, a national health care program for camelids was launched in 2008.

Knowledge about camelid management and diseases has increased among camelid keepers and veterinary practitioner. Several ―new‖ diseases in the Swedish camelid population have been diagnosed and reported, e.g. dicrocoelios and neosporos.

30. A Study of Dental Abnormalities of Camels in Nigeria

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Adaptation feature of the camel includes its ability to feed without discretion on desert and semi-desert vegetations, and to browse trees and shrubs beyond the reach of other animals. We decided to investigate if these voracious and liberal feeding skills could be at the expense of a healthy dental profile. We looked at the macerated skulls of 29 adult camels from three different regions of Nigeria comprising 15 females and 14 males. A total of 12 different types of dental and related osteologic pathologies identified were attrition, bone recession, carious tooth, dental abrasion, erosions, fractured tooth, and gingival recession, missing tooth, split tooth, extra tooth (wolf tooth), splint and stain. The prevalence rate of dental abnormalities of 100% was observed for attrition and gingival recession in all skulls examined from the three different locations (Maiduguri, Kano and Sokoto). Also, the prevalence rate of 79.9% for stains, 68.9% for erosions, 37.9% for fractured tooth, 34.5% for caries and 30% for missing teeth were observed. The other dental abnormalities such as split teeth (17.2%), extra teeth (wolf tooth) (7%), abrasion (6.8%), bone recession (3.4%) and splint (3.4%) were less frequently observed. Every single camel skull had a minimum of three dental pathologies. Sexual dimorphism occurred in the expression of dental abnormalities with mild group of 65% (females) and 35% (males); moderate, severe and very severe group of 46% (females) and 54% (males) animals. In addition, severe to very severe dental abnormalities occurred in camels from Sokoto (40%), Kano (33%) and Maiduguri (23%) suggesting variation in the prevalence rates at the various locations. In conclusion, our study has shown a high prevalence rate of dental abnormalities in camels in Nigeria and the implications of their occurrence have been discussed in relation to their possible pathogenesis. We suggest that more attention be given to their oral health.

31. Most Common Medical Conditions of Camels in Oman as Observed by Veterinarians in Private Practice: A Practitioner Survey

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Introduction

There is paucity of literature regarding medical conditions afflicting camels in Oman. Practicing veterinarians assume the first line of defense in protecting both animal and public health. Private veterinarians are valuable partners in sharing data regarding the prevalence of common diseases and conditions of each species that they treat. To underline this concept, the present study was conducted with the aim to gather data regarding the frequency of occurrence of medical conditions encountered in private practice. Previous prevalence studies conducted on livestock in Oman have gathered data limited to one disease, such as the study by El Sinnary *et al.*, 1998 for trypanosomiasis in camels. The aim of the present study was to record the prevalence of common medical conditions of camels in Oman.

Materials and Methods

A questionnaire listing 57 medical conditions was organized by body systems and given to veterinarians in several regions in Oman. The survey was pretested with two veterinarians to check the appropriateness of the language utilized on the survey. They took approximately 30 minutes to complete the survey. They did not have any difficulty in understanding the questions, which ruled out the need for a bilingual questionnaire (English/Arabic). All the participating veterinarians were briefed about the survey on the first visit and the questionnaires were collected on the next visit to the practice. A total of 23 questionnaires were distributed among the private vets of different regions in Oman such as Ash Shariqiyah (n=9), Al Batinah (n=12), Al Dakiliyah (n=1) and Al Buraimi (n=1). Responses were analyzed and the results were shown in terms of most frequent conditions/diseases of various body systems, presence of paraveterinary professionals within their practice and the hypothetical questions regarding their agreement in setting up more numbers of clinical diagnostic facilities and a camel referral hospital. Answers to questions concerning the most frequently observed conditions in relation to season (summer/ winter), racing camels/ camel calves and their results are not included in this preliminary result. The survey responses were analyzed in Microsoft Excel^{R}2010, using general tools as filtering and percentile to check the most frequent conditions of different body systems.

Results

From a total of twenty three veterinarians, who received a questionnaire, there were twenty respondents. One respondent vet declined to participate and two had not filled in their questionnaire in time for their results to be analyzed and included be in these preliminary results. The results of this study are summarized in the Table 1.

Table1

Conditions	Percentage of their frequency
Digestive system	
1. Indigestion	85%
2. Impaction	68.75%
3. Endoparasitism	67.5%
Respiratory system	
1. Upper resp. tract Infection	73.75%
2. Bronchopneumonia	72.5%
3. Pneumonia associated with camel pox	52.5%
Musculo skeletal system	
1. Sprain and strain on joints	71.25%
2. Post-race muscle exertion	70%

3. Lameness of forelimbs	68.75%
Skin and Integumentary	
1. Mange	97.5%
2. Ring worm	95%
3. Acariasis	92.5%
Wound and other conditions	
1. Maggot wounds- Myiasis	61.25%
2. Wounds arising out of RTA	51.25%
3. Wounds-eye and surroundings	41.25%`
Nutritional deficiency	
1. Copper deficiency	80%
2. Vit E/Selenium deficiency	70%
Infectious diseases	
1. Trypanosomiasis	100%
2. Camel pox	65%
3. Camel Orf	55%
Udder	
1. Acute mastitis	80%
2. Hemogalactia	60%
Reproductive system	
1. Infertility treatment to she camels	70%
2. Dystocia	57.5%
3. Abortion	57.5%
Urinary system	
1. Cystitis/ urethritis	36.25%
2. Partial obstruction of urinary passage	33.75%

The present survey results convey that a large majority of private vets are practicing without para vets within their teams (75%). There was widespread agreement for the need of advanced regional diagnostic facilities (80%) within the country to service clinical samples.

Discussion

To the best of our knowledge this is the first study in Oman undertaken to ascertain information from field veterinarians relative to diseases commonly encountered in their camel practices. Undoubtedly, trypanosomiasis, mange, acariasis, endoparasitism and mycotic disease-ring worm, and viral diseases, such as, camel pox and contagious ecthyma are the most widespread infectious diseases seen. These results are in harmony with those reported in a review of camel diseases by Fassi- Fehri., M.M. (1987), who reported that the most common diseases of camels are endoparasitism, trypanosomiasis and mange. The significance of the results underlines the economic importance of these diseases.

An approach of _Field to lab‘ is most important for the developing countries to identify the animal disease and conditions of economic and public health concern. Extracted from this study is also the importance veterinarians give to the availability of veterinary technologists, who work in conjunction with field veterinarians and who would contribute in the field, laboratory diagnostics, prophylactic immunizations and also in extension activities, which can be of paramount importance to the national veterinary service in Oman, as the majority of practicing veterinarians work without paraveterinary professionals and diagnostic facilities.

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32. An Outbreak of Severe Dermatophylosis in Young Omani Camels

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Introduction

Camels in Oman are reported to show a frequently recurring skin condition, especially during the rainy season, in Dhofar. Skin diseases are common in camels ranging from parasitic (sarcoptic mange), fungal (ring worm), bacterial (dermatophylosis) and viral (pox). A reported causative agent of bacterial dermatophylosis is *Dermatophilus congolensis* which is a gram positive bacterium, belonging to the heterologous group of Actinomycetes with members that affect animals and humans. The disease, also known as cutaneous streptothricosis, is an exudative, pustular dermatitis with the formation of crusty scabs that contain the microorganism. Skin infections caused by *Dermatophilus congolensis* have been reported in natural (Gitao, 1992; Gitao *et al*. 1998 a,b) and experimental infection in camels (Abu Samra *et al*., 1976).

History

Twelve Omani camel calves, below one year of age were brought to Sultan Qaboos University from the south of Oman (Dhofar). They were kept in one enclosure for quarantine purposes. Initially, the camels did not show any ill-health signs. Two weeks later, two animals showed small, round areas of alopecia on different parts of the body, involving the flank, chest, neck and upper fore and hind limbs. The lesions were characterized by grey-whitish circumscribed areas ranging in size from few millimeters to several centimeters (Figure 1). Thick crusts were observed, which came away with a tuft of hair that left a depressed area on the skin. The animals suffered from intense pruritus causing them to rub their bodies against the poles in the enclosure. Within a few days the infection spread rapidly to the rest of the herd. The lesions in all animals tended to develop on the hind limbs, abdomen, neck and less frequently on the head. Infected areas with long hair cover, especially on the rump and flanks showed extensive hair matting. The lesions on the neck developed into areas of alopecia and hair loss where thick whitish dry scabs were formed. The regional lymph nodes were enlarged in most cases. Morbidity rate was 100% but no mortality occurred among the affected calves.

Diagnosis

Diagnosis was based on clinical signs, as well as from smears made from scabs. Fresh skin crusts were cut on glass microscope slide with scalpel blade and emulsified with a drop of distilled water. The smear was allowed to dry, fixed by gentle heat and stained with Giemsa stain. The slide was then examined under an oil-emersion lens.

Discussion

Information from local field veterinarians indicated the prevalence of this skin condition in the southern region of Oman, especially, during the rainy and post rainy season. It spreads widely within herds and is extremely pruritic resulting in the camels rubbing their bodies against hard objects. Feed intake decreases and secondary infections of open skin lesions occur.

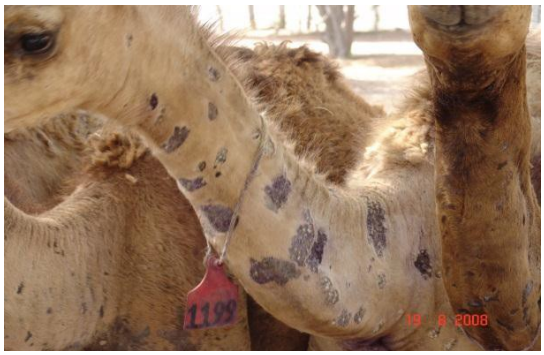

Figure 1: Lesions tended to develop on the neck, hind limbs, abdomen, and less frequently on the head, characterized by alopecia, crust formation and hair matting.

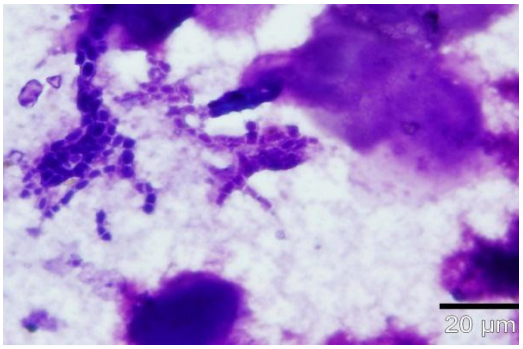

Figure 2: A micrograph showing branching filaments and zoospores of *Dermatophilus congolensis* derived from camel skin scrapings (Giemsa stain)

In the present report, on the basis of the characteristic crusting of the lesions, the appearance of branching filaments composed of coccal zoospores observed in parallel lines (Figure 2), and seasonal predilection, a diagnosis of dermatophilosis was made caused by *Dermatophilus congolensis.* Thesymptoms and lesions were similar to those reported by Gitao *et al*., 1998. *Dermatophilus congolensis,* as well as *Microsporum gypseum* infections have been reported separately in camels, as well as mixed infections involving both agents (Gitao *et al*., 1998a). The characteristic staining and morphology of *Dermatophilus congolensis* is generally considered evidence of a diagnosis (Quinn *et al*. 2004). The spread of dermatophilosis in cattle has been associated with *Amblyomma variegatum* ticks. Although this observation has not been extended to camels, the tick has been found in Omani camels (Dr. Akin Bobade, personal communication). Other external parasites such as Tabanidae have also been suspected to transmit dermatophylosis in camels (Gitao *et al*., 1998b).

Upon arrival, camels were injected with Ivermectin (WE NEED TO GIVE THE ACTUAL DOSE===HOW MANY MG WERE IN EACH ML). The entire camel was sprayed with 1/1000 Gematox concentrated solution using a pump derived jet, three times with a 12 day interval. Skin lesions were sprayed daily with oxytetracycline+gentin violet spray. Suspected fungal infected areas were weekly sprayed with Dichorphen (7%) two times a week. The camels were also given an long acting penicillin comprised of -(MUST GIVE THE ACTUAL AMOUNT=HOW MUCH WAS IN ONE ML) of Benzathin penicillin B.P., 112.5 mg Procain penicillin B.P. 150 mg, every two days for 5 days. This protocol appeared to be effective, as the infection cleared within few weeks. Field veterinarians may benefit from the current work to draw a protocol for controlling this common skin condition in Oman.

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33. Use of Polymerase Chain Reaction (PCR) for Identifying Sensitive and Resistant Isolates of *Trypanosoma evansi* from Selected Sites of Sudan

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Introduction

Trypanosomiasis is one of the major diseases affecting camels, caused mainly by *Trypanosoma evansi* and transmitted mechanically primarily by *Tabanus species* and other biting flies. The disease generally takes a chronic form where huge production losses occur due to lowered milk and meat production in adults, abortion, and mortalities in young camel calves (Schwartz and Dioli, 1992).

Drug resistance emerged as one of the major obstacles for the control of trypanosomiasis. It can be defined as the ability of a trypanosome strain to survive, despite the administration of a trypanocide given in doses equal to or higher than those usually recommended. Therefore, this study is planned to:

1. Determine the extent of drug resistance of some Sudanese isolates of *Trypanosoma evansi* from Butana, Gadarif and Kordofan State against Quinapyramine sulphate and Cymelarsan drugs using an in-vivo method.
2. Study the DNA profile of some isolates to demonstrate possible differences between resistant and sensitive isolates.

Materials and Methods

The study was conducted in three Districts namely Butana, Gadarif and Southern Kordofan. These areas are regarded as the most important sites for camel rearing in pastoral production system in Sudan

Experimental design

Each isolates of *T. evansi* was tested for drug resistance against Quinapyramine and Cymelarsan. For that purpose albino mice were used as described by Eisler (2001).

1- Control group: Positive control: Each isolate of *T.evansi* from each district was inoculated intraperitoneal in 6 albino mice and observed for two months without drug administration.

2- Experimental group: Each isolate of *T.evansi* from each district was inoculated intraperitoneally in 6 albino mice and then tested for drug resistance against Quinapyramine and Cymelarsan; the drugs were given S/C. The mice were monitored over two months. A trypanosome isolate was considered as drug-sensitive if at least 5 out of the 6 treated mice were cured. If fewer than 5 mice were cured, the isolate was considered resistant to the dosage used (Eisler, 2001).

Polmerase Chain Reaction (PCR)

The DNA (5 µl) was added to 17.5 µl mixture, 2 µl primers and 0.5 µl polymerase (Taq). Then the mixture was centrifuged for 1 minute. Then the PCR was running for 2 hours at 56 ºC. PCR containing amplified products were loaded onto gels of Seakem agarose and electrophoresed gels were stained with ethidium bromide and *T. evansi* primary PCR products were easily identified following visualization under UV light.

Results and Discussion

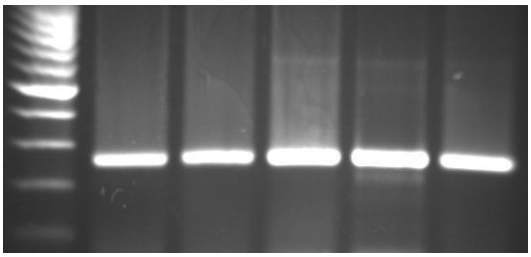
The results of all states showed that out of 36 mice tested (18 in tested group and 18 in control group) only 6 mice were cured with Quinapyramine sulphate. Out of 36 mice tested (18 tested group and 18 control group) 16 mice were cured and only two mice were not cured with Cymelarsan (Table 1).

Table 1: Testing *Trypanosoma evansi* in mice for drug resistance in Butana, Gadarif and Southern Kordofan state

Drug	Isolates tested	control group	tested group	mice cured	Interpretation
Quinapyramine sulphate	13	18	18	6 33.33%	Drug-resistance
Cymelarsan	13	18	18	16 88.89%	Drug-sensitive

Polymerase Chain Reaction (PCR) was used on 13 isolates of *T. evansi* from Butana, Gadarif and Southern Kordofan state and the result showed that PCR was very sensitive in detecting differences in Butana and Gadarif state. All isolates of *T.evansi* were similar. In Butana and Gadarif states, 9 of isolates *T.evansi* were resistant to Quinapyramine sulphate and 7 isolates were sensitive to Cymelarsan. One isolate out of 4 isolates tested by PCR in Southern Kordofan state was different (the isolate was sensitive to both Quinapyramine sulphate and Cymelarsan (Figure 1,).

Figure 1: *Trypanosoma evansi* from Butana state



Many techniques have been developed for the detection of *T. evansi* infection including microscopy, card agglutination test (CATT), microhematocrit centrifugation technique (MHCT), enzyme-linked immunosorbent assay (ELIZA), DNA hybridization and polymarse chain reaction. A study by Wasana *et al*. (2000) had shown that PCR-based assay is one of the most powerful tools for the detection of *T. evansi* in several animals and vectors. It will be therefore beneficial for epidemiological studies of this parasite and for the control program. In Sudan, Ardaib and Majid (2006) indicated that nested polymarse chain reaction (nPCR)-based assay, using well characterized *T. evansi* primers, provides a simple, rapid, sensitive and specific detection in naturally infected camels (*Camelus dromedaries*) and can be used as a valuable tool during epidemiological surveys and control program.

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34. Studies on Pathological Changes of Contagious Skin Necrosis (CSN) in Camels (*Camelus dromedarius*) in Hail Region, Kingdom of Saudi Arabia

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Introduction

The dromedary camel (*Camelus dromedarius*) is one of the most valuable domestic animals in arid regions such as Saudi Arabia. The population of camels in Hail region is about 160,000 heads (Agri-report, 2010). CSN in camels was first described by Cross (1917). The disease is sporadic and mainly affects camels under nomadic husbandry (Leese, 1927; Yagoub, 1996; Yagoub and Mohammed, 1996; Yagoub and Mohammed, 2001).The prompt detection and effective management of skin diseases in camels rely greatly on field diagnosis. The cornerstones of the diagnosis are pathological examination; gross examination and necropsy with supporting laboratory investigations. The objective of this study was to study the gross pathological changes associated with CSN.

Materials and Methods

This study was conducted in Hail area at Northern Saudi Arabia. A field survey included 11,000 camels of both sexes from 220 herds with ages range 6-month to 8-year during one year period (2009-2010). Infected camels with CSN were carefully examined and the site and type of lesions were recorded. Description, phase of lesions development and distribution of lesions on camel body were recorded.

Results and Discussion

The control camels were healthy with no skin lesions detected. The total number of infected camels with CSN was 1080 camels, which represented 9.6% of total number in the 220 herds. The present study showed that the disease was highly contagious, which is in accordance with findings of Higgins (1986) and Yagoub, (1996). There were no changes in the body temperature and the respiratory rate of diseased camels. However, lymph nodes were seen to enlarge in some camels, which is in agreement with findings of Cross (1917) and Leese (1927). Hot, painful swellings, which suppurated and sloughed off leaving necrotic areas and defined characteristic lines of demarcation of necrosis, loss of color, loss of strength and zone of demarcation between necrotic and viable tissue were detected (Figure 1). These findings were more or less similar to that described by Cross (1917), Leese (1927), Higgins, (1986) and Yagoub (1996). Lesions were situated in center of gluteal region, inguinal, perineal, shoulder, neck, flanks, limbs, thoracic area and abdominal area.

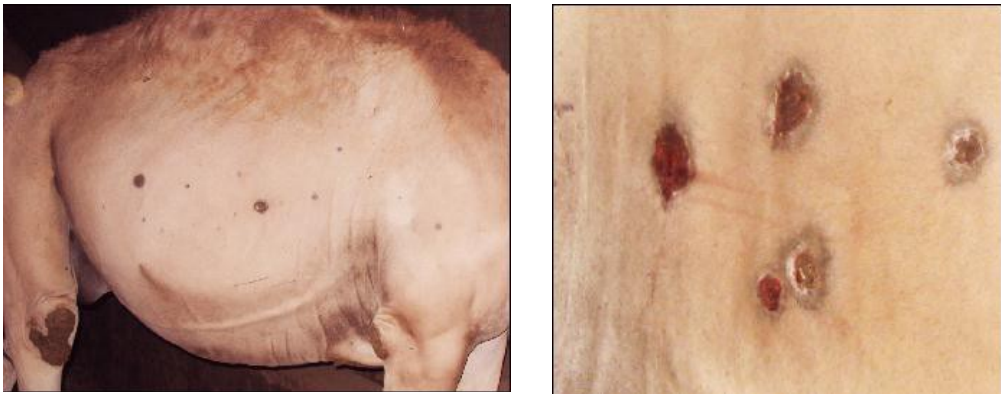

Figure 1: Gross pathology of lesions of CSN in the flank region of camels

The anatomical locations of the lesion found in this investigation (Figure 2) were similar to that observed by Edelesten and Pegram (1974) and Domenech *et al* (1977). Other sites including the root of neck and tail, head and median aspect of the thigh were affected. This observation was in

agreement with findings of Yagoub (1996), Yagoub and Mohammed (1996), Yagoub and Mohammed (2001).

The current study was the first to confirm the presence of CSN in Hail Region, Kingdom of Saudi Arabia.

Figure 2: Gross pathology lesions of CSN in the limbs of camels

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