Reproduction

26. Incidence of Early Pregnancy Loss in Dromedary Camels (*Camelus dromedarius*)

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Introduction

An early pregnancy loss is probably one of the most important factors resulting in the reduction of reproductive efficiency in camels. At present, there is no practical way to reduce embryonic loss in camels, however, recognizing the occurrence and incidence of embryonic loss may be instrumental in application of new reproductive technologies to increase service rate in a herd. Transrectal ultrasonography has been used to diagnose and monitor early pregnancy in dromedary camels (Skidmore, 2000; Vyas *et al*., 2002). The present study was aimed to record the incidence of early pregnancy loss in dromedary camels (*Camelus dromedarius*) by ultrasonography.

Materials and Methods

This study was conducted during the breeding season on dromedary camels aged between 5 to 24 years belonging to the herd of Royal Camel Corps, Royal Court Affairs, Muscat, Sultanate of Oman. These animals were fed fresh green fodder, dates with free access to mineralized salt lick blocks and water. The follicular development was monitored by periodic scanning (2-3 times in a week) using ultrasonographic equipment (LOGIQ P5, GE Health Care, Wauwatosa, WI, U.S.A) equipped with 5 to 10 MHZ linear transducer (I739; GE Health Care). The animals with mature follicle (13 to 18 mm in diameter) were bred by natural mating and pregnancy diagnosis was conducted by ultrasonography on 20 to 25 days following breeding. The animals were restrained in a suitably designed crate, in standing position, for scanning the uterine horns and ovaries. The transducer probe was positioned dorsal to genital tract and advanced cranially. The dorsal and lateral surface of each uterine horn was scanned for signs of pregnancy. Pregnancy was confirmed in 35 heifers (Group I) and 65 multiparous camels (Group II) by the presence of fluid of varying amounts (embryonic vesicle) and visualization of an echogenic mass (embryo) in the lumen of the uterine horn, plus the presence of a corpus luteum (CL).The presence of twins was recorded through the observation of embryonic vesicle and embryo in each uterine horn, along with either two CLs on the same ovary or one each on both ovaries. Furthermore, pregnancy in these animals was monitored at weekly intervals up to 90 days of gestation. The pregnancy loss prior to day 50 was considered as an embryonic loss and after day 50 as an early fetal loss. Embryo/fetal death was declared based on two subsequent examinations where the conceptus remained unchanged, or there was a decrease in size of or an absence of the conceptus as compared to the previous evaluation. Data were analyzed statistically with Chi-Square and Fisher Exact test using SPSS 15.0 software (SPSS Inc, Chicago, IL, USA)

Results and Discussion

The present study demonstrated the use of ultrasonography to monitor the timing and extent of early pregnancy loss in dromedary camels. Embryonic death in camelidae may be attributed to genetic factors, corpus luteum insufficiency or hostile uterine environment, however, no single factor can be manipulated to improve embryo viability. Early pregnancy loss between day 20 to 90, post breeding in group I (5.7%) was non-significantly lower than group II (16.9%). The pregnancy loss during embryonic stage and early fetal stage was 10.8 % (7/65) and 6.9% (4/58) in group II whereas in group I no early fetal loss had occurred. In a clinical survey study, high rate of embryonic death up to 35% was reported in dromedary camels (Tibary and Anouassi, 1997). The incidence of twin pregnancies was higher ($P<0.01$) in group II (13/65; 20 %) than in group I (1/35; 2.8 %). In the present study in multiparous dromedary camels the incidence of twin pregnancies was much higher than that reported in cows (8.9%; John *et al*., 1995). These findings suggest that the incidence of double ovulation leading to twin pregnancies was affected by parity in camels. Similarly, Lopez-Gatius *et al*., (2005) reported the incidence of double ovulation in cattle to be 5-10 % (1st parity), 10-15%(2nd parity) and 20-25%(3^{rd} parity). The right horn pregnancy was lost within 45 to 60 days post breeding in all the twin pregnancies, while the left horn pregnancy continued in 10 of 13 animals. In

conclusion, the present study demonstrated the use of ultrasonography as a diagnostic tool in detecting early pregnancy loss in camels and aid in early rebreeding of non-pregnant camels to improve reproductive efficiency.

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27. Characteristics of Ovarian Follicular Dynamics in Dromedary Camels (*Camelus dromedarius*) During Breeding and Non-Breeding Season

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Introduction

Camels are said to be seasonal breeders and their reproductive efficiency under natural conditions is generally considered to be low. A sound knowledge on ovarian follicular dynamics and its regulation is the key element to adopt modern reproductive technologies for improving fertility in camels. The pattern of ovarian follicular development has been documented in several domesticated and wild ruminant species (Adams, 1999). Ovarian follicular wave pattern in dromedary camels has been reported during the breeding season (Skidmore *et al*., 1995). The extent to which the season affects follicular development in camels is not reported in dromedary camels. Hence this study was carried out to evaluate the characteristics of ovarian follicular dynamics in dromedary camels (*Camelus dromedarius*) during breeding and non-breeding seasons.

Materials and Methods

This study was carried out in adult dromedary camels (n=7) aged between 12 to 20 years during breeding (January to March) and non-breeding (June to August) seasons. These animals were kept in pens isolated from males and fed fresh green fodder with free access to mineralized salt lick blocks and water. Ovarian follicular dynamics was monitored daily by ultrasonographic equipment (LOGIQ P5, GE Health Care, Wauwatosa, WI, U.S.A) equipped with 5 to 10 MHZ linear transducer (I739; GE Health Care) for a period of 50-60 days during both the seasons. At each examination the size and position of all follicles ≥4 mm in diameter were recorded and sketched on the ovarian charts to analyze the pattern of growth and regression. A follicle wave was characterized by the emergence and synchronous growth of a cohort of follicles (3 to 4 mm in diameter), one of which continues growing while the others regress at variable intervals. The day of follicle wave emergence was defined as day 0. A dominant follicle (DF) is one that continues to develop when the growth and development of other follicles is inhibited. Growth phase of DF was defined as a period from the growth of the DF from 4 mm to an ovulatory size of 11mm and mature phase (dominance) was from the last day of growth phase of DF to the day when DF appears to lose its dominance and allows the emergence of the next wave. An interwave interval (IWI) was defined as the interval from the emergence of one wave to the emergence of the subsequent wave. The characteristics of follicular waves were analyzed by descriptive statistics and regression analysis was used to calculate the growth rate of DF. Student‘s t test was used to the find significance between the seasons. All statistical analysis was carried out using SPSS 15.0 software (SPSS Inc, Chicago, IL, USA).

Results and Discussion

Fourteen interwave intervals (2 interwave intervals per animal per season) during each season were analyzed. It was found that each wave in an individual animal is characterized by the appearance of a group of follicles (≥3 to 4 mm) that emerge together and continued a common growth phase up to 6 -7 mm in diameter. Usually one of these follicles (future DF) continued to grow, while other follicles cease growth and regress. In majority of waves, the DF continues its growth without a static phase during its dominance and even after losing its dominance resulting in the development of oversized follicles (Large follicles), that remain static for some time and then regress without interfering with the normal ovarian follicular development. The characteristics of the follicular wave during breeding and non-breeding seasons are presented in Table 1.The number of follicles recruited into a wave did not differ between the seasons. The DF in dromedary camels acquired ovulatory capacity when it reached a diameter of 10 mm, and the response to induced ovulation increased significantly as the DF reached a diameter of 11 mm (Unpublished data; mature DF). There was no effect of season on growth rate of the DF from 4 mm to an ovulatory size of 11 mm. The effect of season or heat stress on size of dominant follicles is inconsistent in bovines. Badinga *et al*., (1994) found that the season affects the ovarian follicular development and dominance in cows. Other studies

determined that neither heat stress (Trout *et al*., 1998) nor season (Wolfenson *et al*., 1997) influenced size of dominant follicles. Inconsistent effects of heat stress on follicle growth could be due to differences in duration of exposure, maximal ambient temperatures, or nutrient intake. However, in the present study, the seasons affect the growth rate and maximum diameter of mature dominant follicle, but not the dominance period and the interwave interval. In conclusion, the season affects the growth of DF during its dominance period. However, the other characteristics of a follicular wave were not affected by season.

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Table 1: Effect of season on the characteristics (mean ± SEM) of follicular wave in dromedary camels.

Characteristics	Breeding Season	Non-breeding Season	P value
Follicles recruited per wave	14.2±1.7 (9 to 30)	14.0±1.7 (8 to 31)	1.000
Growth rate (mm/day) of dominant follicle in growth phase	1.16±0.03	1.06±0.02	0.874
Duration of growth phase (days)	6.29±0.19	6.50±0.17	0.418
Growth rate (mm/day) of dominant follicle in mature phase	1.56±0.105[a]	1.1±0.04[b]	0.006
Duration of mature phase (days)	10.36±0.65	9.21±0.99	0.346
Maximum size of dominant follicle (mm)	27.42±0.99[a]	22.5±1.69[b]	0.018
Interwave interval (days)	16.6±0.68	15.9±1.0	0.560

Values in the same row with different superscripts differ.

28. Evaluation of an Extraction Method for Progesterone Determination in Dromedary Feces by Radioimmunoassay

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Introduction

Non-invasive methods for the measurement of steroids and their metabolites were established in the late 1970s of birds and in the early 1980s for some mammalian species (Palme, 2005). These methods are widely used to investigate the evolution of hormone concentrations and/or its metabolites in relation with reproduction, behavior, animal welfare, and ecology. As a non-invasive process, it presents several advantages: permits the monitoring of reproductive physiology under diverse conditions, and samples are easily collected, transported, and stored.

Based on the fact that metabolism and excretion of steroids differs significantly among species (Hay *et al*., 2000; Chelini *et al*., 2005; Mostl *et al*., 2005), non invasive techniques must rigorously be validated for each species, before application. Validation could interest nature of sample (urine, saliva, milk and feces), extraction procedure and determination method of hormones such as (RIA, ELISA).

The objective of the study was to develop a simple fecal progesterone metabolites extraction method for RIA measurement in dromedary (*Camelus dromedarius*). Extraction method was analytical and physiological validated and correlation with blood values was established during the reproduction season in camel.

Materials and Methods

This study was conducted during December-January period. In first step, 6 pregnant camels (10.2 ± 2.2 years old, 473 ± 48 kg body weight, 57 ± 10 days in gestation) were used. Blood and fecal samples were collected from each camel. Serum and fecal samples, were stored at -20ºC until analysis were used in analytical validation (intra- and inter-assay variation, recovery of added quantities, and parallelism). In second step, 4 no pregnant milking camels (11.2 ± 1.3 years old, 477 ± 15 kg body weight, 275 ± 18 days in milk) were used. They were i.v. injected with 5 ml of Receptal® (25 µg de Busereline; GnRH analogue). Blood and feces samples were daily obtained during 15 days post injection and were stored at -20ºC until physiological validation.

Before extraction, the stored samples were well mixed to avoid steroid variations among individual fecal pellets. Feces (0.25 g) were weighed in glass tubes, distilled water (0.5 ml) and methanol (2.0 ml) were added and mixed for 30 min. Petroleum ether (1.5 ml) was added and futher mixed. The tubes were centrifuged and 1 ml of methanol phase was then transferred to glass tubes and stored at -20ºC for RIA assay. Serial dilution serial of fecal extracts were prepared in phosphate buffer (0.01M; pH 7.4; 0.01% BSA) and assayed. Serum and fecal levels of progesterone were performed by solid phase RIA (Immunotech, France). Data were presented as mean ± S.E.M.

Results and Discussion

RIA test for progesterone had an average maximum binding (B0/T) of 42.2%. The average of nonspecific binding (NSB) of the reagents was 1.9%. The concentration of progesterone corresponding to 20, 50 and 80% B/B0 were 0.2, 1.3 and 7.3 ng/ml, respectively. In pregnant as well as in non pregnant camels, B/B0 of non diluted samples varied between 7.0 and 10.0% giving progesterone metabolites concentration between 19.0 and 28.0 ng/ml. So, 1:120 final dilution of fecal extracts was necessary with B/B0 values ranging between 41 and 60%.

The progesterone concentration in 3 samples (high, medium and low) of plasma and feces are shown in table 1. Intra and inter-assay variations are two indicators of precision in RIA tests. In the conditions of this study, they were in the range of 13-80 and 2-71% in plasma and 10-17 and 7-45% in feces, respectively.

Table 1. Mean, intra and inter-assay variations in high, medium and low concentrations of progesterone in plasma and feces.

	Plasma (ng/ml)			Feces (ng/g dry matter)		
Concentration	Mean	Intra CV	Inter CV	Mean	Intra CV	Inter CV
High	7.8	13.2	2.3	1068	13.7	45.7
Medium	1.7	17.7	25.3	144	17.2	7.3
Low	0.2	80.8	71.3	84	10.7	18.3

Recovery of added quantities of progesterone in feces ranged between 65.2 and 138.2%. A significant correlation between expected and detected values was observed ($r = 0.71$; $P<0.035$). Garrott *et al*. (1998) published a comparable recovery value in red deer species.

Progesterone determination in serial dilution (3:4, 1:2, 1:4, 1:8) of rich (6.88 ng/ml) fecal extract was performed in triplicate and yielded a displacement curve parallel to the standard curve.

Three of four camels were ovulated. Progesterone concentration remains low for 6 days post treated injection. Ovulation is proved by progesterone concentration higher than 0.8 ng/ml in blood and 150.0 ng/g dry matter of feces in the 7^{th} and 9^{th} days post injection, respectively. Progesterone concentration reaches peak on the 10^{th} (5.3 ng/ml) and 12^{th} (537.3 ng/g dry matter) days after injection. Decline of progesterone concentration started 12 and 14^{th} days post injection in blood and feces, respectively. Concentrations of progesterone in serum and its metabolites in feces are correlated ($r = 0.64$; $P<0.009$). These results indicated that measurement of progesterone level in feces can be used for the study of corpus luteum activity in camels. Nevertheless, 1 day lag time between the secretion of progesterone in blood and its appearance in feces after its metabolism in bile was proven ($r = 0.90$; $P<0.0001$).

Modification of the profile of plasma progesterone was reflected by alterations of fecal progesterone concentration occurring during the discrimination of progesterone profiles in feces excreted by ovulated and non-ovulated camels.

In conclusion, determination of progesterone concentration in camel feces by RIA method using methanol and petroleum ether extraction is a useful tool to assess corpus luteum activity in mated dams.

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29. Fetal Age Estimation in Dromedarian Camel Using Developmental Horizons

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Introduction

Until the advent of motorized transport and the development of certain nomadic economies, the camel remained almost the only beast of burden and personal transport animal in the areas, where it was adapted (Wilson, 1984 and Wilson, 1998). The role of the camel in the modern world is changing. The teaming increase in population, coupled with poor economic potentials of some countries completely transformed the traditional uses of camel to serve as the source of meat and milk (Mukasa-Mugerwa, 1981; Khanna, 1990). In East Africa, (Kenya, Ethiopia, Sudan, and Somalia), the camel is bred for slaughter (Mukasa-Mugerwa, 1981). In the Northern part of Nigeria, where camels are found, they are used as traction animals; with cattle being the most predominant (Tukur and Maigandi, 1999).

In Sokoto and Maiduguri camel meat was found to rank second to cattle beef (Mustapha and Oluyisi, 1993; Abubakar and Maigandi, 1994 and Agaie *et al*, 1997). Despite the economic value of this animal species, many of pregnant animals are wasted. This paper was therefore aimed at examining the level of development of the wasted fetuses at Sokoto Central Abattoir.

Materials and Methods

The camel fetuses were collected daily from the Sokoto Central Abattoir. The fetuses collected were then transported to the department of veterinary anatomy laboratory of Usmanu Danfodiyo University, Sokoto, for the analysis.

The weight and CVRL of each fetus was taken using metler balance and a tape rule. The formula GA= (CVRL+23.99)/0.366 (Elwishy *et al*, 1981) was used to obtain the fetal age in days. Thereafter the developmental horizons were observed.

Results

Sixty seven (67) camel fetuses were obtained, forty six (46) were females while the males were twenty one (21). More than half (38) constituting 56.7% were within the second trimester. First trimester had 29.9% (20) and the third trimester had 13.4% (9) respectively. The mean CVRL varied from 37.44±7.10cm of first trimester fetuses to 109.13±10.21cm of the third trimester fetuses while the mean weights were 1105.36±73.21g and 23,335.15±6912.20g at first and third trimesters respectively (Table 1)

Fetuses classified within the first trimester were with camelid features. The abdomen appeared transparent with some organs appearing dark, the eye buds, ear buds and jugular veins were prominent. In the female, the mammary buds and vulva were present. While the male had scrotal sac developed but no palpable structures. The calvaria were very soft and transparent (Plate 1).

As shown on plate 2, the second trimester fetuses have eyes and ears well developed. Hairs appear on the lower eyelid and ear margins. The lips (upper and lower) also have hair. The calvarium was soft but very soft at the fontanales (cranial and caudal). Mammary buds and vulva were more prominent at this stage. The jugular vein was only prominent at the early stages of the second trimester. The scrotal sacs became more prominent with structures being palpable.

The fetuses of third trimester have their whole body covered with short hair initially except at the inner thigh. The hair continues to grow as the fetus advanced in age. The skull at this level was thick and tough (Plate 3).

Table 1: Mean CVRL and Weight distribution per trimester ± SEM.

Trimester	CVRL(cm)	Weight(g)
First	37.44±7.10	1105.36 ±73.21
Second	71.81±3.81	10,623.50±1502.31

Third	109.13±10.21	23,335.15±6912.20

Discussion

It was observed in general that there was an increase in body weight across the trimesters in the fetuses with advancement in pregnancy. This is in agreement with observations of Anderson *et al* (1987) that there were obvious body weight changes in MDX mice which seem to increase with age.

The observation presented in this study on fetal age, has not been found anywhere for this species (camel). However, there are evidences of ageing camel fetuses using ultrasound and Enzyme Linked Immunosorbent Assay – ELISA (Skidmore, 2000; Mahamat *et al*, 1997). Contrary to the findings of Dennler de la Tour,(1971) that during prenatal development the fetus actually has two humps, the fetuses observed in this study were single humped even at the earliest stage. In agreement with the observations of Sivachelvan *et al* (1995), the calvarium was soft during the first and second trimester stages with clear evidence of fontanels which disappeared before birth.

In conclusion, the information obtained in this study will go a long way to assist researchers to bridge the existing gaps of the identified structures on the fetuses.

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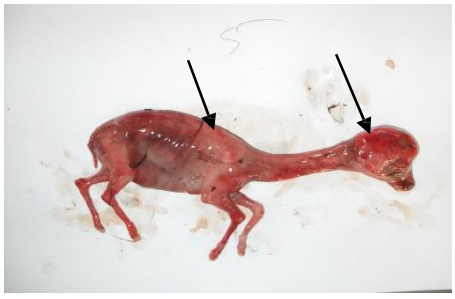

Fig. 1: Camel Fetus at First Trimester with transparent abdominal muscle and dark abdominal content (blue arrow) x 125

Fig.2: Camel Fetus at 2nd Trimester with hair on the upper eyelid(black arrow) and external jugular vein(white arrow) x 125

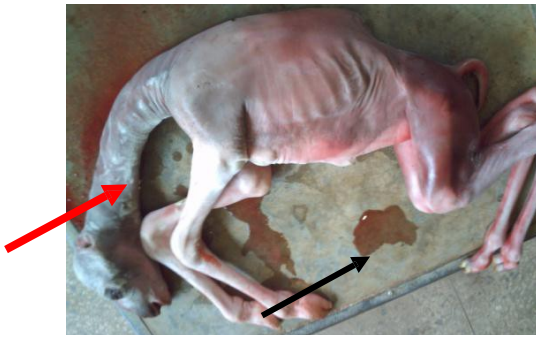

Fig.3: photograph of camel fetus showing short hair all over the body at early 3rd Trimester except the medial thigh (arrow) x125.

30. Polymelia in a Third Trimester Camel Fetus: A Case Report

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Introduction

Congenital anomalies involving different animal species and structures have been reported in Sokoto (Sonfada *et al*, 2007; 2009; Umar *et al*, 2005). Conditions of the limbs were found to be 20.83% (which comprises 12.5% arthrogryposis and 8.33% rickets). Causes of these defects range from genetic to environment, however the majority of the malformations are said to be multi-factorial in aetiology (Sadler, 1990). Frequency of individual congenital defect varies with such factors as species, breed, geographical area, parental age, nutritional level and environmental factors (Sonfada *et al* 2010). This paper is aimed at reporting a case of congenital anomaly encountered at Sokoto Central Abattoir.

Case Report

Following a daily visit to Sokoto Central Abattoir for a survey of fetal waste, a six legged camel female fetus was encountered on the 25th June 2011. The fetus was taken to Veterinary Anatomy Laboratory, Usmanu Danfodiyo University, Sokoto. Where the CVRL was taken using tape rule (butterfly ^{R}) and the weight of the fetus was equally taken using a beam balance. The fetal age was determined by GA = CVRL + 23.99/0.366 (Elwishy *et al* 1981). Thereafter dissection of the fetus was carried out according to method described by Chibuzo(2006).

Results

The fetus had a CVRL of 85cm with a weight of 12kg indicative of third trimester fetus. Grossly the fetus was observed to have a full camelid features with extra two limbs that possess complete segments of a hind limb at the lateral abdominal wall. The fetus also had a prominent anus, vulva and four mammary teat. There was a ventral abdominal hernia (Plate 1-2). The pes and manus of the hind and fore limbs were respectively in permanent dorsal flexion position. Radiographic examination revealed true bony segments of the extra limbs (Plate 3). Though the bones of the pelvic girdle (os coxae) of the extra limbs were developed but not fused, they were separated by skin fold (Plate 4-5) While the normal limbs had muscles surrounding the bones of the thigh and leg, the extra limbs were covered by connective tissues and skin, in permanent flexion position and devoid of patella (Plate 5-6). The normal limbs were bigger and longer than the extra limbs (Table 1 & 2) however the difference was not statistically significant (P>0.05).

The abdominal viscera was found to adhere to the abdominal walls (Plate 7), there was also an incomplete development of the diaphragm at the right side. The thoracic and abdominal cavities were only separated by the pleural membrane on the right side while the left side had the diaphragm partitioning the cavities (Plate 8-9). The right kidney, ovary and urinary bladder were all absent (Plate 10). There was scoliosis of the thoracic vertebrae (Plate 11).

Table 1: Length of normal and extra hind limb segments(cm).

	Right Normal	Right Extra	Left Normal	Left Extra
Femur	16.5	14.5	16	13.5
Tibia	17.5	15.5	17.5	15
Pes	24.5	19	21.5	17.5

P>0.05

Table 2: Circumference of normal and extra hind limb long bones(cm)

	Right Normal	Right Extra	Left Normal	Left Extra
Femur	5.67	3.77	6.13	3.67
Tibia	6.73	5.00	7.27	5.00
Metatarsal	6.73	4.80	6.50	5.00

P>0.05

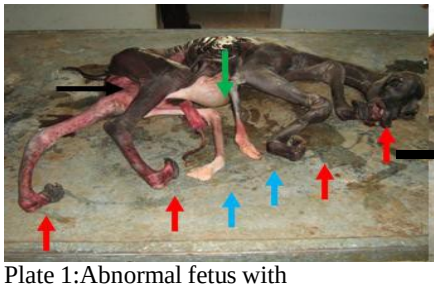

Plate 1:Abnormal fetus with abdominal hernia(green arrow), extra limbs(blue arrows), normal limbs with permanent dorsal digit flexion (red arrows)

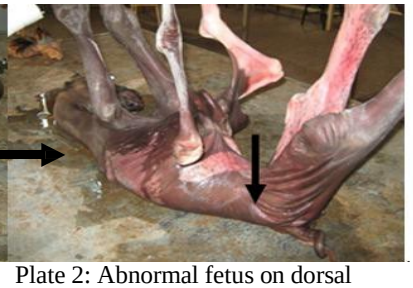

Plate 2: Abnormal fetus on dorsal recumbency with herniated contents returning to the abdomen (arrow)

Plate 3: Radiograph of abnormal fetus with all the limbs illustrating the osseous structure

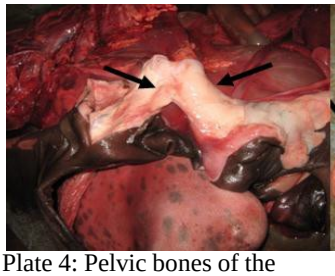

Plate 4: Pelvic bones of the extra limbs (arrows)

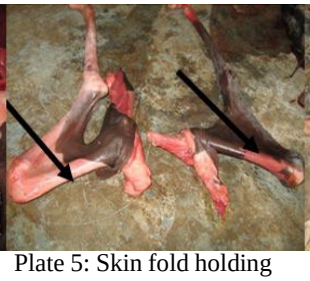

Plate 5: Skin fold holding the thigh and leg of extra limbs in permanent flexion(arrows).

Plate 6: Skin fold holding the thigh and leg of extra limbs in permanent flexion (arrows)

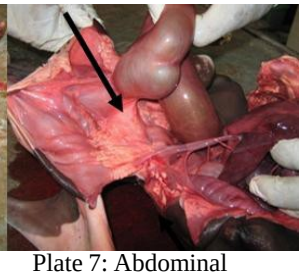

Plate 7: Abdominal viscera adhered to lateral abdominal wall (arrows)

Plate 8: Pleural membrane separating thoracic and abdominal cavities on the left side(arrow)

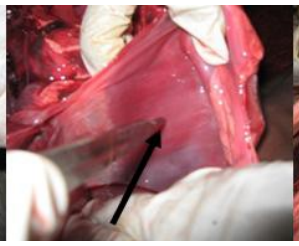

Plate 9: Developed Right side diaphragm.

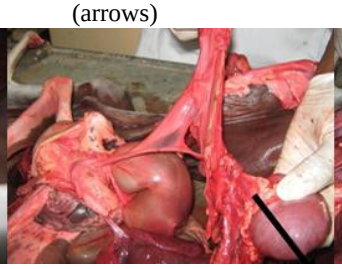

Plate 10:Single Left Kidney

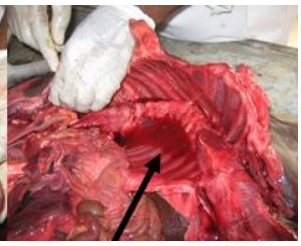

Plate 11: Scoliosis of the thoracicvertebrae(arrow)

Discussion

Polymelia is for the first time encountered in the camel species despite many of congenital anomalies reported from the study area in this species(Garba, 1993; Sonfada *et al*, 2009; 2010). In general, anomalous of any kind stimulate curiosity, the presence of extra legs in this case differs from the observations of Ibrahim *et al*, (2006), Bahador *et al*, (2007) and Buhari *et al*, (2008) in location and in addition to the extra legs, ventral abdominal hernia was classically observed. Other malformations like the absence of right kidney, right ovary and cranial portion of the right uterine horn were similar to the findings of Ibrahim *et al*, (2006).

Despite the interest and curiosity associated with the congenital malformations, information on the exact causes is always minimal and restricted to genetic, environment or combination of the two. As common to most malformations, the aetiology of polymelia could be multi-factorial, however dispersing of germinal cells or prior splitting of the embryo has to be considered as possible causes (Ibrahim *et al*, 2006). Poisonous plants have been incriminated in some reported cases of malformations from the study area (Sonfada *et al*, 2007), such plants like *Veratrum californicum*, locoweed, wild and cultivated tobacco etc, have been attributed to musculoskeletal defects including twisted and deformed limbs, abnormal development of the bones and joint(Knight and Walter, 2004). Musculoskeletal defects as seen in this case could also be linked to the teratogenic factors, it has been established that ingestion of teratogenic plants like *Veratrum californicum* by pregnant cows between days 30 and 36 of gestation resulted in selective inhibition of growth in the length of the metacarpal and metatarsal bones (Keeler, 1972; Jubb *et al* 1985). Environmental factors are said to be responsible for many congenital defects, level of nutrition, excess or shortage of nutrients and extremes in temperature during pregnancy (Schalles *et al*, 2006) among others are such factors. Low rainfall, large

livestock population and high density of farming population could lead to overgrazing and nutrient deficiency which may eventually result to some common anomalies encountered in various livestock species in the study area (Sonfada *et al*, 2007).

Polymelia, if not complicated with any other defect could be managed clinically (Bahador *et al*, 2007) but can decrease maternal productivity and may also result into problems like dystocia. Camels are prone to hazards of teratogenic plants because the keepers are only operating traditional system of management without any other source of feed than whatever the animal is able to browse during grazing. It is therefore recommended that extensive enlightenment be given to the camel owners and supplementary feed be introduced to the species as done to other species. Above all, adequate clinical attention and documentation of the existing camel problems be given priority.

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31. Some Observations on Breeding and Reproductive Behaviour of *Camelus dromedarius*

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Introduction

The camel is probably one of the most useful farm animals of the desert serving mankind for a long time in the most harsh environment. The camel has been inadequately addressed in the field of research and development in Pakistan. However, a few postgraduate studies including two doctoral level theses have recently been completed. One of the Ph.D thesis pertained to breeding and reproductive behaviour of camels (Iqbal, 1999).

Materials and Methods

Fifteen males and eight she-camels kept at the Barani Livestock Production Research Institute (BLPRI), Kherimurat, District Attock were used for this study. The visual observations were recorded on various aspects of breeding and reproductive behaviour of camel.

Results and Discussion

The duration of Flehmen‘s response in 16 males duration averaged about 5.18 ± 1.62 seconds. The average frequency of the appearance of palatal flap was 2 ± 0.29, while the frequency of teeth grinding accompanied by frothing by all males was 2.5 ± 0.27. These may be regarded as overtures preparatory to courtship.

The male approached the respective female and took 13.18 ± 1.25 seconds to acquire the proper breeding posture over the body of the female to commence mating. During copulation, the female grunts while the male gurgles in a muted voice and dribbles saliva from the mouth. The average frequency of gurgling was 10.62 ± 2.17 per coupling. Frequency of biting by the female was higher. The number of thrusts made by the male per coupling was found to be 44 ± 5.87. During mating, overall frequency of the appearance of palatal flap towards the right and left side was 12.69 ± 1.93 per coupling with a bit more on the left. Net time to accomplish the mating process averaged about 12.18 ± 1.06 min per coupling. Pertinent results of some previous studies are: 15 min (Yagil, 1982); 15 to 25 min (Rathore, 1986); 8 to 15 min (Arthur *et al*., 1989). The average gurgling frequency was found to be 10.62 ± 2.17 per coupling. Flehmen‘s response by the male was also reported towards heifer, middle-aged and aged she-camels by Rahim and El-Nazier (1992) was 20 to 40 seconds. Frequency of biting by the male to female and vice versa during mating was 0.31±0.17, being higher by the female. The frequency of appearance of palatal flap and gurgling by the males was found to be 1.93 ± 0.23 and 1.62 ± 0.27, respectively. Males in full rut grind their teeth, suck air, belch, draw the head back, lash the tail, crouch with jerky movements of the pelvis and generally make themselves look ridiculous. Diarrhoea is also a frequent accompaniment of rut (Wilson, 1984). Aggression in the male camels ultimately leads them to the abattoir (Schmidt-Nielsen, 1956) and it is most probable that aggression is due to dramatic increase of androgen levels in the blood (17.0 ± 3.5 to 35.0 ± 1.5 ng/ml) above the basal levels (Yagil and Etzion, 1980). Increased number of biting attempts by the female to male could probably be due to unleveled ground, great variation in the body size of the couple, presence of any hard object on the ground beneath recumbent female, extra ordinary vigorous male and physiological status of the female (heifer, middle-aged or old one). Young males have been reported to take less time than the old ones (Qureshi, 1986). Net breeding time for a successful copulation varies owing to several factors including e.g. body condition, age of the male, nutritional status, season, frequency of mating, experience, etc. Immediately before the commencement of the calving process, females were found in a state of restlessness, seeking isolation from rest of the animals, frequent rising/lying down and showing no interest in feeding. They sometimes tried to flee away, most probably due to labour pain.

Labour pain started about six hours (1.5-9 hours) before the commencement of parturition followed by the attempts made by parturient female to expel the calf. She-camels in this study took 3 to 7 min in complete removal of the calf from the dam‘s body. Of the 8 animals, 5 she-camels (62.5 %) calved during the day time while 3 (37.5 %) at the night. Generally, bactrian camels take longer in delivering a calf than the dromedary, most probably due to larger size of the calf (Moldagaliev, 1976). Presentation of the calves during parturition was observed as 100% normal in all the cases in the present study.

Of the total 8 animals calved, 5 (62.5%) were lying on left side, while 3 (37.5%) on their right. After successful calving, the camel-calf generally started to breathe as soon as its head appeared outside the vulva, due to the impeded placental circulation as a result of the powerful contractions of the uterus. After parturition no respiratory problem was found in any of the newborns.

Expulsion of the foetal membranes from the female‘s genital tract was completed within an average period of 12.25 min. This finding is similar to that of Rath *et al*. (1990), but contrary to those of Musa (1983), Arthur *et al*. (1985), who reported 30 to 40 min period. Generally speaking, healthier the animal, quicker the expulsion of the foetal membranes. Immediately after calving, all the she-camels paid full attention to their calves. This was accompanied by the production of a specific voice by the female. Newly born calves were found attempting to stand within about 31.88 ± 3.64 min following birth and nearly all were found strong enough to make attempt to walk within next 12.13 ± 1.14 min. The calves first attempts to suckle milk were usually unsuccessful and often sought out the teat by nosing between the forelegs of the dam. Immediately after birth calves accompanied dams in their peregrinations. The calves located their mother‘s udders in about 249.88 ± 26.03 min after their birth with a range from 180 to 381 min. On average, they made first suckling attempt in 99.12 ± 11.28 min with a range from 50 to 150 min.

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32. Effect of a Controlled Intravaginal Drug Releaser (CIDR) and GnRH Administration on Ovarian Follicular Dynamics of Female Dromedary Camel During Seasonal Anestrus Period.

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Introduction

Efficient methods to induce and synchronize ovulation in the camel are required as interest grows in the potential application of artificial insemination and embryo transfer programs (Cooper *et al*., 1992; Al-Sobayil 2006). Indeed, the establishment of protocols that can control follicular growth and produce a dominant follicle capable of ovulating at a known time after treatment would allow fixed timed mating or artificial insemination programs, as well as synchronization of camels for embryo transfer programs (Skidmore *et al*., 2009). This experiment was conducted to assess the use of Controlled Intravaginal Drug Releaser (CIDR) and a GnRH injection which could be suitable for control and induce ovarian activity in female camels, during seasonal anestrus.

Material and Methods

The study was carried out in Maryout Research Station, Desert Research Center (Alexandria, Egypt). Nine female dromedary camels (bred in a semi-intensive system) 6 to 15 years of age were used for the trial that lasted from 15th July to 5th of August. Clinical and gynecological examination (Tinson and Mc kinnon, 1992) were performed to exclude any disease or genital abnormalities (cysts, vaginal stenosis). Camels were examined in standing position. Follicles were counted and measured by electronic caliper and Controlled Intravaginal Drug Releaser (CIDR, Pfizer®,Italy) were inserted (T0). The stage of the follicle development at the time of CIDR insertion was recorded. Polyester tails of the devices were cut. Animal was monitored every 3 days for CIDR loss. Nine days after 500 µgof $PgF_{2\alpha}$ (Estrumate®, Ontario, Canada) were injected was 100 µg of a GnRH analogue (Gonabreed®, Australia) were administered on day 10, the day of CIDR removal. Rectal palpation and ultrasound monitoring were performed again on the day of CIDR removal (T1) and eleven (T2) days after. Number and follicle dimensions were subjected to a repeated measures. Analysis of variance (ANOVA) utilizing the procedure of the general linear model (SAS, 1999). Independent variable time was T0, T1 and T2. Data were normally distributed. Turkeys post hoc test was used to perform statistical multiple comparison. P level was set at 0.5. All data were expressed as quadratic mean and standard error of the mean (SEM).

Results

Gynecological examination performed during July revealed that camels had mean follicular number 2.5 ± 0,42 and mean follicular diameter of 1.05 ± 0.12 cm. rather than being to seasonal anoestrus. All animals retained the devices showed various grades of vaginitis at the time of the device removal. Ultrasound at the time of CIDR removal revealed that two camels spontaneously ovulated and that follicles number was not affected by the treatment. On the contrary, the mean follicular diameter showed a statistically significant decrease between T0 and T1 ($P<0.01$). The decrease of follicular diameter was less significant between T0 and T2 ($P<0.05$) and any significant difference was found between T1 and T2.

Discussion

Shalash (1987) stated that breeding season in Egypt lasts from December to May. This is in contrast to our findings Wilson (1989) that nutrition and management can override the effect of photoperiod and allow camels to breed during the whole year.

The retaining rate of CIDR was 100%, two camels spontaneously ovulated and all of them developed vaginitis. These data are in agree with the findings of Skidmore *et al*. (1992), however, the explanation of spontaneous ovulation in camels following CIDR or a previous ovulation still need further support (Marie et Anouassi, 1987). Vaginitis is probably due to the infection during CIDR

insertion (Padula and Macmillan 2006). Cleaning of perineum and vaginal cavity and more careful insertion would be effective in reducing such side effect.

Treatment with CIDR statistically affected mean follicular diameter in camels. GnRH was unable to stimulate follicular growth. Even if a slight increase was recorded it was not possible to distinguish between the GnRH treatment and a spontaneous follicular growth. Probably, multiple low doses of GnRH, rather than single injection, could be much more effective in stimulating ovarian function in female camels during seasonal anoestrus. However such hypothesis needs to be supported with further studies.

Conclusions

Female camels could show ovarian activity during July and the CIDR treatment is able to affect the mean follicular diameter leading to its decrease. It can also cause spontaneous ovulation and vaginitis. GnRH treatment was unable to improve follicular growth after CIDR treatment. Optimization of protocol is required in order to achieve better results.

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Table 1 Effect of Controlled Intravaginal Drug Relaser (CIDR) and FSH on mean follicular diameters in primiparous and pluriparous female dromedary camel

	T0	T1	T2	S.E.
Follicle number	2.50	2.30	3	0.42
Follicle diameter	1.05^{Aa}	0.51^{B}	0.64^{b}	0.12

Different letters in the same line show statistical differences (a, b: $P < 0.05$; AB : $P<0.01$)
T0: CIDR in; T1: CIDR out and GnRH administration; T2: 11 days after GnRH

33. Effect of Controlled Intravaginal Drug Releaser (CIDR) and PMSG on Ovarian Activity of Primiparous and Pluriparous Dromedary Camel during Seasonal Anestrus Period

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Introduction

Methods to induce and synchronize ovulation in the camel are required for potential application of artificial insemination (Cooper *et al*., 1992). This study was carried out to assess if Controlled Intravaginal Drug Releaser (CIDR) and an PMSG injection are effective for synchronization and induce ovarian activity in primiparous and pluriparous camels, during seasonal anestrus.

Material and Methods

The study was carried out in Maryout Research Station Desert Research Center (Alexandria, Egypt). Ten female dromedary camels (multiparous n=5 and primiparous n =5), aged 6 and 10 to 15 years respectively, were used for the trial that lasted from 15th of September to 6th of October. Clinical and gynecological examination were performed for excluding any disease or genital abnormalities (cysts, vaginal stenosis). Camels were ultrasonographically examined in standing position (Tinson and Mc kinnon, 1992). Follicles were counted and measured and Controlled Intravaginal Drug Releaser (CIDR, Pfizer®, Italy) was inserted (T_0), after perineum wash and vaginal cavity flushing. Polyester tails of the devices were cut and animal monitored every 3 days for CIDR loss. The stage of the follicle development at the time of CIDR insertion was random. 9 days after 500 µgof $PgF_{2\alpha}$ (Estrumate®, Ontario, Canada)were injected. 3000 i.u. PMSG (Folligon, Intervet, Australia) were administered 10 days later, the day of CIDR removal. Rectal palpation and ultrasound monitoring were performed again the day of CIDR removal (T_1) eleven (T_2) and thirteen (T_3) days after. The follicle and dimensions were subjected to ANOVA analysis of variance and to general linear model procedure (SAS, 1999). Independent variables were animal groups (pluriparous and primiparous) the time (T_0, T_1, T_2 and T_3) and their interaction. Data were normally distributed. Turkeys post hoc test was used to perform statistical multiple comparison. Probability level was set at $P \leq 0.5$ and all data were expressed as quadratic mean and standard error of the mean (SEM).

Results

All camels retained the devices had vaginitis were at the time of the removal. Ultrasound at the time of CIDR removal showed that camel were spontaneously ovulated. CIDR and PMSG treatments didn‘t affect mean number of ovarian follicles in both animal groups. In pluriparous camels mean diameter were significantly increased only between T_1 and T_3 with $P<0.05$ while, in primiparous camels mean follicular diameters were significantly decreased at T_1, than at T_2 and T_3 ($P<0.01$) (Table 1).

Discussion

The high retaining rate and absence of vaginitis, were due to the cleaning of perineum and vagina and to careful insertion of the CIDR. Spontaneous ovulation did not occur, in contrast to the observation of Skidmore *et al*. (1992). This is probably because the mean diameter of the follicles was below 0.9 cm at the time of CIDR insertion. Treatment with CIDR in September didn‘t affect mean follicular diameter in both camel groups, probably due to low ovarian activity during this season CIDR treatment wouldn‘t be necessary for reducing follicular diameter and its effectiveness for synchronizing follicular wave need to be further investigated.

PMSG treatment in primiparous camels, statistically influenced the mean diameters at 11 and 13 days after treatment. On the other hand, such influence was only significant 13 days and in less measure ($P<0.05$) in pluriparous females. This is in agreement with (Malhi *et al*., 2006) that reported a reduced superstimulatory response in aged cows and suggested to modify the PMSG dose according

with the age of the camel in order to promote right stimulation of ovarian activity for inducing growth of a preovulatory follicle.

Conclusions

The CIDR plus PMSG treatment carried out in September showed an effect on day 13 thus demonstrating a synchronization activity on pluriparous and primiparous female dromedary camels. Primiparous camels showed higher responsiveness to the treatment, nevertheless further studies are requiredto optimize the protocol.

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Table 1 - Effect of Controlled Intravaginal Drug Releaser (CIDR) and PMSG on mean follicular diameters in primiparous and pluriparous female dromedary camel

Animals	T_0	T_1	T_2	T_3	S.E.M.
Pluriparous	0.56	0.52^{a}	0.89	0.93^{b}	0.08
Primiparous	0.65	0.30^{A}	0.77^{B}	0.96^{B}	

Different letters in the same row means statistical differences (a≠b: P<0.05; A≠B : P<0.01)
T0: CIDR in; T1: CIDR out and PMSG administration; T2: 11 days after PMSG; T_3: 13 days after PMSG.

34. Studies on Common Reproductive Disorders in Dromedary Camels (*Camelus dromedarius*) in United Arab Emirates (UAE) Under Field Conditions

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Introduction

The camel (*Camelus dromedarius*) is an important multipurpose livestock species uniquely adapted to harsh arid and semi-arid areas that can be used for meat, milk, wool, and hide production and transportation and as a source of entertainment, celebration and competition. There are 24,246,291 million one-humped camels in the world with 80% of them in Africa and the highest population in Somalia (7 million) and Sudan (4.25 million). In Asia about 70% of dromedaries are found in India and Pakistan. There are approximately 494242 camels in Abu Dhabi (United Arab Emirates), with the highest population in the Eastern and Western part of the UAE. Camel (C*amelus dromedarius*) is an important domestic animal species uniquely adapted to the hot and arid environment. The versatility of the camel and its ability to survive and perform in the harsh arid and semi-arid areas of the world has earned it names such as "ship of the desert". It is by nature able to withstand the perils of a desert even for a long period of time without food and water. The reproductive efficiency of camels under natural conditions is generally regarded to be low. The reasons for this low reproductive efficiency of the camel (*Camelus dromedarius*) is probably due to the relatively short breeding season, a longer prepubertal period, a long gestation period of 13 months, a delayed puberty, a prolonged (8–10 months) period of lactation-related anestrus leading to a long inter-calving interval, limited oestrus period, poor pastoral management systems, inadequate nutrition and the lack of use of assisted reproductive techniques such as embryo transfer and artificial insemination. Despite, the low reproductive performance of camels, reproductive disorders can lead to economic losses in terms of reduced fertility, low life time production, culling of the animal from the farm longer calving interval and increased expenses on medication in farm animals. Camels are prone to many diseases which are major constraints from improvement of camel health. Reproductive disorders are one of the most common important pathological conditions and/or diseases in camels in UAE. Accordingly, the present study was taken up with a view to determine the incidence/prevalence rates of different reproductive disorders in camels in UAE and to identify the common causes of reproductive disorders.

Materials and Methods

For assessing the incidence/prevalence of reproductive disorders in camels, a systematic survey was conducted. This was done by visiting 364 organized private camel farms (a total of 4374 camels aged 5-15 yr) around Abu Dhabi Emirate during August 2007 to April 2010. The farm size ranged between 9 and 12 camels. The camels were allowed to graze freely for limited time in the desert, but were also supplemented with fescue and/or alfalfa fodder**,** with or without a supplement of grain. The information pertaining to the camel examined during this study was collected. This included identity of the camel, housing and management, concurrent disease, body weight, age, occurrence and duration of disorder, previous disorder history, feed intake, lactation number, and medication of the camel. The sick animal was examined clinically and samples (blood, tissues and swabs) were collected for bacteriological and hematological examinations to decide the type and cause of the reproductive disorder.

Results and Discussion

The results of the present study are presented in Table 1.Taking together all camels (4374) examined, the overall incidence of common various reproductive disorders was 7.75%. The details of various reproductive disorders in camel were discussed in the present study.

Table 1. Prevalence of common various reproductive disorders in camels

Reproductive disorder	No. of camels examined	No. of camels found infected	Prevalence rate (%)
Abortion	543	49	9.02
Uterine prolapse	490	61	12.45
Uterine torsion	342	13	3.8
Vaginal prolapse	378	22	5.8
Udder edema	654	34	5.2
Dystocia	603	56	9.29
Early embryonic death	243	22	9.05
Repeat breeding	321	56	17.45
Retained placenta	458	17	3.71
Recto-vaginal fistula	342	9	2.63
Total	4374	339	7.75

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35. Reproductive Performance Improvment of Maghreby Negga by Zootechnic Practices

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Introduction

The dromedary camel is an important animal in the arid and semi-arid areas, it is raised for meat, milk, leather and fiber production as well as a racing animal. The scientific community plays an essential role for considering camel under three aspects underlying the importance of camelids, now and in the future. The camelids are interesting as a biological model, a productive animal for food supply in remote areas, and an element of the arid ecosystem where they contribute to combat desertification and food security. Camel scientists have to convince funding agencies to promote desert productivity and preservation. However, some lack in camel research can be considered (Faye, 2008). Opportunities to improve reproductive efficiency in camel are limited, not only by the long gestation period and short breeding season, but also by the continuing use of traditional systems of reproductive management in most breeding herds. These methods make it difficult to ensure that an optimum number of females are pregnant at the end of season consequently decreasing fertility (Niasari-Naslaji, 2008). The production and reproduction in camels are affected by many factors such as late puberty (3 to 4 years for females and 5 to 6 years for males), restricted breeding season (from November to April), induced ovulation, long gestation period (13 months), long calving interval (2 years) and high incidence of early embryonic death. The aim of this study was to improve reproduction performance of camel using methods based on zootechnic practices.

Material and Methods

This study was conducted at the experimental farm of the High School of Agriculture at Mateur. A total of 26 females Maghreby Negga were survived, within 17 born and raised in station. Exactly, 40 gestations were recorded (total period for all survived female). During the experimental period 49 births were recorded including 28 males and 21 females. All services by males on females were recorded. Animals were weighed every 14 days. Weights of each female were recorded one day before and after deliverance. Gestation length, intervals between calving and successful mating was recorded.

Results and Discussion

Survived herd allowed female became pregnant for the first time (age of first successful mating). Difference, between female born and raised in experimental station and their bringing with herd (traditional system), was significant. Age of the first group (born and raised in station) at first successful mating was about 28 $\pm$ 7 month. Age for the second group varied between 33 $\pm$ 48 months with an average of 39 month. Age at first successful mating depends to age of animal but this parameter was significantly affected by the percentage of the mature weight of the young camel. This result was similar to these observed by kamoun (1990) and kamoun and Wilson (1994). Kamoun (1990) demonstrated that essentially the percentage of the mature weight affect the age at first reproduction event in she camels.

To estimate young birth weight (kg), weights of each female were recorded one day before and after delivery. This weight was varied according to age of animal. Birth weights varied from 24 to 48 kg (n=49, μ=33,6 +/- 6,2 kg). Female born and raised during experimental period had better conformation and weighed more than that of traditional system. Kamoun (1990) demonstrated that full access to milk before weaning, is the determining factor in physical and sexual development of the young calves.

In total 40 gestations were recorded for all survived females. Gestation length was 375 +/- 14 day (n= 40). Female can be pregnant only 8 days after calving. Generally the intervals between calving-calving and calving-successful mating were 526 +/- 145 days and 147 +/- 131 days respectively. This interval varied according to alimentation rate, body weight and conformation and feed availability. Age at first parturition and interval between parturition varies from 32 to 68 months

and from 17.5 and 51 months, respectively. Reproductive performance, in terms of age at puberty, at first conception and at first birth can be improved by ensuring adequate nutrition in early life.

Young females were breed before they reached 3 years of age. Lactating females were able to produce up to 253 days of pregnancy. Recovery rate varied according females between 8 days and 404 days. This result indicates the high potential of camel to produce milk. Camel milk production was an important pathway to improve camel performance.

Conclusion

Reproductive performance, in terms of age at puberty, at first conception and at first birth can be improved by ensuring adequate nutrition in early life. Improved early reproductive performance should lead to better total productivity. Occurrences of the first reproductive event depend essentially on the percentage of the mature body weight.

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36. Effect of Female Camel Urine on Different Teseosterone Levels in Adult Male Rats

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Objective

To investigate the effect of female camel urine on hormonal levels in male rats and to evaluate total protein, globulin, albumin and body weight gain according to administration of female camel urine.

Materials and Methods

Twenty four Wister Albino, adult male rats weighing 140 to 200 grams were in the Central Veterinary Research Laboroteries premises at Soba, Khartoum, Sudan utilized for the study. They were kept under standard condition of temperature (23^{O}C) and relative humidity (65%) 12h light and 12h dark cycle and adequate ventilation .They were provided with balanced diet and water at libitum.

Urine was collected either by free catch or by tashweel technique at administered at (2ml/100gm BW). High and low (TL) were brought by parental injection of testosterone enanthate (1.5mg) and Lead Acetate (8mg) according to Brunner *et al* (1992) and Biswas and Ghosh (2004) respectively.

Blood samples were taken once before female camel urine (FCU) treatment and weekly after FCU treatment. The samples were collected in a plain vials ,allowed to stand and thereafter centrifuged at 2000 rpm for 10 minutes, serum was then separated and frozen at 2^{0}C for further analysis .

Serum testosterone was measured by enzyme linked immunosorbent assay (ELISA) microwell method described by Rajkowski *et al*, (1977) .

Total protein and Albumin were determined according to Friedman and Young, (1997), using Biuret reagent kit and Bromocresol green respectively.

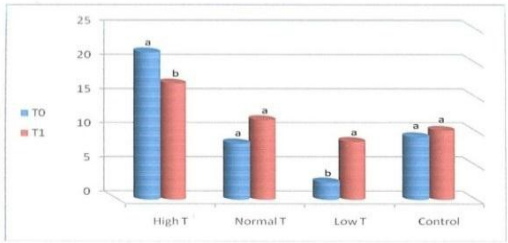
Globulin values were calculated by subtracting the values of albumin from the corresponding values of total protein, Abdel Fattah *et al* (2008).

Statistical analysis was performed using computer statistics software package (Version 8). Analysis of variance (ANOVA) was performed according to Day and Quinn (1989).

Results

Seven days after FCU administration , a highly significant ($p< 0.01$) decrease in testosterone level in group three was observed. Also an insignificant increase in group four, no changes were observed in group one and two. At day 21 there was an increase in serum TL in all groups treated with FCU compared to the previous weeks as showed in Table 1 and Figure 1.

Fig (1): The effect of she-camel urine on the serum testosterone level (ng/ml) for three weeks



- T0 = testosterone level before camel urine treatment.
- T1 = total means of testosterone level after camel urine treatment.
- Columns in the same group contain different letters are significantly different.

Table1: Effect of female camel urine on testosterone level (ng/ml)

Tretments	Day0	Day7	Day14	Day21
High T	21.60±3.2^{Aa}	13.65±2.1^{Ba}	14.5±2.0^{Ba}	22.95±3.2^{Aa}
Normal T	8.25±0.6^{Bb}	10.20±1.1^{Bb}	9.05±1.7^{Bab}	15.75±6.3^{Aab}
Low T	2.55±3.7^{Bc}	6.05±3.6^{Bc}	7.28±2.2^{ABb}	12.13±4.9^{Ab}
Control	9.175±0.9^{Ab}	11.25±0.6^{Aab}	10.05±7.4^{Aab}	9.075±5.6^{Ab}

Means within the same column followed by different small letters are significantly different.

Conclusion

Oral administration of female camel urine for three weeks resulted in transient lowering on the high testosterone level, gradual increase in the low testosterone level while the group of normal level was not affected by FCU administration.All groups treated by FCU showed significant increase in total protein, globulin and rats body weight. This study concluded that camel urine can rectify and regulate serum testosterone level, increase protein synthesis and support the body immunity.

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Anatomy and Surgery

37. The Cerebral Ventricular System of the Dromedary Camel (*Camelus dromedarius*): Anatomical Aspect and CSF Sampling Techniques

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Introduction

The camel is known by its ability to cope with the hot arid and desert environment apparently without affecting productivity. During the last century, specific investigations have highlighted the mechanisms governing such adaptation (Schmidt-Nielsen, 1964; Macfarlane, 1968; Gauthier-Pilters and Dagg, 1981) including anatomical and physiological peculiarities. The general anatomy of the camel has been largely explored by Smuts and Bezuidenhout (1987) and others, but reports on the central nervous system, and particularly the cerebro-ventricular system, in this species are still scarce. The present work aims to investigate the conformation and topography of cerebro-ventricular system in the dromedary camel. A good knowledge of the anatomy of the cerebral ventricles in this species would be useful for conducting CSF sampling and for subsequent research experiments concerning the mechanisms of central hormonal secretion such as vasopressin and melatonin.

Material and Methods

The anatomical study was carried out on 12 heads of camels slaughtered at the Temara and Dakhla abattoirs. The heads were first cleaned and fixed by infusion of a 10% aqueous formalin solution. Some of these heads were kept in the freezer and served to obtain transversal and sagittal head slices following the basi-horizontal plan of Horsley-Clarke (H_0, which goes through ventral edge of the orbit and the centre of the external acoustic meatus) to study the topographical anatomy of the ventricular system. In the other heads, the brain ventricular cavities were filled up with either coloured Rhodopas solution to obtain moulding or barium sulphate solution for X-ray radiography.

The CSF sampling was conducted both at the lateral ventricle and at the atlanto-occipital space. At the lateral ventricle, the sampling was made on three camels by drilling a hole in the skull beside the bregma point and implanting a needle into the lateral ventricle cavity. At the atlanto-occipital location, the sampling was conducted at the abattoirs on 25 camels before slaughtering using a needle carefully introduced in the subarachnoid space between the occipit and the first cervical vertebra (atlas) while maintaining the heads in extreme flexion.

Results and Discussion

The use of the moulding and radiography as well as the brain slicing have shown that the camel cerebral ventricular system presents great similarities with that of other large ungulates concerning its extent, conformation and topography. The comparison of the morphometric indexes as reported by Conzalez-Soriano et Garcia (2001) exhibits great concordance of data obtained from moulding and radiographic measurements. As in bovine (Lignereux, 1987) and ovine (Lignereux, 1991), the lateral ventricle presents a horseshoe like shape but differs by the long extension ventrally and laterally of its frontal horn and the presence of the collateral eminence of Meckel at the ventral aspect of both lateral ventricles. The third ventricle is characterized by its well developed supra-pineal, pineal and infundibular recesses. A long and slender duct, aqueduct of Sylvius, connects the IIIrd ventricle to the IVth ventricle. This later, lying below the cerebellum, presents two lateral recesses showing similar direction as those of bovine (Lignereux, 1987). These recesses are interconnected via the fastigial recesses and also communicate with the subarachnoid space by a lateral opening located at the anterior side of the IVth ventricle. The CSF sampling from the lateral ventricle required surgical intervention under deep anaesthesia, the implantation of a cannula holding bolt assembly and the introduction of a stainless steel hypodermic needle. The patency of the cannula was maintained with a stylet located in the needle. The whole assembly remained rigidly fixed in position throughout the sampling period. The site and the angle of implantation of the cannula can be reasonably accurately

determined without the use of any stereotaxis equipment. The fact that CSF flowed freely out of the cannula indicates that the cannula tip was indeed in a ventricular space while the cannula assembly caused no apparent discomfort to the animal and was not too damaging. The CSF sampling at the atlanto-occipital region was carried out on animals without anesthesia but with a good contention. The sampling technique was similar to that described in bovine (Guatteo, 2002) and equine (Orsini and Divers, 2001). The animal is maintained in recumbent position and forelimbs tied. Once the site is prepared, the head is hold in extreme flexion and the needle is introduced in the atlanto-occipital space perpendicularly to the median line of the neck. The CSF is then withdrawn using a syringe. This technique is actually easy to carry on unless the problem of animal contention and the use of adequate material which was also revealed in others species (Marie-Aude, 2002; D´Ablon, 2004)

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38. A Study on the Radiological Anatomy of the Foot of Camels by Digital Radiography and Computed Tomography

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Introduction

Camel do suffer from occupational hazards e.g., burn injuries over foot in those working on Kilns (Gahlot *et al*,1980), bruises in those paraded on roads, fractures of digits in those working in mines and punctured feet in those being used for draft purposes in urban areas. The various traumatic or mechanical injuries thus received results into variety of foot affections with associated lameness (Singh, 1995).

Available literature shows scanty reports on foot disorders of camels and their diagnosis and treatment (Singh *et al*, 1980: Gahlot, 1984: Gahlot and Chouhan, 1992). A careful radiological examination provides valuable aid in the early diagnosis and treatment of the malady and prognosis can be improved. In view of this the radiological anatomy of foot of camel by digital radiography and computed tomography scan was done.

Materials and Methods

The radiological examination of a normal camel foot of fore and hind limbs obtained from two adult freshly dead camels was done by dorsopalmar / planter and lateral views. The foot was anatomically studied by computer tomography scan machine (Seimens somatom plus 4) with 100kVp, 120 mAs on 14x17 inches screened film and by digital radiography machine (Fugic® Allengers) with 60 kVp, 10 mAs.

Results and Discussion

The radiological anatomy of foot of fore and hind limb was studied by digital radiography and C.T. scans. An interpretation of digital radiograph revealed that camel does not possess distal sesamoid bones. The metacarpus and metatarsus remained bifurcated at its distal extremity. There were four proximal sesamoid bones present on caudal aspect of fetlock joint. The first phalanx was largest of all and third phalanx was smallest. The thick keratinized sole was visible on ventral aspect of foot. It had a more developed digital cushion. The superficial and deep digital flexor tendon were not visible.

However, C.T. images of foot and hind limbs did not show any variation. C.T. images through various section of foot shared details of all anatomical parts of foot. These have been depicted in fig 3-8. C.T. images also confirmed absence of distal sesamoid bone. Various portion across the foot showed metacarpal and metatarsal, divided cannon bone, fetlock joint, proximal or first phalanx, second or middle phalanx and distal or third phalanx, fetlock, pastern and coffin joints, proximal sesamoid bones, Nails or pes, interdigital notch, interdigital septum, deep digital flexure tendon, superficial digital flexure tendon, fibrocartilagenous enlargement of deep digital flexure tendon, middle scutum, digital cushion, common capsule of digital cushion and yellow fibroelastic bed.

The digital radiograph and computer tomography imaging of camel foot showed no difference in anatomy of fore and hind foot. Camel had 4 proximal sesamoid bones but distal sesamoid bones are absent. However, Hifny *et al* (1995) mentioned that in cattle, the proximal sesamoid bones are four in number, two for each trochlea. In dorsopalmar/dorsoplantar projection the two sesamoid are superimposed over each trochlea, the middle bone is larger than the lateral one. They appear as a vertical pear than the lateral one. They appear as a vertical pear shaped structure with a 2.5 cm vertical length projection the four sesamoid are superimposed over each other and located palmar or plantar to the head of the large metacarpal or metatarsal bone. In camel, the proximal sesamoid bones have nearly the shape, size and measurement as in cattle.

The distal sesamoid bones are present in cattle and they are two in number and rectangular in shape and vertical length 1.5 cm and 2.7 cm in dorsopalmar/dorsoplantar projections. The distal sesamoid bones were not observed in camel.

In camels, the medullary cavity of metacarpal or metatarsal were completely divided into two separate parts by complete radio opaque septum which is in consonance to the finding of Hifny *et al* (1995).

In camels, the length of large metatarsal and metacarpal were equal which is in according to the finding of Hifny *et al* (1995). The small size of 3rd phalanx in camels may give advantage of fewer traumas to this bone thus resultant pathologies are also minimized. This is in consonance to the finding of Hifny *et al* (1995).

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39. Surgeries of Head and Neck Region of Camels (*Camelus dromedarius*)

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Introduction

Surgical affections of head and neck of camels are very important as they occur frequently and have been reported. The fracture of mandibles are commonest of all and need utmost attention to repair it as both the lips go apart and prehension is jeopardized. The soft palate injuries is next common affection that makes camel completely off feed and needs an exclusive surgical resection to restore the food intake by mouth. Eyes are watch tower of camels and are often injured. A careful surgicotherapeutic treatment is necessary to prevent loss of vision.

Materials and Methods

Present report is based primarily upon a review of previously published work of author, however, those reported by others have also been included in this report. Various surgical affections of head and neck of camels were diagnosed and treated by the techniques developed by authors and other researchers. Entire work was carried out in clinical cases of camels brought in the clinic of department of Veterinary Surgery and Radiology, College of Veterinary and Animal Science, Bikaner.

Results and Discussion

Diverse surgical affections of head and neck region of camels were categorized and are discussed below;

Lacerated Nostrils: It occurs in young camels who are not trained and they get easily excited during training or vehicular traffic and skin proximal to the embedded nose pegs is lacerated to a variable length. It is sutured after debridement under infraorbital nerve block and xylazine sedation (Gahlot, 1994).

Buccal or salivary fistula: This usually occurs just below the eye and is unilateral in majority of cases. It occurs due to absence of one maxillary cheek tooth; feed straws strike to oral mucosa at this gap during mastication and gradually wound is converted into fistula. If fistula involves salivary duct, it is called salivary fistula otherwise buccal fistula. Its surgical management includes ligation of stenson‘s duct and debridement of the fistulation tract (Gahlot and Gupta 1996, Gahlot and Chouhan, 1992 and Gahlot, 2000).

Mandibular fractures: These are treated by a variety of techniques, namely interdental wiring technique (Gahlot *et al*, 1984, 1989; Gahlot 1990), reinforced brass rod interdental wiring technique (Hanuman and Gahlot, 2001) and bone plating (Ramadan, 1994). The interdental wiring technique offers advantage of being economical, easy to perform and effective technique for repair of mandibular fractures.

Soft palate injuries: These are very frequent during breeding season and dulla or soft palate is injured and trapped inside or hangs outside, thus not allowing animal either to eat or drink. Its surgical resection is recommended to save the camel (Gahlot *et al*, 1988; Gahlot 1992, 2000 and Ramadan, 1994).

Ophthalmic affections: Camels suffer from a wide range of ophthalmic affections which include laceration of cornea, eyelids, panophthalmia, corneal opacity, descematocele etc. These have been reported elaborately (Bishnoi and Gahlot, 2001; Gahlot 1992, 2000; Ramadan, 2004).

Oesophageal obstructions: Camels do suffer with oesophageal obstructions and usually cervical oesophagus is involved. Its successful management has been reported (Ramadan, 1986 and Ramadan and Abdin-Bay, 1990).

Surgical affections of ear (Gahlot, 2000), facial paralysis (Gahlot *et al*, 2004) and torticollis (Rollefson *et al*, 2001) occur less frequently in camels.

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40. General Anaesthesia in Camelids: An Overview

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Introduction

General anaesthesia is routinely used as a means of a chemical restraint for diagnostic procedures and major and minor surgery in camelids. General anaesthesia is helpful for many procedures in camelids practice, including exploratory laparotomy of the colicky calf (cria), castration of adult llamas, or exploring a fistulous tract. Camelids can be difficult to manage under general anaesthesia and large animal anaesthetic machines are required for volatile anaesthesia in camels that are > 150 kg BW.

General anesthesia in new and old world camelids may be induced and maintained with injectable agents, inhaled agents or a combination of these agents. Previous reports describe the use of many drugs (e.g. xylazine, guaifenesin, ketamine, thiopental, halothane and isoflurane) for sedation and general anaesthesia. Hence the focus of this review will be to add this base of information by reviewing new material pertinent to the anesthetic management of camelids (llamas, alpacas and camels).

Review

Camelids should be fasted 12-18 hrs and deprived of water for 8-12 hrs prior to anaesthesia because they are susceptible to complications associated with recumbency and anaesthesia: tympany, regurgitation and aspiration pneumonia. In an anaesthetized camelid continuing contraction of C1 of the stomach moves ingesta towards the cardia. This cycle is a hindrance during anesthesia. These mechanisms are under parasympathetic control therefore atropine may be used to diminish stomach contractility. It is essential that laryngeal reflex be abolished before attempting endotracheal intubation. Fasting neonates is not advisable because hypoglycemia may result. Venipuncture and catheterization of the jugular vein are often performed prior to anesthesia. Adult camelids require 16 gauge catheters while 18 gauge catheters are appropriate for juvenile camelids. Adequate physical restraint during venipuncture or catheterization is required. Atropine administration (0.02 mg/kg IV or 0.04 mg/kg IM) is recommended to prevent bradyarrythmia and will also decrease salivary secretions. Use appropriately sized equine endotracheal tubes in camels. The recorded history of general anesthesia in camel has its origin as inhalation anesthesia when Leese (1927) used chloroform. The progress in inhalation anesthesia continued and ether or halothane inhalation were used to maintain anesthesia induced with other anesthetic agent.

Singh *et al* (1962) reported their preliminary observation in the initial use of I/V general anaesthesia in camel and used chloral magnesium anaesthesia in camels and found it superior to chloral alone. Said (1963) induced anaesthesia in camels with chlorpromazine hydrochloride premedication followed by chloral hydrate. Said (1963, 1964) was first to use thiopentone sodium I/V to produce anaesthesia of half an hour duration in camel. Similar observation on this anaesthesia was also reported by Sharma (1980) & Sharma *et al* (1984). Administration of nesdonal followed by its repetition produced anesthesia of 20 minutes duration in camels (Hassanein, 1975). Dennig (1972) used Rompun (xylazine), Peshin (1980) subjected xylazine for its evaluation in camel and similarly EI-Amrousi *et al* (1985) used Saffan to produce anaesthesia of short duration. White *et al* (1986) produced anaesthesia in camels with ketamine for minor surgical interferences. Singh *et al* (1994) evaluated thiopentone induced halothane anaesthesia as safe anesthetics in camels. Kashyap (1994) in an experimental study evaluated Detomidine Hydrochloride as sedative and as pemedicant to ketamine hydrochloride in dromedary camels. Ramadan (1994) used high doses of xylazine followed by ketamine to produce anaesthesia in camels lasting for 30 minutes. Fahmy *et al* (1995) studied the efficacy of propofol anaesthesia with xylazine and diazepam premedication in camels. Duke *et al* (1997) studied cardiopulmonary effects of propofol infusion in llamas.

Sharma (2000) studied behavioral response and various physiological, hematological and biochemical parameters in camels anaesthetized with propofol (1mg/kg) I/V concluded that propofol was found to be suitable for immediate induction of surgical anesthesia of ultra short duration in camels where quick and smooth recovery was desirable. Palecha (2002) concluded that premedication with midazolam (0.2mg/kg) reduced the dose propofol by 25% in camels. Xylazine (.25-.35 mg/kg IM) and ketamine (6-10 mg/kg IM, 15 min later) usually provide 30-60 minutes of recumbency in camelids. The simultaneous administration of xylazine (.44 mg/kg IM) and ketamine (4 mg/kg IM) usually provides restraint for 15 – 20 minutes.

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41. Radiographic and Ultrasonographic Appearance of Mature Dromedary Camel Tarsus (One Humped Camel)

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Introduction

The camel tarsus is a composite joint consisting of multiple articulations, involving numerous soft and bony structures (Smuts, 1987) and it is susceptible to a considerable incidence of pathology (Raes *et al*., 2010). In the horse, radiography and ultrasonography are the most common techniques for diagnosing tarsal injuries (Vanderperren *et al*., 2009a). Radiography remains the main stay of equine musculoskeletal imaging due to its cost, ready accessibility and global evaluation of bony structures (Kinns and Nelson, 2010). Ultrasonography is the most cost effective imaging modality for evaluation of soft tissue injuries (Vanderperren *et al*., 2009a), bone surface (Raes *et al*., 2010) as well as the articular cartilage of the equine tarsus (Tomlinson *et al*., 2000). Lameness of the camel hind limb is popular and most frequently encountered in the tarsal region due to nature of laying behavior in camels. The aim of this study is to depict the radiographic anatomy of the camel tarsus as well as describing the uncharacterized soft tissue structures of the camel tarsus to develop an optimal technique for examination of these structures to serve as reference for evaluation of tarsal pathology.

Materials and Method

Six pelvic limbs were obtained from three adult dromedary camels euthanized for reasons unrelated to musculoskeletal disorders. The donor camels one male and two females. Their age was 4, 8 and 14 years respectively. The tarsal joints were radiographed in four projections, dorsoplantar, lateromedial, dorsolateral-plantaromedial and plantarolateral-dorsomedial views using digital x-ray machine (Philips digital x-ray unit). For the echographic examination, a real time ultrasound machine (Aloka, Pie medical equipment) equipped with 7.5 MHz convex transducer. Two limbs were freshly dissected and examined macroscopically and another two limbs were frozen at -20^{O}C and sectioned to be compared with the resulting images.

Results and Discussion

Conventional radiography is the classic diagnostic technique of imaging bone involvement and ultrasonography represents an excellent complementary diagnostic tool to radiography for determination of soft tissue structures in equine practice (Tenbrunner-Martinek *et al*., 2007). In the present study, the radiographic examination was performed in four projections (Verschooten and Schramme, 1994). The dorsoplantar view (Fig.2) was optimal for evaluation of the articular surfaces and joint spaces of the tarsocrural as well as the intertarsal joints. The lateromedial (Fig.1) was the best for evaluation of the talocalcaneal joint, the dorsolateral-plantaromedial view for the medial aspect of the tarsocrural joint and the plantarolateral-dorsomedial view for the plantar aspect of the sustentaculum tali and the lateral trochlea of the talus (Butler *et al*., 2000). The normal appearance of the soft tissue structures of the tarsus in equine(Vilar *et al*., 2008), cattle (Flury, 1996) and dog (Caine *et al*., 2009) has been reported. In this study, the normal ultrasonographic anatomy of the tarsal region in adult dromedary camel is described. The ultrasonographic examination of the camel tarsus was performed in a systematic manner similar to that reported for the equine tarsus in both longitudinal and transverse planes (Whitcomb, 2006). The ultrasonograms in both planes correlated well with the freshly dissected and the frozen sectioned specimens.The tarsal tendons were more or less oval in shape. Their homogenous echogenicity appeared as uniform distribution of pin point white echoes in the transverse plane (Fig.3) and parallel linear fiber pattern that appeared as long white echoes in the longitudinal plane (Fig.4). Similar findings were reported for the same region in equine (Dik,1993) and cattle (Flury, 1996). Sonographic evaluation of the tibiotarsal joint capsule was easier from the dorsomedial aspect of the tarsus just below the medial malleolus and the longitudinal plane was most informative (Fig.3). The intertarsal joint capsules could not be evaluated due to minimal synovial fluid. The articular cartilage of the medial and lateral trochlear ridges of the talus appeared as a hypoechoic band overlying the hyperechoic subchondral bone. The bone surfaces elsewhere in the tarsocrural joint and other intertarsal joints were seen as hyperechoic reflection deep to the soft tissue structures with the occasional presence of anechoic synovial fluid. Similar findings were described in

tarsus of equine (Dik, 1993; Whitcomb, 2006). The collateral ligaments were recognized in the longitudinal view with its echogenic densely packed linear fibers and examined from its origin to insertion to be differentiated from other structures. The plantar ligament had medial and lateral limbs extending through the plantar aspect of the tarsus. Similar finding were detected in the tarsus of the dog (Caine *et al*., 2009). The plantar ligament was more echogenic than the deep digital flexor tendon (DDFT) and both were more echogenic than the superficial digital flexor tendon (SDFT) (Fig.4). In conclusion, digital radiography and ultrasonography are complementary to each other and suitable for assessment of camel tarsus.

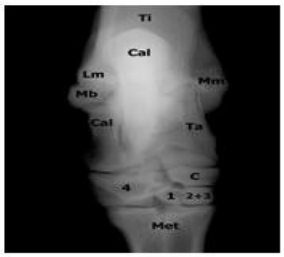

Fig.(1) dorsoplantar view at the tibiotarsal joint.

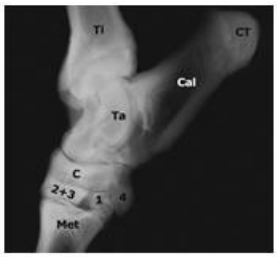

Fig.(2) Lateromedial view

Fig.(3) transverse view

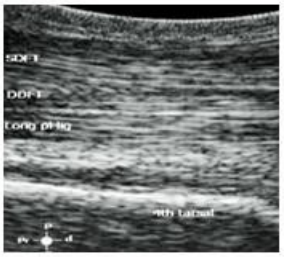

Fig.(4) longitudinal view on the plantar aspect of the tarsometatarsal joint.

Ti; tibia, CT; calcaneal tuber, Cal; calcaneus, Ta; talus, C; central tarsal bone, 4; fourth tarsal bone, 1; first tarsal bone, 2+3; fused second and third tarsal bones, Met; metatarsus, Lm; lateral tibial malleolus, Mm; medial tibial malleolus, Mb; malleolar bone

P; plantar Pr; proximal, d; distal, L; lateral, M; medial, EDL; extensor digitorum longus, Pr. Tr.; peroneus tertius, Med Con; medial condyle of talus, Lat Con; lateral condyle of talus, Sy Cap; synovial capsule, long pl. lig.; long plantar ligament

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42. The Microanatomy of the Cerebellum Cortex of the One Humped Camel *(Camelus dromedarius)*

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Introduction

The cerebellum is comprised of two anatomical components, the cerebellar cortex and nuclei. This complex brain structure mediates essential functions for movement, balance, cognition, language (Ito, 2005) and some emotional behavior as fear (Wolf *et al*., 2009). There are different components cells in the cerebellum cortex, the most distinguished morphologically are Purkinje (PC), granule and Golgi cells. The PC is the only neuron in the cerebellum along whose axons information leaves the cerebellum (Avrushchenko, 1981). Characteristics of cerebellar cortical cells are central to ideas about its role in motor learning (Mauk, 1997). In this work we present a morphometrical data of dromedary cellular components of cerebellum cortex.

Materials and Methods

The cerebellums of three (3) Algerian adult (Terghi) dromedaries were obtained directly after slaughter. Small specimens were fixed in 10% phosphate-buffered formalin for one week at least and processed for paraffin embedding. Sections (10 µm) were prepared and stained with Crossman trichrome (Boeck,1989) combined with Hensen nuclear stain. Other sections were treated with Nissl stain according to Paxinos (1997). Morphometric measurement (mean± Std. Dev.) of cerebellum cells was obtained with software programmes; Image Tool- IT300 and MacBiophotonics ImageJ.

Results and Discussion

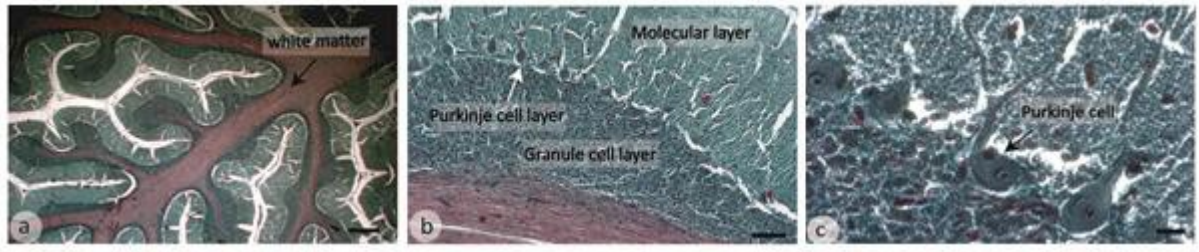

Figure 1. Cerebellar histology in adult dromedary. **a**. The Outer cellular layer of grey matter is colored in green; the inner fibrous layer of white matter (arrow). **b**. the cortex layers. The granular layer contains small neurons. The Middle Purkinje layer of large neurons. The outer molecular layer contains few neurons and many processes. **c**. magnified view of (b) demonstrating layers cells profiles. Scale bar: a = 1mm; b = 50µm; C= 10µm.

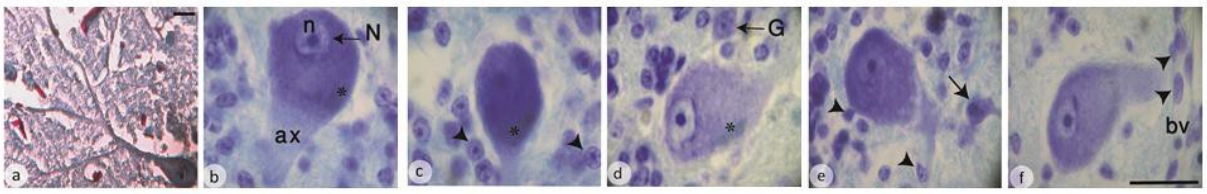

Figure2. a. The Purkinje cell (PC) with its well developed ramifications. **b**. The initial segment of Purkinje cell axon (axon hillock) (ax), nucleus (N), nucleolus (n). **c**. Granule cells (arrowheads) with their typical star shaped nucleus. d. Golgi cells (G) (arrow). **e**. Cells in structural relationship with Purkinje cell, granule cells (arrowheads); basket cell (arrow). **f.** Blood vessel (bv) near a Purkinje cell surrounded by numerous glial cells (arrowheads). Note that the PC in figs. b, c and d present

a granulations in their cytoplasm (asterisk) and the PC of figs b, c, e are dark comparing to those of d and f figs. Scale bar: a = 50µm, (in f) b-f = 5 µm.

The body cell diameter (µm) of Purkinje (PC), Golgi and granule cells were respectively (11.72 ± 1.51), and (2.59 ± 0. 43) and (1.65 ± 0.24). The diameter of nucleus and nucleolus of PC were respectively (5.10 ± 0.61) and (1.88 ± 0.33). The distribution of granule cells in the granule cells layer is (5.26±0.78) cells / 100µm^2 and in the Purkinje cell layer (1.90±0.28) cells / 100µm^2.We noticed that just the nucleus of PC diameter is bigger than the diameters of cell bodies of the others. The PC is a central element in the cerebellum cortex and most distinguished cell in the nervous system, this is reflected by its considerable shape compared to the others cells. Hence, when during embryogenesis, its afferents use the PC cell cluster as a scaffold to organize their topography (Apps and Hawkes, 2009). We have observed in our study that there is different morphological features of this cell namely presence or absence of cytoplasm granulations, darkness of some cells comparing to others. In fact, this heterogeneity has been reported by morphological studies in dog (Avrushchenko,1981) and in recent studies by molecular approach suggesting that this heterogeneity might have functional implications for motor learning (Mateos, 2001). It will be interesting to explore the plasticity of these cells in animal experiencing hard condition and running through long distance in hot desert as the dromedary.

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43. ongenital Anomaly of the Coronary Arteries in the Camel Heart *(Camelus dromedarius)*

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It has been established that the normal origin of the left and the right coronary arteries, in all mammals is from the aortic sinuses above the left and right aortic cusps respectively (Ghoshal, a 1975; Shively, 1987; Smith and Fisher, 1987; Dyce, Sack and Wensing, (1996); Taha and Abdel-Magied, 1996). However, various anomalies have previously been reported regarding the origin of the coronary arteries. Of these; absence of the ostium of the left main coronary artery (Vidne, Nili, Aygen and Levy, 1979; Smith and Fisher, 1987; Taha, 2001); origin of the coronaries from the pulmonary trunk, (Sandusky and Smith, 1978); common origin of the two coronaries (Sandusky and Smith, 1981); on the other hand, other anomalies related to the coronaries or their branches were also mentioned in the literature. These include: aneurysm of one or both coronary arteries; (van Nie, 1968); hypo- or hyperplasia of one or both coronaries, (van Nie, 1968); thin wall resembling that of a vein,(Sandusky and Smith, 1978); absence of the circumflex branch of the left coronary artery (Gentzler, Gault, Liedtke, Mccann, Mann and Hunter, 1975; Bestetti, Costa, oliveira, Rossi and Araujo, 1985); rudimentary coronary artery in Syrian Hamsters (Mesocricetus auratus), (Durán, Arqué, Fernández, Fernández, Gallego, Rodriguez and Sans-coma, 2009). In addition, there were more than 100 documented cases in the literature where the right coronary artery solely supplied the entire heart; all of these cases were reported in humans. However, Taha (2001) has reported congenital absence of the left coronary artery in a bovine calf and that the larger part of the right coronary artery curved caudally around the origin of the pulmonary trunk reaching the left longitudinal groove and at about its middle it divided into two main branches and several smaller branches that supplied the left and right ventricles.

Materials and Methods

A total of 20 hearts were obtained from adult camels (*Camelus dromedarius*). Injection techniques were employed to study the blood supply of the left and right coronary arteries. They were injected with red vinyl acetate. Then the injected hearts were immersed in 10% formalin for 15 days. Finally, dissection was performed carefully to study the course of the coronary arteries.

Results and Discussion

The congenital anomaly associated with both left and right coronary arteries was observed in one heart out of the twenty dissected. In this heart, the right coronary artery shortly after its origina from the cranial aortic sinus ran cranially in the coronary groove for a distance of 3cm and then divided into two major branches (Fig.1). A cranial circumflex branch (Fig.1&2) continued its course in the coronary groove until reaching the subsinuosal interventricular (right longitudinal) groove in which it descended (Fig.2).

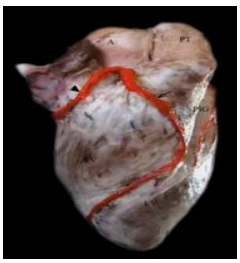

Fig.1: Cranial aspect of the heart. Note that the right coronary artery divided into two major branches a cranial circumflex branch (arrow head) and the large caudal branch (arrow). (A) Aorta; (LV) left ventricle; (PIG) paraconal interventricular groove; (PT) pulmonary trunk; (RV) right ventricle.

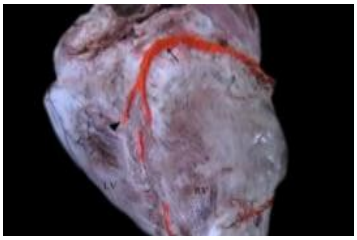

Fig.2: Right aspect of the heart. Note that the cranial circumflex branch reaching the subsinuosal interventricular groove dividing into two branches the cranial branch (arrow head) dipped in the myocardium, and caudal branch (arrow). The later was bridged twice by myocardium and it ran towards the apex of the heart.

It then divided into two branches in the proximal third of the groove. Both branches descended in the groove. Thecranial of the two branches dipped in the myocardium and the caudal one was bridged twice by myocardium as it ran towards the apex of the heart (Fig.2). The large caudal branch of the right coronary artery which does not normally exist, assumed a peculiar course (Fig.1). It ran ventrally and 2caudally around the origin of the pulmonary trunk until it reached the middle part of the paraconal (left longitudinal) groove where it descended distally. Just above the apex of the heart it ran cranially almost reaching the subsinuosal interventricular groove. In the same heart, the left coronary artery which originated from the caudal aortic sinus divided as usual into paraconal interventricular and caudal circumflex branches. This division has not occurred as usual at the level of the paraconal interventricular (left longitudinal) groove but a little bit caudal to it (Fig.3). The paraconal interventricular branch assumed a peculiar course too by descending parallel and caudal to the paraconal groove and thus has left the proximal two thirds of the paraconal groove devoid of any artery. However, the distal third of the groove was occupied by the anomalous branch of the right coronary artery which was mentioned above. These two abnormal courses of the coronary arteries have not previously been reported in the camel. However, abnormalities of the coronary arteries in other domestic animals have previously been reported except the camel included: absence of one of the two ostia, origin from the pulmonary trunk, aneurysm of one or both arteries, hypo- or hyperplasia of one or both arteries, complete absence of one of the two arteries (van Nie,1968; Genitzler, et al., 1975; Sandusky and Smith, 1978; Vidne, et al., 1979; Sandusky and Smith, 1981; Bestetti, et al., 1985; Smith and Fisher, 1987; Shively, 1987; Dyce, et al., 1996; Taha, 2001; Durán, *et al*., 2009).

Fig.3: left aspect of the heart. Note that the left coronary artery (arrow) runs laterally and caudally between the pulmonary trunk (PT) and the left auricle (LA). The division of the artery into paraconal interventricular (PI) and the left circumflex (LC) arteries occurred a little bit caudal to the usual position (*) at the level of the paraconal interventricular groove (PG). Note also that the paraconal interventricular artery runs parallel and caudal to the paraconal groove and furnishes branches (arrows head) to the left ventricle (LV).

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44. Computed Tomography and Cross Sectional Anatomy of the Metacarpus and Digits of the One-Humped Camel and Egyptian Water Buffalo

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Introduction

The camel and buffalo are very important meat producing animals, as well as the buffalo is the main milk producing animal in Egypt. Classical anatomic atlases do not provide wide views for modern diagnostic and surgical techniques. CT was not initially used in veterinary medicine because of its limited accessibility and high costs. However recently the accessibility has improved, which has increased the need of expertise in the use of this technique in animals (Bahgat, 2007; Vanderperren *et al*., 2008; Raji *et al*., 2008). The purpose of this study was to provide an atlas of synchronized normal computed tomography and cross sectional anatomy of the metacarpus and digits in the one-humped camel and Egyptian water buffalo to provide a basis for diagnosis of their diseases by the aid of CT.

Materials and Methods

The present work was carried out on the metacarpus and digits of twelve symptomatically healthy adult camel and buffalo. The specimens underwent consecutive CT scan, with slice thickening of 1 cm, using TOSHIBA 600 HQ (Ahmed Farid radiology Center-Benha). After CT images were obtained, the buffalo and camel metacarpus and digits were frozen at -20° then sectioned transversely using an electric band saw, to correspond with the CT images. Important anatomic structures were detected and labeled in gross cross-sections photographs and its corresponding CT scans.

Results and Discussion

The skeleton of the metacarpus was formed in both animals by the fused third and fourth metacarpal bones. The small metacarpal bone (Mc.V) (Fig 1) was present in the buffalo and absent in camel. In both animals, the medullary cavity of the fused third and fourth metacarpal bones was divided internally by a vertical bony septum which was a complete septum in the camel, complete at the proximal and distal extremities in the buffalo and small, incomplete fused shaft in buffalo (Figs 1-4). The CT of the present study in both camel and buffalo showed the adjacent extensor tendons as transverse narrow strap with undifferentiated outlines on the dorsal aspect of fused metacarpal bones, proximal phalanges and middle phalanges. The flexor tendons are seen as roughly rounded mass with undifferentiated outlines on the palmar aspect of fused metacarpal bones, proximal phalanges and middle phalanges. The undifferentiated outlines of the adjacent extensor and flexor tendons in CT images is equivalent to cross sectional anatomy without dissection of the intervening fascia, where the outlines didn't appear in the latter also. Therefore, the cross sectional anatomy is superior to CT only when the intervening fascia is dissected (Figs 1-4). CT is an excellent imaging modality, and has some potential advantages over routine radiography; it provides images which can be used for better diagnosis of abnormalities and for evaluating the extent and severity of the lesion (Mackey *et al* 2008). Also, has considerable advantages over CT ultrasonography because ultrasound images represent only a portion of the complete cross-sectional anatomy and is unable to penetrate structures that contain minerals (Samii *et al*., 1998).

Legends of Figures

Panels A&B in each figure were a distal view of CT scans of camel and buffalo, respectively, and panels C& D were cross sections anatomy of camel and buffalo, respectively.

Fig. 1: CT scans and cross sections at the base of large metacarpal bone (1) 3rd and 4th metacarpal bones, (2) bony septum, (3&4)-medullary cavities, (5) interosseous muscle, (6&7) medial and lateral tendons of common digital extensor muscle, respectively, (8) Tendon of lateral digital extensor muscle, (9&10) Tendons of deep and superficial digital flexor muscles, respectively, (11) 5th metacarpal bone in buffalo.

Fig. 2: CT scans and cross sections at the level of the middle of the shaft of the large metacarpal bone. (1) Fused third and fourth metacarpal bones, (2) bony Septum between fused third and fourth metacarpal bones, (3&4)-Medullary cavities, (5) interosseous muscle, (6) Tendon of common digital extensor muscle, (7) Tendon of lateral digital extensor muscle, (8&9) Tendons of deep and superficial digital flexor muscles, respectively,

Fig. 3: CT scans and cross sections at the level of the metacarpophalangeal (Fetlock) joint. (1) Distal end of third metacarpal bone, (2) Distal end of fourth metacarpal bone, (3) Intertrochlear notch, (4) Proximal sesamoid bone, (5) Metacarpophalangeal articulation, (6) collateral sesamodean ligamens, (7) palmar ligaments, (8) inter-digital intersesamoidean ligament 9- divided Tendon of deep digital flexor muscle, (10) Tendon of superficial digital flexor muscle, (11) Manica flexoria, (12) Fifth digit of buffalo.

Fig. 4: CT scans and cross sections at the level of the distal interphalangeal (Coffin) joint. (1) Distal end of middle phalanx of third digit, (2) Distal end of middle phalanx of forth digit, (3) Distal phalanx of third digit, (4) Distal phalanx of fourth digit, (5) Distal sesamoid bone, (6) Tendon of deep digital flexor muscle, (7) Tela subcutanea tori (digital cushion), (8) Distal interphalangeal articulation, (9) distal Interdigital ligaments.

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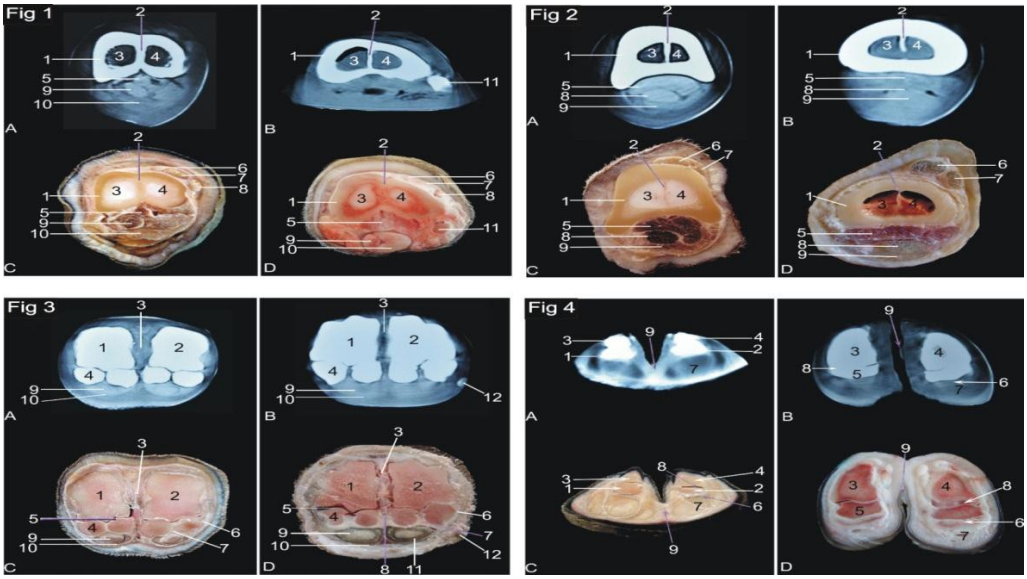

45. Histological and Hormonal Studies of the Goiter in the Dromedary (*Camelus dromedarius*)

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Goiter is a pathology well investigated in humans but in veterinary medicine, studies related to this condition are very scarce particularly in dromedary. This study examined and compared the histological features and hormonal traits of 25 goiter-identified individuals and 75 normal camels. Macroscopically, the goiter is characterized by enlarged thyroid glands and the presence of cysts from 2.9 mm to 3 mm in diameter containing a yellowish thick liquid. Weight characteristics of the thyroid and its lobes were different being goiter-identified and normal animalsrespectively: 38.28 ± 4.51 g and 12.09 ± 2.50 g for the right lobe, 39.33 ± 5.48 g and 12.18 ± 2.30 g for the left lobe, 3.76 ± 0.63 g and 1.59 ± 0.70 g for the isthmus and 81.37 g ± 9.21 and 25.87 ± 4.16 g for the thyroid gland. The histological study showed that in goiter-identified individuals, colloidal structure present an important structural change of the vesicles with the presence of thyroid follicles rounded, oval, tubular or irregular, of variable sizes. Some follicles are filled with an overly distended colloid rich, homogeneous colored pink and sometimes calcified and an epithelium flattened. Others remain small and hyperplasic epitheliums with cubic or cylindrical that present on some locations a proliferation of cords or papillae. The estimated percentage of interstitium with "LEICA Qwin" shows a densification of the fibrous thyroid stroma of goiter-identified camels. For goiter-identified camels, the immunohistochemical study shows that the cells are marked by antibodies anti thyroglobulin and there is a presence of a colloid substance between the thyroid follicles.

Determination of thyroid hormones and the Thyroid Stimulating Hormone (TSH) serum concentrations showed a significant decrease ($P<0.05$) of all concentrations in goiter-identified individuals when compared to normal animals. Serum concentrations for respectively goiter-identified and normal animals were 7.80 ± 0.25 (pmol / l) compared to 14 30 ± 0.50 (pmol / l) for free thyroxin (FT4), 1.64 ± 0.08 (pmol / l) compared to 4.12 ± 0.16 (pmol / l) for free tri-iodothyronin (FT3) and 0.016 ± 0.016 (pmol / l) compared to 0.137 ± 0.008 for TSH.

46. Surface Morphology Investigation of Tunisian Dromedary Hair

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Introduction

In Tunisia, there are some 100,000 camels (*Camelus dromedarius*) that produce more than 100,000 kg of hair annually (Sghair, 2003); however, only a small quantity is harvested and used by Bedouin people to make traditional clothes. Great effort is needed to make the farmer conscious of the importance of camel hair as an income product. Investigations are needed to demonstrate to the industrial supervisors that this product could contribute to the national needs of hair and reduce their outcomes. Thus, we describe the morphological properties of dromedary hair with the aim of providing means for identifying and to distinguish these fibres from other animal fibres used in textile industry.

Materials and Methods

The samples of the dromedary fleece of various ages were obtained from the Arid Lands Institute, Medenine, Tunisia. Using the hand microtome, we obtained 'fiber snippets 0.4 mm long, regardless of fiber diameter. The fibers were mounted on aluminum stubs with double sided adhesive tape and sputter-coated with 20 nm thick gold layer in rarefied argon. Scanning electron microscopic (SEM) analyses were performed using an S360 model (LEO, Oberkochen, Germany).

Results and Discussion

The results show that the diameter of dromedary hair raw materials varies from 10 to 135 µm or greater. There are two distinct fibre populations: the fine one is of textile relevance and the coarse one is rather worthless and must be separated prior to spinning and subsequent processing. The dehared (separated) dromedary fibre presents a relatively low mean fibre diameter (≈17 µm) with a high coefficient of variation (CV ≈25%). The individual finesses varies from 10 µm to 50 µm with a rarely fibres greater.

Figure 1 shows that the scales of the dromedary fibre are on average extremely long and quite visible; they tend not to protrude from the fibre, appear almost convex, and provide a wavy appearance in profile of the relatively coarse fibre.

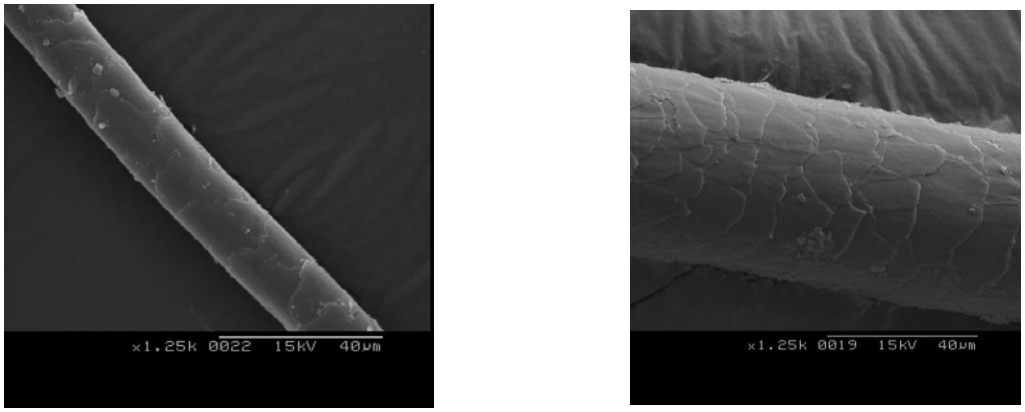

Figure 1 Appearance of the dromedary hair (undercoat on the left and guard hair on the right).

On counting the scale frequency, that is, the number of scale margins within a determined fibre length of 100 µm on the surface of a fine (diameter < 30µm) and coarse (diameter > 30µm) dromedary fibre, comes out roughly 5 at 8 and 8 at 12 scale margins, respectively. This displays well a significant difference for the superficial structure, which is the overlapping of the cuticle cells (Bauters, 1982). Phan *et al*. (2000) found that fine and coarse cashmere fibres provide the same scale frequency, with 6

at 7 scale margins. Hence, based only on the scale frequency, it is impossible to identify the cashmere fibre from fine dromedary hair.

The mean height of the cuticle scale is 0,12 µm and 0,24 µm respectively for fine and coarse dromedary fibre. These explain why dromedary fibres present a soft touch due to the prominence of the scale edges. This aspect of the surface structure has a high correlation with the felting capacity of the matter, and contributes to the concepts of handle and gloss. The height of the cuticle scale is approximately 0,8 µm for wool. Dromedary hair can therefore be easily distinguished from wool.

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Pastoral Systems

47. Camel Production Systems in Egypt and their Role in Rural Livelihoods

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Introduction

Camel meat presents about 10% of the red meat consumption in Egypt. Majority of the camels are imported from Sudan, and lesser share from Somalia and Djibouti; around 130,000 heads are raised in the arid and semiarid governorates of Egypt (FAO, 2010). Over the last ten years the preference for camel meat increased significantly from 12 to 30 thousand tons of meat consumption (MALR, 2010). Camel husbandry activity has been raised at the South border and East Delta governorates. With the increase in the demand of camel meat, and its low production costs, camel production has become a promising mean of reducing the gap between production and consumption of red meat in Egypt.

Materials and Methods

Afield survey was conducted in four different locations in Egypt, with high camel populations, during the year 2010/2011. A total of 116 camel herders were interviewed with a structured questionnaire (Table 1); 29 among which were from the coastal zone of Western Desert (Matrouh governorate), 29 from the South border with Sudan (Aswan governorate), 28 from the East Delta region (Sharkia governorate) and 30 from Oasis region (New valley governorate). Information, regarding production system, production and reproduction performance, marketing, contribution to family income and main constraints facing camel herding were collected.

Results and Discussion

Three main camel production systems prevailed in the four locations; (1) a house hold landless system is the main production system in Sharkia (71%) and in 38 % of the camel herders in Aswan. The system is based on fattening of camel- calves, either locally produced or imported, on concentrates and crop residues; (2) Crop-livestock system, that represent 60 % of the herders in New valley and 52 % in Aswan; (3) Ranching system prevailed in Matrouh (97 %) and in some herds in New valley and Aswan (17 and 10 % respectively). Herds in Matrouh and New valley are breeding herds, while those in Sharkia and Aswan are mostly ―flying‖ herds that are only kept for three to four months. Live camels are a major regional trade business between Egypt and east African countries (especially Sudan and to a lesser extend Somalia and Djibouti) through the Egyptian - Sudanese border or along the Red Sea cost to Shalatin and west to Abo- Simbel. The destination of both trade routes is the famous Daraw camel market in Aswan. Around 40-50 % of the camels are then shipped by trucks to Birqash market West of Cairo. Traders from Sharkia and other Delta governorate buy imported camels for slaughtering after a short fattening period.

Table 1: Camel production systems in the studied locations

Governorate	Matrouh	Aswan	Sharkia	New Valley
No. of herders	**29**	**29**	**28**	**30**
Production systems (%):				
House-hold landless system	3	38	71	23
Crop-livestock mixed system	0	52	25	60
Ranching system	97	10	4	17
Breeding herds (%)	100	21	7	90
Herd size(%):				
1-10 (small)	16	3	0	20
11-30 (medium)	0	24	3	6
> 30 (large)	3	50	3	4
Main camel breeds	Maghrabi	Sudani	Sudani	Maghrabi + Moaled*

* Moaled is of cross between Sudani and native Egyptian camel.

Majority of the camel owners take care of their herd by themselves. Only 7% in Aswan and 3% in Matrouh used rented herders. Around three-quarter of the herders in the four locations are able to read

and write, whereas around 10 % were illiterate. Fourteen percent of the camel owners in Sharkia have completed their university education.

The herd size differs significantly according to the production systems that prevailed in each location. Herd sizes in Matrouh are distributed equally between small, medium and large herds dependent on the capital resources of the herders, whereas small herds were predominant in Aswan, Sharkia and New valley governorates for fattening or as a rivalry business with other crop-livestock activities.

Camels contribute more than 60 % of the total income of half the Sharkia herders (table 2). Most of these herders fattened camel-calves for a short cycle of 3-4 months. A similar production pattern is followed by 31% of the herders in Aswan. In Aswan and Matrouh governorates camels contributes in average 40-60 % of the family income of the herders. **C**ontribution to family income was relatively low in New valley, wherein 94% of the herds camels supplied up to 40 %. Camels are a source of investment for farmer with low risk and minimum management requirements (Jasra and Isani, 2003).

Table 2: Contribution to family income

Governorate	Matrouh	Aswan	Sharkia	NewValley
Up to 40 % (low)	52	38	36	94
40 – 60 % (medium)	31	31	14	3
More than 60 % (high)	17	31	50	3

The major constraint facing camel production reported by 90% of the herders in Matrouh and 72% in Aswan was the price of concentrated feed (table 3), which is related to the lack of forages and crop residues in both governorates. It was also seen as an important constraint by 46% in Sharkia and 30% in the New valley.

Table 3: Major constraints facing camel herding as expressed by the herders

Governorate	Matrouh	Aswan	Sharkia	NewValley
No. of herders	18	18	17	24
Price of concentrate feed %	84	61	46	30
Price of water%	48	3	0	13
Diseases %	6	7	0	3
Drought %	31	7	0	20
Cost of labors %	0	0	37	60
Trans-border animal migration problems %	3	13	0	0

Another important constraint in Matrouh was herd watering as reported by 50 % of herders, they bear extra costs for transferring water to their herds. In New valley, labor cost was named often, as constraint (60% of the herders) and to a lesser extent by the herders in Sharkia (37%). Frequent droughts affecting the conditions of natural rangeland, were listed as a problem by the herders in Matrouh and New valley 31 and 20% respectively. Trans-borders animal migration problems were highlighted by Aswan herders.

In conclusion, camel production is a rising business in Egypt due to an increased demand of their meat as cheap source of animal protein, and presents an important source of income (up to 60%) for vulnerable communities in arid governorates of Egypt. Camels represent a high potential regional trade business between East African Arab countries.

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48. Farmers' Attitude Towards Interventions Regarding Camel Calf Health Care and Management Practices Under Pastoralists Conditions

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Introduction

The camel is an important species uniquely adapted to hot and arid environments (Schwartz, 1992) and, therefore, contributes significantly to the food security of the nomadic pastoral households. This unique adaptability makes this species ideal for exploitation under the arid and semi-arid land conditions. The contribution of camels to the human welfare of developing countries is generally obscured by several factors, which tends to underestimate their true value. Firstly, the estimates of camel populations are usually inaccurate due to lack of periodical census. Secondly, their products seldom enter a formal marketing system; thus, their contribution to subsistence and the national economy tends to be grossly underestimated. As a consequence, less attention has been given to camel improvement for so long in the national development plans (Njiru, 1993).

Productivity of the animal depends on genetics, health status and management. Proper management and health practices ultimately lead to improved production and reproduction. A survey was conducted to observe the existing management practices to calf health in relation and to suggest where interventions are required for the improvement of health and production of camel calves in the study area.

Material and Methods

Forty-eight camel herds were visited in the peri-urban areas of Jhang. The farms were categorized as small-sized herd (having up to 2 milch female camels), medium-sized herd (having 3-5 milch female camels) and large-sized herds (having more than 5 milch female camels). The following information was obtained on predestined proforma through interviewing the camel herders: i) Care and management of calves, ii) Disease pattern, iii) Health management practices (deworming and post natal treatment) vi) Feeding management and mortality percentage.

The data were analysed using SPSS-Ver.16. The techniques of Chi-square ($\chi 2$) and Somers'd were used to test the relationship between herd size (HS) and different indicators of health care and management of camel calves for the variables measured on nominal and ordinal scales, respectively.

Results and Discussion

This study revealed that in the study area incidence of mange was maximum (85.4%) in all categories of herd size (Table 1). Overall mortality rate was 65.8% among all herd sizes and was not significantly ($p>0.05$; $\chi^2=0.606$) different among different herder's level (Table 2). Table 4 demonstrates various husbandry practices adopted by camel herders.

Table 1: Disease incidence in camel calves at different herder's level

Disease	Small (n=16)	Medium (n=16)	Large (n=16)	Total (N=48)
Mange	13 (81.3)	15 (93.7)	13 (81.3)	41 (85.4)
Diarrhea	10 (29.4)	11 (32.4)	13 (38.2)	34 (70.8)
Pneumonia	12 (35.3)	11 (32.4)	11 (32.4)	34 (70.8)
Camel pox	5 (27.8)	7 (38.9)	6 (33.3)	18 (37.5)
Anthrax	2 (25.0)	3 (37.5)	3 (37.5)	8 (16.7)
Average	8.4 (39.8)	9.4 (46.9)	9.2 (44.5)	27 (56.3)

Table 2: Mortality in calves at different herder's level

Herd Size	Born	Died	Mortality rate (%)
Small	30	18	60.0
Medium	76	50	65.8
Large	84	57	67.9
Total	190	125	65.8

Findings regarding calf mortality are in accordance with Mukasa-Mugerwa (1981), Hussein (1987), Agab and Abbas (1998), Kamber *et al*. (2001) and Farah *et al*. (2007) who have reported mortality rate more than 50%. Occurrence of mange at maximal intensity (83%) was also reported by Al-Rawashdeh *et al*. (2000).

Table 3: General condition of camel calves at different herder's level

condition	Small (n=8)	Medium (n=10)	Large (n=11)	Total (N=29)
Good	**6 (54.5)**	**1 (10.0)**	**1 (9.1)**	**8 (25.0)**
Average	**3 (27.3)**	**2 (20.0)**	**3 (27.3)**	**8 (25.0)**
Emaciated	**2 (18.2)**	**7 (70.0)**	**7 (63.6)**	**16 (50.0)**
Total	**11 (34.4)**	**11 (31.2)**	**11 (34.4)**	**32 (100)**

Table 4: Various husbandry practices adopted by camel herders

Parameters	Small (n=16)	Medium (n=16)	Large (n=16)	Total (N=48)
Time of first colostrum feeding				
Before placenta expulsion	2 (12.5)	3 (18.8)	3 (18.8)	8 (16.7)
After placenta expulsion	14 (87.5)	13 (81.2)	13 (81.2)	40 (83.3)
Type of treatment				
Call a vet. immediately when calf fell sick	3 (18.8)	2 (12.5)	3 (18.8)	8 (16.7)
Use indigenous medicines then call a vet.	8 (50.0)	2 (12.5)	1 (6.2)	11 (22.9)
Never call a veterinarian	5 (31.2)	12 (75.0)	12 (75.0)	29 (60.4)
Deworming				
Yes	-	2 (12.5)	1 (6.2)	3 (6.2)
No	16 (100)	14 (87.5)	15 (93.8)	45 (93.8)
Separate space allocation				
Yes	-	-	1 (6.2)	1 (2.1)
No	16 (100)	16 (100)	15 (93.8)	47 (97.9)
Manger provision				
Yes	-	2 (12.5)	2 (12.5)	4 (8.3)
No	16 (100)	14 (87.5)	14 (87.5)	44 (91.7)

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49. Description of Two Complex Traditional Fostering Husbandry Techniques Used by Camel Pastoralists in the Horn of Africa and Arabian Peninsula

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Introduction

A lactating camel, contrary to other domestic livestock species such as cattle, requires the presence and interaction of a calf to achieve a long and abundant lactation. In the case of calf deaths or rejection the lactation of the mother is usually very short: 3-5 months instead of the normal 14-16 months, and the amount of daily milk produced reduced (Schwartz and Dioli, 1992). It is therefore essential that a lactating camel, in case her calf dies, readily adopts another calf or that a newly lactating camel does not reject her own calf. This objective is achieved implementing a set of complex husbandry techniques: ―*qalla'h*‖ used in the Horn of Africa (Dioli, 2007) and ―*diar*‖ used in the Arabian Peninsula.

Materials and Methods

The observations and clinical descriptions of the fostering techniques described in this paper have been obtained by directly witnessing camel herdsmen implementing ―*qalla'h*‖ and ―*diar*‖ set of procedures on two female camels that had both lost their own calves and were forced to foster different calves. Observations were integrated with clinical examinations of the mothers and in depth interview with the livestock herdsmen performing the procedure.

Results

The first camel was an adult female of Somali breed, approximately 8 years, belonging to a herd kept in northern Kenya, who had recently delivered but subsequently lost her 2-month old calf for unknown causes. The herdsman (ethnic Somali) decided to use the ―*qalla'h*‖ technique so that a new calf could be adopted by the orphan mother and her lactation retained. The technique ―*qalla'h*‖ is widely used among all camel pastoralist of the Horn of Africa, particularly by ethnic Somali. It consists in the occlusion of the anus and concurrently in the partial occlusion of the nostrils. To achieve this two flat pieces of wood are applied to the stretched skin folds of the anus and then tightened together trapping the skin folds between them and therefore impeding defecation. Immediately after that long flat stripes of bark are applied around the nostrils to partially obstruct the nostrils and to obstacle nose breathing. (Figures 1 and 2). The devices were applied for two days consecutively: from early morning, left on throughout the day and removed in the early evening: 18-1900. During this period the female camel was not allowed to graze with the main herd but kept in proximity of the camp together with the foster calf and constantly supervised by the herdsman. During this period the herdsman physically encouraged several times the foster calf to suckle and in each of these occasions the behaviour of the female camel was closely monitored to assess the degree of rejection and the strength of her ―milk let down‖ reflex. At the end of the second day the strategy was successful and upon removal of the devices the camel adopted the foster calf as her own calf and therefore no devices were applied in the subsequent days. The second female camel was an adult female approximately 10 years old of Omani bloodline, belonging to a herd kept in the outskirts of Abu Dhabi (UAE), who had recently delivered but lost her calf 24 hours earlier. The herdsman (ethnic Omani) decided to utilise the ―*diar*‖ technique so that she could foster another calf. The ―*diar*‖ technique is used in all Arabian Peninsula and is very similar to the ―*qalla'h*‖ aiming to occlude the anus and the nostrils. However there are important differences: the anus is closed by the insertion of a large cloth ―cork‖ into the rectum that is kept in situ by a thread stitched to the perianal skin, the loose threads subsequently tied to a transversal piece of wood and then all tied together with thick cloth thread (Figures 3 and 4). The nostrils are not partially occluded but totally blocked by the insertion deep into the nasal sinuses of cloth balls and subsequently by wrapping several ―sock like‖ cloths over all the nostril area (Figures 5 and 6). The herdsman reported that in some cases, to ensure that the nostrils are totally occluded, ―instant glue‖ is applied around the rim of the nostrils and then the nostrils pressed shut till the glue dries. The devices were applied for a few hours from around midmorning till early evening. During this period the female camel was kept in a paddock with the foster calf and constantly supervised by the herdsman. The devices were removed by the herdsman in

the evening of the same day upon detection the complete acceptance of the foster calf. The consequence on both camels subjected to the ―*qalla'h*‖ and ―*diar*‖ techniques were mainly behavioural with the exhibition of marked symptoms of distress through prolonged vocalization particularly during the application of the device restricting nose breathing. The perianal mucosa and nostril areas were slightly oedematous and hyperaemic more so in the case of the ―diar‖ since the small traumatic lesions in the perianal skin caused by the inserted threads. However no permanent wound developed and both female camels continue a normal lactation with their foster calves.

Discussion

These two traditional practices: ―*qalla'h*‖ and ―*diar*‖ and their small variations are used virtually in all countries in Africa and Arabian Peninsula although they are complex and not easily implemented. Obviously the reason of such a widespread use is their effectiveness in convincing a female camel to adopt her rejected calf or a calf that is not her own. Such effectiveness is probably due to combination of two main reasons:

- The devices cause such a profound distress to the animal that rejection behaviour toward her own calf or toward the foster calf is completely inhibited. It must be mentioned that camels are obligatory nose breather and therefore the occlusion of the nostrils cause a marked feeling of impending suffocation. The increasing abdominal pain caused by the progressive accumulation of faeces in the intestine also undoubtedly strengthens this distress.
- Establishment of the Ferguson effect: the accumulation of faeces in the terminal portion of the intestine cause pressure on the vaginal walls causing the production of oxytocin and the consequent setting up of milk let down reflex. The validity of this hypothesis is confirmed by the custom, among Somali camel pastoralist, before milking an orphan lactating camel of briefly occluding the anus with the same device use in ―*qalla'h*‖ to stimulate the milk let down reflex.

It is undeniable that ―*qalla'h*‖ and ―*diar*‖ exert a great deal of stress on the animals on which they are applied. These practices may without doubt be classified as outright animal cruelty. As such they are ethically to be condemned. Obviously animal welfare goes to a second place in the harsh desert environment where a milking camel represents the difference between a live human child and a dead one. However, to adopt s‖*qalla'h*‖ and ―*diar*‖ fostering methods in a modern environment where such survival priorities do not exist is highly questionable and warrant further studies to identify and to develop more humane methods of fostering.

Figure 1

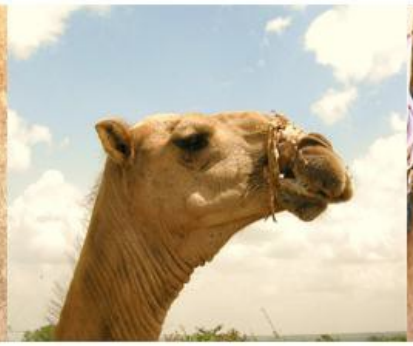

Figure 2

Figure 3

Figure 4

Figure 5

Figure 6

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50. Husbandry Practices of Camel Herders in the Region of El-Oued (Southern-East of Algeria)

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Introduction

Traditionally, camels have been considered a pillar of the pastoral society of the Algerian Sahara. They filled many functions, such as food, transportation, work and tourism. Kaufman (2005) reported that camels (*Camelus dromedarius*) produce milk and offspring and provide transport in pastoral husbandry systems in the Afro-Asian dry land belt. Since the current use of the engine, many camel‘s services have become less important. In parallel, methods of management of animals have significantly changed (Adamou, 2008).

Knowledge in regards to types of camel, breeding and husbandry method employed in Algeria is very limited. Therefore the aim of this study was to evaluate camel management practices under traditional transhumance systems and the husbandry constraints that limit the potential of production. The outcome of this study could have huge importance for the elaboration of any strategy of improvement of camel farming systems.

Materials and Methods

Using a questionnaire that specified the characteristics of camel husbandry systems in the El-oued region. Field visits were arranged to 65 camels herds (4085 camels) in order to identify methods and practices applied in the control and management of reproduction, feeding, production. Data were analyzed by Excel-stat.

Results and Discussion

According to the results of our study 59 % of the interviewed camel farmers were owners, while 41 % were shepherds, however, 74 % of the owners were illiterate. The owners average age was 56 years, 26 % of them are practicing a secondary activity with camel farming.

This investigation showed that 81 % of survived herds were kept under the extensive system, where straying is a predominant feature for camels. This practice has become a common management tool in camel herds to reduce the nutritional requirements and workforce during periods of nutritional shortage. However, in extensive system, it is impossible to control reproduction, breeding and feeding. Also, it is difficult to control the sanitary conditions of the animals and zoonotic transmission.

In agreement with Adamou (2008), our results showed that the mean size of herds were about 72 heads with a minimum of 3 heads and a maximum of 656 heads. About 80% of the investigated herds were managing their livestock without habitats or niches for the animals. Additionally, some owners, in order to slaughter, practice fattening camels in fattening units in which the tethering is the widespread system. This new system seems to develop in recent years, following the increase in prices of red and white meat and the high consumption of camel meat.

The data of the present study indicated that the average weaning age of camel calves in the area is more than 1 year. Camels are watered every 1 or 2 days during the dry months. Camels might come in contact with other species of animals during breeding (24.5%), grazing (56.5%), and at watering points (66 %).

Meat production is the main purpose of farmers because its meat is the only marketed product. More than 98% of the produced milk is used for family subsistence or for free offering. This might be due to the socio-cultural heritage against selling milk in those tribes. Taboos or prejudices are considered as constraints for camel milk marketing in this region.

Table 1: General practices and management in the study area

Different practices	Yes	No
Origin of breeding stock :		
Heritage	100	0
Sheep	0	100
Type of herds:		
Mixte with other live stock	66	34
Only camel	34	66
Contact of camels with others animals:		
During breeding	24.5	75.5
During browsing	56.5	43.5
At water points	66	36
Al the time	7.5	92.5
Caring of the farms by farmers:		
Thermselves	83	17
Their children	64	36
Others	23	77
Supplementation with cut-forage	7.5	92.5
Supplementation with consenter	73.5	26.5
Shortages in carmels feed	92.5	7.5
The management of shortage in feeds:		
Transhumance	28	72
Buy commercial feeds	36	64
Reduce the number of camels	79	21
Watered by:		
Community well	100	0
Water pipe	0	100
Buying water	0	100

Different practices	Yes	No
Breeding system:		
free-mating	100	0
Hand mating	0	100
Paddock mating	0	100
Weaning age:		
Less than 1 year	6	94
1 year	70	30
More than 1 year	24	76
Castration of male camels	0	100
Selection of the breeding male:		
Appearance and physical strength	89	11
Breeds	81	19
Productions	15	85
Uses of antibiotics to the newly arrival camel	83	17
Screen for diseases before introduction to the herds	94.5	5.5
Veterinarian visits:		
No	70	30
Rare	28	72
Usually	2	98
The use of Supplementation in camels farms:		
Winter	32	68
Spring	7.5	92.5
Summer	62.2	37.8
Autmn	22.6	77.4

Owners believe that the rutting male can breed from 50 to 120 dams in each season. The selection of the breeding male depends on the appearance, physical strength, behavior, and breeds.

Table. 1 shows that most of the farmers practiced the free-mating in the pasture, whereas the hand mating and the paddock mating are seldom practiced. However, the only practical method used for pregnancy diagnosis in camel reproduction is the visual method (cocking of the tail, frequent urination).

According to 85% of the farmers, calving is usually uncomplicated and the incidence of dystocia is very low, however neonatal mortality appear to be a major problem. This can be explained by the lack of the evaluation and the care of the peri-parturient females and the newborns in 89% of cases; these practices are of great importance in reproductive management (Tibary and Anouassi, 1997**)**. However, a significant lack of health coverage by the veterinary policy was observed in this survey.

Castration of male camels that are not suitable for breeding is not practiced in this region; while, in the regions of South West of Algeria, castration technique is a common management for fattening purpose (Aichouni, 2007).

Conclusion

Traditional management systems of camels are characterized by low inputs, poor husbandry systems, poor nutrition, poor veterinary care, and poor marketing system. It is possible to develop a farming economy and to produce significantly more milk and meat which reflect in good advantages to the family livelihood, camel and farm sanitation, feeding, general management and husbandry.

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51. First Results of Using Electronic Boluses for Dromedary Identification

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Introduction

Camels are animals showing few distinctive coat traits and needing auxiliary marks for individual recognition within and between herds, which is a critical point for implementing performance recording, traceability, genetic and health improvement programs. Camel identification is traditionally done using hot iron branding (the ―*washm*‖) on high and most visible body parts (e.g. under or behind the eye or ear, cheek, neck, upper part of the legs) on either body sidethat will not be covered by long hair, as reviewed by Landais (2001) and Hilden (2011). Nevertheless, these marks are not compatible with current animal welfare standards and have limited utility when used at regional or national level.

The purpose of this work was to assess the performances of different camel identification systems under Egyptian conditions.

Materials and Methods

A total of 83 camels (*Camelus dromedarius*) of 5.7 ± 0.5 yr of age (range, 1.1 to 13.8 yr) and 444 ± 16 kg BW (range, 59 to 691 kg BW) from the APRI Camel Experimental Farm at Marsa Matrouh (Matrouh Governorate, Egypt) were used. They were in loose stalls and fed berseem clover hay (1 to 2.5 kg/d), rice straw (1 to 2.0 kg/d), saltbush (1 to 2.0 kg/d) and concentrate (0.5 to 3.5 kg/d) according to their requirements. Older camels (n = 45) had hot iron brands (1 to 3 digits, 20 cm high) and the readability of each brand digit was visually evaluated. All camels were initially tagged in the left ear with 1 rectangular plastic tag (2 flags, 15 × 50 mm, 3 g), laser recorded in both flags with a 3 digits number, and with 1 electronic bolus applied by trained operators according to Caja *et al*. (1999). Boluses were cylindrical capsules of different dimensions (W, weight; V, volume) and made of different materials to reach 2 ranges of specific gravity (SG) as shown in Table 1. Low SG boluses were designed to be lost for calculating the bolus retention model in camels. All boluses contained a 32 × 3.8 mm radiofrequency transponder (Ri-Trp-RR2B-06, Tiris, Almelo, the Netherlands) working at a low frequency (134.2 kHz).

Table 1. Features and number of different types of electronic boluses used in camels (n = 83)

Bolus	Low SG[1] (<2.0)			High SG (>3.0)		
Type	W (g)	V (mL)	n	W (g)	V (mL)	n
Small	12.7 ± 0.1	8.5 ± 0.1	20[2]	20.1 ± 0.2	5.2 ± 0.1	17[3]
Medium	-	-	-	51.4 ± 0.1	14.3 ± 0.1	16[4]
Large	33.3 ± 0.3	22.1 ± 0.1	15[2]	75.1 ± 0.2	22.4 ± 0.1	15[3]

[1]SG = W/V; [2]Specially made prototypes from plastic tubes filled with concrete; [3]Ceramic boluses made by Rumitag (Esplugues de Llobregat, Barcelona, Spain); [4]Ceramic bolus made by Innoceramics (Teramo, Italy).

Electronic boluses were read before and after application (d 0, 1, 2, 7, 14, 21, 32, 61 and approximately every 2 mo until 1.5 yr) using handheld transceivers (Gesreader Ges2S and Ges3S; Datamars, Bedano, Switzerland). Reading data were downloaded by using Rumisoft software (Datamars). Ear tag retention and readability were recorded at the end of the experiment. Readability (0 or 1) of different devices was analyzed with the PROC CATMOD of SAS (v. 9.1; SAS Inst. Inc., Cary, NC) using a Logit model with an estimation method of maximum likelihood.

Results and Discussion

No injuries or casualties occurred during ear tag and bolus applications. Moreover, no relevant changes in camel's health and behaviour were observed as a consequence of the different identification devices used. On the contrary, 18% of the camels showed previous signs of healing problems as a consequence of branding. Moreover, only 38% identification numbers branded were able to be read fully, dissuading of using it. Regarding ear tags, 66% were retained at the end of the experiment, the averaged annual losses being 22% during the first year. Lost ear tags were associated with ear breakages or with healing problems resulting in a large ear hole unable to retain the rectangular ear tag and, therefore, the use of button tags should be preferable. Moreover, reading difficulties were reported because of the height of the ears with respect to the floor. Bolus retention varied dramatically according to SG (Figure 1) in agreement with data from cattle (Ghirardi *et al*., 2006a), sheep (Ghirardi *et al*., 2006b) and goat (Carné *et al*., 2011). High SG boluses (>3) were fully retained (100%) in camels independently of their dimensions (small to large) and weight (20 to 75 g), suggesting that they could also be applied in camel calves.

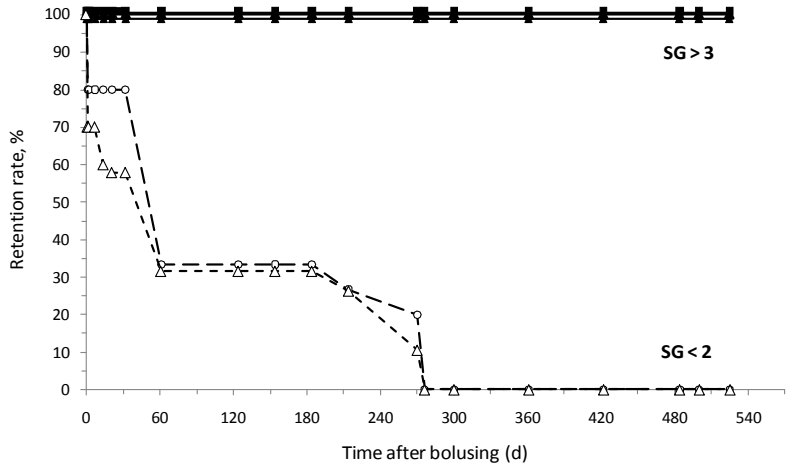

Figure 1. Bolus retention in camels according to dimensions and specific gravity (SG): Low SG (Δ, small; ○, large) and High SG (▲, small; ●, medium; ■, large).

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52. The Semi Intensive Camel Farming a Newly Adopted System in Sudan: Description and Role In Food Security for Herders' Communities

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Introduction

Camels are kept in subsistent production systems as a multi function animal (Ramet, 2001). Female camels can not only maintain milk production under dry conditions when milk from other species is scare, but also for a longer time (Al Haj and Al Kanhal, 2010). Moreover, camels are playing an important role in the economic and social life of nomadic tribes in addition to their contribution as a major source of food security (Farah *et al*., 2007). In Sudan, camels are mainly kept under traditional management systems. Ishag and Ahmed (2011) reported three camel management systems in Sudan. They concluded that the majority of camel owners are adopting sedentary and nomadic management systems. Moreover, El Zubier and Nour (2006) described camel husbandry and practices in the pre-urban area of Khartoum State. In Sudan there are no well established camel dairy farms (Shuiep *et al*., 2008). However, currently a new trend towards commercialization of camel milk associated with the new semi intensive camel system has starting in Khartoum State as well as other big towns. Although selling of milk is neither practiced nor accepted by camel herders in the traditional systems. Hence, the objectives of this study are to characterize and describe the semi intensive camel system and its role in camel herders' communities.

Materials and Methods

Information about the semi intensive management systems was obtained by personal interview with camel owners (n=25) in west Omdurman. The questionnaire was designed to obtain information on general information on household, herd management, uses of laborers for husbandry practices, role of family members in herd management, breeding practices, and structure of herds, economical practices and source of feeding. Moreover, some of information were collected during interviews was supported by personal observations. The data was statistically analyzed using SPSS software version 13.

Results and Discussion

Questionnaire analysis conducted in this study revealed that camel breeders could be categorized in four educational levels as shown in Figure 1. The percentage of graduated camel herders found in this study is higher than that reported by El Zubeir and Nour (2006) and Ishag and Ahmed (2011), they all reported more than 90% illiterates in different camel herder communities. The high percentage of educated herder indicates that more educated people are involved in camel semi intensive system, which could explain the commercial orientation of camel production in contrast to the traditional herders. Moreover the herd size was found as 8.6±4.42, among which the number of productive females, total number of males and number of breeding males were found as 8.4 ±4.19, 0.24±0.52 and 0.20±0.40, respectively. Low numbers for males observed (Table 1) to minimize the cost of rearing, in addition selling young males is an extra income.

Transhumance farmers from North Kordofan and North Darfur States have recently established a new camel management system in Sudan. They own big herds at their home residents (150 to 200). However, they keep a special group of producing females those known by high milk yield in the pre-urban area of west Omdurman, Khartoum State. The animals are kept in an open fences (locally know as *Dakka*). The rearing and management is practiced by the father, his sons or sometime use laborers with experience in handling camel. Moreover producing female camels supplemented with concentrates beside good quality diet in addition to continous water supply. In the semi intensive system female camels are kept in *Dakka* for 12 to 18 months when there is no breeding male in within the herd. The females are then taken to the original herd which is normally localized in natural pasture. However, this period extended up to 24 months in cases that breeding male is

available among the herd for service, after which the pregnant female should also be sent to the main herd in the natural pastures (M. Abdella, Pers. Comm).

Camel herder used labor for milking, which is done twice/day; and produced milk, which is the major reason for this system, is bought at the *Dakka* with high price compared to cow's milk (3 times). Commercialization of camel milk is a new trend practiced in this system as it was not reported in a previous study conducted in the same area by El Zubeir and Nour (2006). This trend might be due to the awareness of the benefits of camel milk which increased the demand. Moreover, the climatic changes during the last decade which caused the limitation of feed availability might also have a role in such changes. The income of this activity contributed to security of the family as well as the original herd.

In semi intensive system there are no other species were kept beside camel. Keeping camel is not cheap (Ishag and Ahmed, 2011). The main costs associated with camel herding according to the interviewees were feeding, taxes and purchase of medications (Table 2). This result is in agreement with Abdalatif *et al*., (2010) and Musa *et al*., (2006) who reported on the influence of these factors in addition to the costs of veterinary services. It could be concluded that the semi intensive camel system recently established in Sudan could play a positive role in food security of herders' communities. Commercialization of camel milk is the main reason behind this system.

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Figure 1: Level of education of camel herder

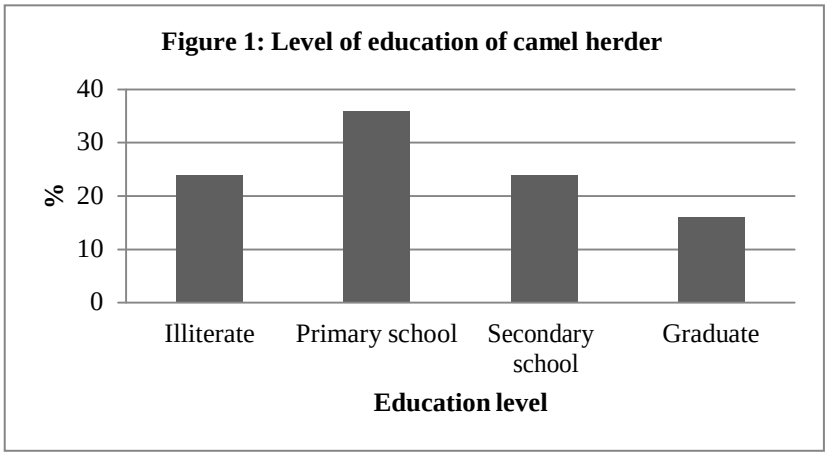

Table 1: Breeding males and their sources in semi intensive system

Male		No. (%)
Breeding	No breeding male	10 (40)
	One breeding male	15 (60)
	Total	25 (100)
Source	From won herd	19 (76)
	Buying from the market	6 (24)
	Total	25 (100)

Table 2: Constrains of rearing camel in semi intensive camel system

Constrains		No. (%)
Coast	Feeding	11 (44)
	Taxes	3 (12)
	Feed and taxes	11 (44)
	Total	25 (100)
Feed	Buying crops	20 (18)
	Grow and buy crops	5 (20)
	Total	25 (100)

53. Impact of Farming System on Calving Interval of Sudanese Camels

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Introduction

The camel is a very important animal in the dry regions because of its ability to provide milk, meat and transport for people under these climatic conditions. In Sudan, camels are traditionally reared in extensive areas with low feed quality and availability. The reproductive efficiency of Sudanese camels under pastoral management (traditional) is low. The calving interval is varying between 28 to 36 months. Low reproductive performance in camels is mainly due to a delayed puberty, long calving interval, limited breeding season, herd dynamics and lack of sufficient feed. The aim of the present study was to investigate the impact of improved management system on camel calving interval.

Material and Methods

Eighteen (18) female camels in late pregnancy and two mature males for mating were used to determine the effect of management system on calving interval, in North Kordofan State (Western Sudan). The camels were selected randomly from Nomadic herd and maintained under two management systems after calving. Group one (N = 9) reared under semi-intensive management: herded during night in closed pen, in addition of natural pasture they received supplementary diet (2 kg concentrates + 5 kg roughage /head/day), watering *ad-lib*, health care, internal and external parasites control were applied. Group two (N = 9) reared under traditional system, depending on natural rangeland and unsupplemented with exception of salt, water regime (6-7 days) was practiced.

In both systems the calves were fellow their dams and suckling was available for the half of the udder during the day. Weaning was depending on pregnancy advance and normally was done by traditional methods. The experimental females in each group kept together with the bull during 18 months the mating were applied naturally without any assistance. Blood samples (N = 252) were collected from jugular vein since 4-months post-partum and continued 14 successive months at monthly interval. The serum samples were separated and stored at -20°C until hormonal assay were performed and progesterone concentration was determined by specific radio immuno assay kits. (Diagnostic Products Corporation, INRA laboratory, France). The progesterone level was compared with behaviour signs of female camel (erect and curving her tail when owner or male coming near her, refusing the male, raising head). The calving interval was calculated by adding the gestation period (12 month) to the period from calving till she camel became pregnant.

Results and Discussion

Under semi-intensive management during post-partum and early lactation period camel‘s reproductive traits were improved. The ratios of pregnant vs non-pregnant during total experimental period (18 months) in semi-intensive and traditional management were 8:1 and 4:5 respectively. The calving interval was shortened under semi-intensive system. In group 1 seven females became pregnant in the period between 5 and 8 month post-partum and the calving interval varying between 17 to 20 months. An additional one became pregnant on 13th month and calving interval was 25 month. In group 2 (traditional system) three she camels became pregnant during the 11 and 16 month post-partum and the calving interval varying between 23 to 26 months, one female camel became pregnant after 17 month post-partum and the calving interval was 29 month.

In pregnant females progesterone concentration increased significantly ($P<0.05$) during early months of pregnancy to a value above 2 ng/ml blood. During pregnancy the value is increased to an

average value of 5.8 ±1.45 ng/ml blood over a period of 8 months followed by a strong decrease during the last two months before calving (Figure 1 and 2).

In conclusion, the findings of the present study assume that the low rate of fertility in the camel under traditional system in Sudan might be due to the general lack of fodder and the poor nutritive value of the natural pastures and water scarcity. This might indicate that in equatorial regions forage and water availability is the major factor governing seasonality of mating and births in camels.Additional feeding of 2 kg concentrates and 5 kg of roughages per day during the lactating period shortened dramatically the calving interval and increased rate of pregnancy. Therefore, it would be possible to expect above 3 times more young calves per year.Blood progesterone can be a valuable tool for assessing early pregnancy in camels coupled with the sensory observations.

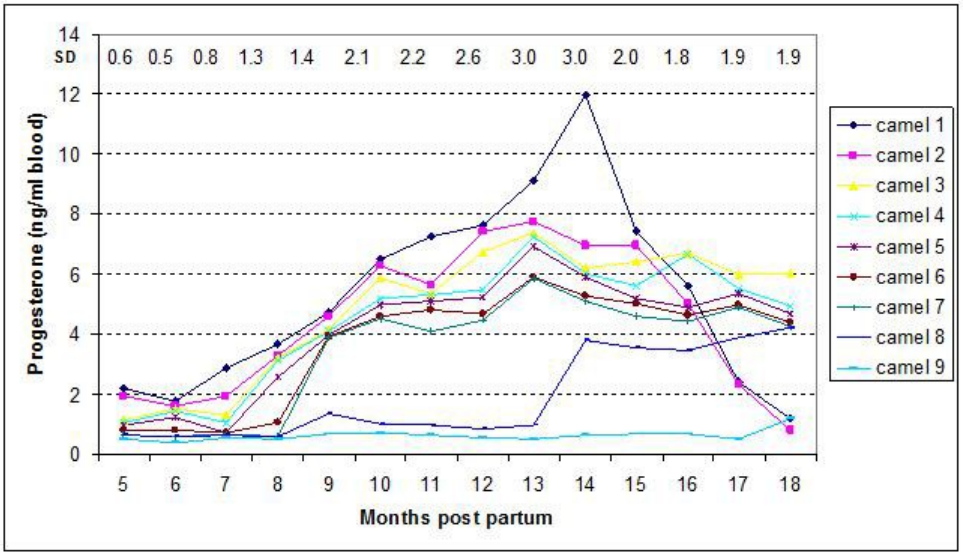

Figure 1: Progesterone concentration (ng/ml blood) on camel under semi-intensive management during the experimental period

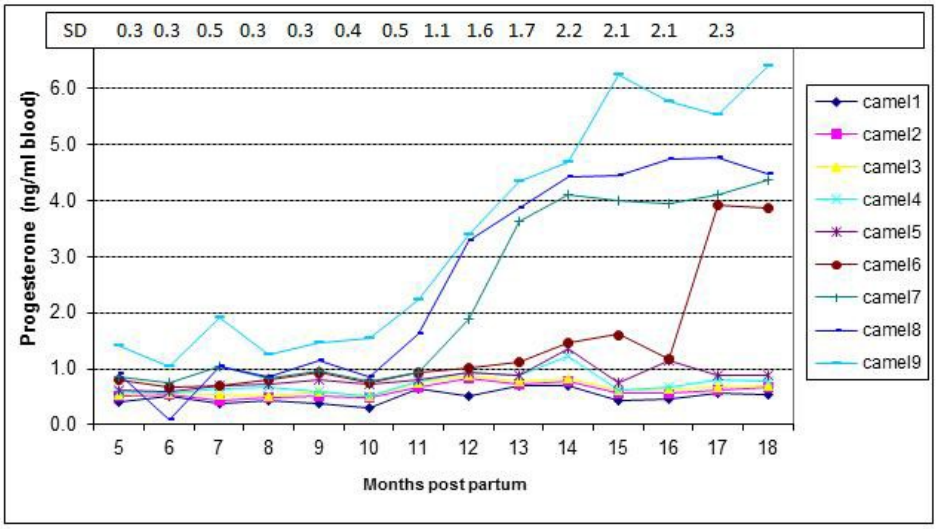

Figure 2: Progesterone concentration (ng/ml blood) on camel under traditional management during the experimental period

54. Camel Terminology of the Omani Bedouins

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This paper examines the rich terminology associated with the camel husbandry of the Omani Bedouin. The role of the camel among the Omani Bedouin has diminished significantly in recent years due to rapid modernisation, resulting in a diminishing awareness of the complexity of camel terminology among the young Omani Bedouin. The present study examines camel terminology among two Bedouin communities which are distinguished geographically and linguistically within Oman: a Mehri-speaking community of the Dhofar region in the south of the country and an Arabic-speaking community of the Šarqiyya region in the north, and then considers a taxonomy of camel terminology. The study is based on ongoing documentation of traditional camel culture among the southern Arabian Bedouin, and represents an attempt both to show the intricacy of camel husbandry terminology and to produce an initial taxonomy of terms.

Two separate sets of data collected in the field in Oman are examined here. The first set of data represents the almost identical dialects of the Āl Bu Hday and the Āl Wahība tribes of the Šarqiyya region, collected by Eades. This is based on the ongoing recording of oral narratives and interviews which began in 2005. The second set of data represents the Mehreyyet dialect of Mehri spoken in Dhofar, collected by Watson. This is based on the ongoing audio and audio-visual recording of oral narratives and interviews conducted since 2009. In both cases, data has been collected from older generation speakers with extensive experience of camel husbandry

The two languages represented in the data – Mehri and Arabic – both belong to the Semitic language family, and are mutually unintelligable. In some cases, lexemes in the two languages share a consonantal root – for example, a young camel is described as *ḥwōr* in Mehri and *ḥwār* in Šarqiyya Arabic (using the consonants /ḥ-w-r/), and a black camel as *ḥazmayyat* in Mehri, *ḥazmiyya* in Šarqiyya Arabic (using the basic consonants /ḥ-z-m/). In many cases the different terms are unrelated. Nevertheless, a key finding of the study was that in spite of the differences between the two languages, a wide range of concepts associated with camel husbandry were shared between the two languages. These concepts are distinct from terminology associated with camel husbandry in the northern Arab world.

The data for this study is roughly organised on the basis of the following taxonomy: stages of life; selected parts of the camel; camel trappings; actions associated with camels including gaits, other actions and vices; types, colours and fur types; and miscellaneous terms. The most general term for camels as a group is *ibil* or more commonly *bōš* in Šarqiyya Arabic, and *bɛ:r* in Mehri. Mehri *bɛ:r* takes feminine plural agreement in all cases. Šarqiyya Arabic *ibil* and *bōš* generally require feminine singular agreement in verbs and adjectives, but anaphoric pronouns referring back to *ibil* and *bōš* are feminine plural; the plural term used when counting in Šarqiyya Arabic is *rkāb*; the terms *nišra* and *ḥalāl* in Šarqiyya Arabic are used to refer to camels, goats and sheep, and *ḥalāl* is not associated specifically with camels as in northern Arabian B dialects (Ingham 1990: 69); reference to a large number of camels or different types of camels is made with the terms *ḥešwān* or *bīšān*, which do not occur in the dialects of the coastal regions of the Šarqiyya. In Mehri, *mōl* refers to livestock in general.

The very rich camel culture of the Bedouin of Oman is reflected most obviously in their terminology for camel husbandry. The rapid modernisation of Oman in the past forty years has meant that the role of the camel has become less important, and while some aspects of modernisation - such as the introduction of camel beauty competitions and milking competitions - allow for the maintenance of aspects of camel culture, most do not. The resulting loss of traditional knowledge among younger Bedouin is manifest particularly in a diminishing awareness of the complexity of camel terminology. As part of the documentation of traditional camel culture among the southern Arabian Bedouin we believe it is essential to collect oral texts relating to camel husbandry in the region and produce a detailed glossary for both Arabic and Mehri.

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55. Reproduction and Breeding of Dromedary Camels: Insights from Pastoralists in Some Selected Villages of the Nigeria-Niger Corridor

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Introduction

Camel reproduction studies in Nigeria target pastoralists when their herds are in the country during the annual transhumance movement (Kalla *et al*., 2008) or depend solely on abattoir specimens (Djang *et al*., 1988; Ribadu *et al*., 1991; Waziri *et al*., 1999). This study differs in approach from similar studies in Nigeria in the sense that the pastoralists were followed into the Niger Republic with the added advantage of acquiring information from older members. These members, with many years of camel keeping experience, often do not make it to Nigeria during the annual transhumance movement probably due to advanced age. Also, few of the pastoralists that reside in northern Nigeria and those that enter the country weekly from the neighbouring Niger Republic were interviewed during camel market days in northeastern Nigeria for information on their breeding aims and indigenous characterization of camel ecotypes. This is the first documentation of breeding aims and indigenous characterization of dromedary camels in northern Nigeria. The present study is, therefore, a survey with the triple objective of documenting the views of pastoralists on camel reproduction, describing their indigenous criteria for differentiating camel ecotypes and highlighting their breeding aims.

Materials and Methods

This study was carried out in two phases. The first phase was a documentation of the views of pastoralists on camel reproduction in southeastern Niger. Kursilla village in Maine-Soroa Department of Diffa Region and Gujjo village in Goure Department of Zinder Region, all in southeastern Niger, were purposively selected for the study. The second phase of this study was on the indigenous criteria for differentiating camel ecotypes and pastoralists' breeding aims. Garin Alkali livestock market in Bursari Local Government Area of Yobe State in northeastern Nigeria was purposively selected.

To understand the views of pastoralists regarding camel reproduction, the accidental or convenience sampling technique was adopted because, according to Tezera (1998) (as cited in Mehari *et al*., 2007), a strictly random sampling may not be possible with pastoral communities due to their mobile, scattered and less accessible nature. A total of 60 respondents were interviewed using structured questionnaire in a single visit formal survey conducted in July 2010. To explore the indigenous criteria for differentiating camel ecotypes and their breeding aims, first, a focused group discussion was conducted. Thereafter, each pastoralist was interviewed using a structured questionnaire to capture their breeding aims according to Marion *et al*. (2002). A total of 25 camel pastoralists were involved in the study.

The data collected were coded, entered, and analyzed using the Statistical Package for the Social Sciences (SPSS Inc. version 16, 2007). Descriptive statistics such as frequencies, percentages and graphs were generated.

Results and Discussion

The respondent pastoralists mentioned that the male camel exhibits rutting during the early-dry season between October and December which coincides with the period of the year that is usually cold. Some signs typical of the male camel in rut mentioned by pastoralists include splayed stance, extrusion of the soft palate, gurgling sound, hostility, urine splashing, tail flapping, marking territory, metallic sound, inappetence, frothing of saliva, and poll gland secretion. Prominent signs of oestrus in the female camel were frequent urination, vulval discharge, vulval swelling, male seeking, bleating, foul vulval odour, tail raising, inappetence, grouping of she camel, and they were mounting one

another. These signs corroborate some of the findings of Mukasa-Mugerwa (1981), Yagil (1982), Fowler (2000) and Bhakat *et al*. (2005).

Most of the pastoralists interviewed responded that they will be able detect pregnancy traditionally within an average of 10.85 days. Frequent urination, tail ―cocking‖, upward head tilting with pointed ears and curved neck towards the shoulder on approach of a bull were mentioned as some of the prominent signs of pregnancy in the camel. According to Yagil (2006), a pregnant camel will show signs of pregnancy by lifting and curving her tail (tail ―cocking‖) when a male camel advances toward her. The male then moves away looking for another receptive female. This is the method used by nomads to determine pregnancy in female camels (Yagil, 2006). The symptoms of pregnancy reported in the present study were corroborated by the findings of Elmi (1989) among Ceeldheer pastoralists in central Somalia. Kalla *et al*. (2008) reported that the cold dry season (November to February) was the period of peak calving among pastoral camel herds at the Komodugu-Yobe River basin in northeastern Nigeria. The calving period (October to December) reported in the current study falls within this range.

The overall impression from the focused group discussion was that pastoralists in the current study differentiate their camel ecotypes solely based on coat colour, though they also believe that some ecotypes were better than others in the expression of certain traits. The dark-brown ecotype constituted 56% of the dam ecotypes in the actual camel herds of the respondent pastoralists in the study area. When asked which ecotype they will prefer in the case of a hypothetical herd, majority (72%) of them mentioned the dark-brown. Reasons given for preference of the dark-brown ecotype were good growth, high milk yield, high reproductive efficiency, aesthetic reasons, symbol of opulence, attracts more price in the market, resist hunger and thirst (hardy), draught power, and religious inclination. Despite the preference shown towards the dark-brown ecotype, they still prefer to have an assortment of dams from other ecotypes. It can, therefore, be safely assumed that camel pastoralists in the current study subscribe more to the idea of an ―ideal herd‖ rather than an ―ideal animal‖ which probably brings to light a survival strategy that depends on the ability of ecotypes to complement one another with regards to performance during different seasons of the year in order to support pastoral life in a fragile ecosystem. This corroborates the findings of Marion *et al*. (2002) among pastoralists in northern Kenya. It can also be implied that the dark-brown ecotype could be a multipurpose considering the various claims made by pastoralists regarding its qualities. However, this is subject to further empirical studies to prove or disprove these claims which at the moment should be best treated as anecdotal data.

The current study has shown that pastoralists interviewed deos possess a repertoire of knowledge about their camels. This knowledge when harnessed and repackaged according to the peculiarities of their production environments could enhance the efficiency of the pastoral livestock production systems and improve their livelihood.

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56. Pilot Introduction of Camel Draught Power Into Mixed Farming Systems of Eastern Kenya

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Introduction

The complete absence of camels as a livestock from farming systems in the semi-arid project region in Eastern Kenya can be explained by the tsetse challenge acting as a natural barrier and by historical and socio-cultural factors. The retreat of tsetse flies due to conversion of more land for use in crop production opens up new avenues for integration of camels. ‗Camel-technology' transfer between pastoralists and farmers is hampered by socio-cultural barriers and unless facilitated is unlikely to take place soon, hence need for the project intervention.

Materials and Methods

Ten sub-adult male Rendille camels (4.5 to 5.5 years of age) were acquired by Kenya Agricultural Research Institute (KARI) through the Kenya Arid and Semi –Arid Lands (KASAL) Research Programme and trained for traction and ploughing on a ranch in Northern Kenya. Six pilot farmers from the project area , the lower mid-lands (LM4 and LM5), in the Semi-Arid lands (SAL) of Eastern Kenya, and who were interested in using camels for draught power were identified and trained on camel handling and management, pack saddle making, harnessing & use of camels for traction by a camel expert. Consequently, the camels were de-wormed (Albendazole), received chemoprophylaxis for *Trypanosoma evansi* (Quinapyramine pro-salt) and were transferred to the pilot farms in Eastern Kenya. Through a hands-on participatory process, the pilot farmers developed, tested and improved the ploughing harnesses. A Rapid Rural Appraisal (RRA) was conducted with the pilot farmers to capture information on animal draught power applications within the study area. The camel's ploughing speed was estimated during the testing of the improved harnesses. Continuous monitoring of the camels' health status with regard to internal & external parasites, incl. Trypanosoma spp. infections, and weight gain/loss estimate was carried out. Information on farmers' perception, attitude and challenges on the camel draught power technology and the camel as a new livestock enterprise in the mixed farming systems of Eastern Kenya was documented.

Body weights of camels were monitored by using body weight estimates based on physical measurements (Evans *et al* 1995).

Results and Discussion

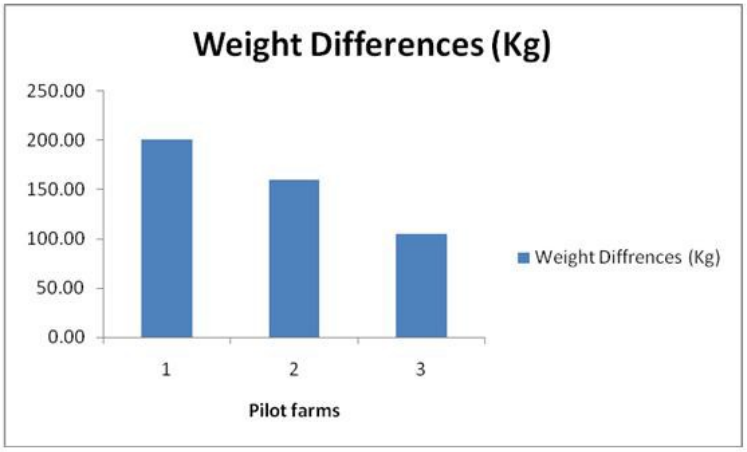
Prior to transfer of the trained camels to the project area in March 2010 six pilot farmers were trained on camel handling and use of camels for draught power. The training period required was only 14 days. Six improved harnesses were developed and successfully tested on-farm in the project area for performance on ploughing with camels. RRA results indicated that all the farmers in the target area use animal draught power for land preparation and transport. The major animals used traditionally in the project area for draught power are oxen and donkeys that are mainly used for ploughing, fetching water, carrying firewood, farm produce and construction materials.

Table 1- Animal Uses in the project area in order of priority

Bullocks	Donkeys
1. Ploughing	1. Transport (as pack animal and for pulling carts)
2. Transportation (cart pulling, fetching water, transporting harvest)	2. Ploughing
3. Breeding	3. Sale for cash
4. Contract ploughing and contract transport	
5. Sale for cash	

On camel ploughing performance, preliminary data indicated the forward speed for camels was 4.07 km per hour (about double the speed for bullocks) and one single camel could plough one acre per day as compared to half an acre (0.5) for two bullocks in the study area.

Animals were de-wormed once during each rainy season. Two animals showed clinical signs of suspected *Trypanosoma evansi* infection (drowsiness), which disappeared after treatment with Quinapyramine. Despite the camels having been introduced into a completely new environment, no Tse-Tse transmitted Trypanosoma spp. infections or any other major disease challenge was experienced over a study period of 1.5 years. The body weight of the camels increased on all the pilot farms (weight gains shown in Figure 1), indicating compatibility in terms of feeding requirements and disease challenge in the study area.



Integrating camels into the existing farming system had the following estimated cost and labour requirements during the 1st year post-introduction:

	Camel (single castrate)	**Pair of Bullocks**
Herding (hours per day)	Self herding	Ksh* 205/ 12 hours
Training (days)	14 days	30 days
Cost of Ploughing (per hectare)	Ksh 1500	Ksh 3000
Transport of Water (farm water requirement per day /per week)	2 mandays/1500 litres per week at Farm water requirement is 200 litres per day	3 mandays for 1500 litres per week at Farm water requirement is 200 litres per day

*Kenyan shilling

The farmers had positive perception and attitude toward the camel as a new livestock enterprise in their mixed farming system. However, they expressed the costs of acquiring a camel as a major challenge. Farmers also expressed great interest in future introduction of female camels for milk production and for breeding. Conclusively the farmers felt there is great potential on application of camel draught power technology and also as a new livestock enterprise within their mixed farming systems.

Conclusion

This pilot study has indicated that there is a great potential for application of camel draught power in dryland farming regions of EasternUkambani for timely land preparation, haulage and transportation and entertainments. Experience has shown that these areas are endowed with adequate camel browsing material. The pilot farmers‘ sentiments on camel are that they can withstand the

frequent drought in the area as compared to cattle which they have previously been using as their source of animal draught power. However the mentioned challenges need to be addressed in future for the wider adoption, adaptation and up-scaling of the technology.

Especialy Eastern Kenya, use of camel as a dairy animal in mixed dryland farming areas of Kenya needs to be explored.

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70. Constraints of the Saharan Rangeland on Camels

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Introduction

Thirty-four percent of the land surface is desert sand semi-deserts, which are distributed world-wide (Roger, 2006). The Sahara is the leading desert but also the most extreme (Ozenda, 2004), It occupies a surface of 8000000 km^2 (Le Houerou, 1990). In addition, nearly 60% of agricultural land in the world is considered non-arable and pasture reserved for, i.e. livestock operations. A great part of these areas reserved for animals' breeding falls within the arid and semi arid regions (Faye1997), and occupies 3,4 billion hectares where you drive animals (cattle, sheep, goats and camels) freely, covered by natural vegetation, corresponding to 26% of the earth surface which is not coveredby ice.(F.A.O. 2007). In Algeria, the space is dominated bythe aridand semi-arid (80%) with extensive pastoral system under the sway of transhumance. Chellig (1992) estimates that nearly 40 million hectares of pastures in arid and semi-arid steppe formed by covering 12 million ha and the Saharan rangeland with 28 million ha. The region of the approach is represented by Ghardaia where breeding remains the main seal, including the extensive system that makes the majority of farmer stake the rangeland as a key resource for food. Hence, the present study attempts to highlight the patterns of exploitation and use of rangeland, while situating constraints that play all around.

Material and Methods

The area of investigation where field surveys have affected the region of Ghardaia known for camel breeding and lifestyle of the community (nomadic). It is one of the best pastoral areas of the Sahara, through their diversity (Oueds, Daya, Hamada, Regand Erg) but also their rich flora, which exert a great attraction for breeders. For practical considerations, two areas were selected for this study; it is in this case Metliliand Zelfana, which dominate the rangeland 37% and 5, 11% in their respective territories. The choice is dictated by simple criteria: diversity of farming systems, presence and importance of cattle ranchers on the rangeland.

Results and Discussion

The natural environment of the camel, represented by the rangeland, considered as the main support for the animal that builds most of its daily diet, where the main constraint resides in its use and exploitation for other purposes. Duality between animal species and duality of breeders' logics are all factors identified as a result of field investigations. These constraints can be summarized by:

- Competition for rangeland.

If the camelis known as an animal that maintains its ecosystem, the situation is quite different with the sheep. Indeed, once the wells are regained and the stay was more prolonged over grazing is automatically punctuated and rangeland degradation is observed. These conditions cause an excessive and uncontrolled harvesting of pastoral resources and an anarchic management of space, which limits the movement of livestock and increases the load. In the absence of real action in the managementof the space of rangeland, the shepherd is the only skipper; he tries to guide his flock to the best-provided spaces in natural vegetation. We often hear breeders use two expressions, the first "we follow the rains," the second "we follow the flowers", indicating the individual character of travel. The thing that Le Houerou (1990) found is that virtually there is no rule of exploitation but that which consists of eating grass whenever and wherever available;

- Subtractionof the space of rangeland.

The range land space is marked by the progress of land development in most of the oueds and depressions. Thus, the new opportunities of pasture are less available to livestock.The surface of the rangeland loss increased from1348997 ha in 2006 to 1,344,303 ha in 2007. (a difference of 4694 ha)

in favor of the agricultural area, which experienced a sharp increase in going from 21742 ha to 26436 ha. This is an extension of agricultural areas and are traction of the pastoral areas;

This was revealed by Bensemaoune and Slimani (2006) who revealed in the year 2004, an increase of the agricultural area, increased from 12207 ha in 2000 to 15252 ha in 2004. This extension occurred at the expense of rangeland which recorded a subtractionof their spaceby regressing to 820758 ha in 2000 to 812544 ha in 2004 (8214 ha lost). What can you deduce? Subtraction of pastoral areas between 2006 and 2007 is half of the surface subtracted for four years (2000-2004).Thing that has led to conflicts between farmers and breeders in relation to the occupation of space (each one claims ownership of the space)

-Clearingsin pastoral areas.

The need for combustible, food for livestock household and heating leads locals to uproot woody shrub species (rtem, Beguel, etc). According to several producers approached, the Drinis scarce because of the excessive uprooting of it for multiple uses (domestic) and for sale in the market (animal food), despite the legislative framework that prohibits sampling of some perennials, like the Drin.

Conclusion

This study illuminates that the rangeland of the region of Gharadaïaare is subject to mismanagement in the use. Their protection is indispensable when combined actions of all stake holders is essential and can be summarized through a number of recommendations:

- Regulate the use of rangeland space through the rotation and animals' stays;
- Sensitize farmers, through the device of vulgarisation concerning the rational and reasoned use of rangeland;
- Planning of pastoral areas through a suitable and planned mesh of water points; Extension of pastoral areas, thanks to the planting and the introduction of indigenous wild species;
- Practice of the method of natural parks to prevent rangel and degradation during periods of drought.

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71. Sociocultural Importance of Camels Among ohe Pastoralists of Northern Kenya

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Introduction

The pastoralists of northern Kenya live in a harsh environment characterised by low rainfall, scarce water and limited pasture. The camel is well adapted to this kind of environment which makes it the most important species of livestock in this area (Kaufmann, 1998). Schwartz and Dioli (1992) describe camel production to be the most suitable one for the arid and semi-arid lands of Kenya. According to Kaufmann (1998), the importance of camel is often higher than its actual or potential contribution to the national economy. The objective of this paper is to describe the socio-cultural importance of the camel as perceived by the pastoral communities of northern Kenya.

Materials and Methods

The study was carried out in northern Kenya covering three neighbouring districts namely Marsabit North, Wajir East and Mandera West. These districts are mainly inhabited by the Gabra, the Somali and the Garri pastoralists respectively. Northern Kenya is chosen for this study based on its large population of camels constituting about 90% of the total camel population in the country (Kiptarus, 2005).

The data were collected by participatory rural appraisal tools such as focused group discussion, semi-structured interviews and matrix scoring. The exercise was conducted in nine groups with an average of eight informants per group. The locations of the study were purposively selected based on the concentration of camel herds in the area. Informants from those locations were selected with the help of the local herders based on who has enough experience in camel herding (Catley, 2005). The informants were gathered in a central place of their choice. Using focused group discussion the informants were asked to list various means by which they earn their livelihoods (Kipronoh *et al*, 2011). They were then asked to list various values/benefits of the camel. Different age groups of camels were also named in the local language. With the median benefit values of camels on the x-axis and age groups names on the y-axis a matrix was constructed. The benefits of camels were then scored against the different age groups.

Camels of up to 2 years of age are considered calves, over 2 years up to 5 years as young adults (males and females), and over 5 years as adult males and females.

Results and Discussion

Each group named livestock as one of the main means of earning livelihoods. Camel was ranked the top most important livestock in the area by proportional piling.

Figure 1: Benefits of and for camels by age group among the Gabra pastoralists

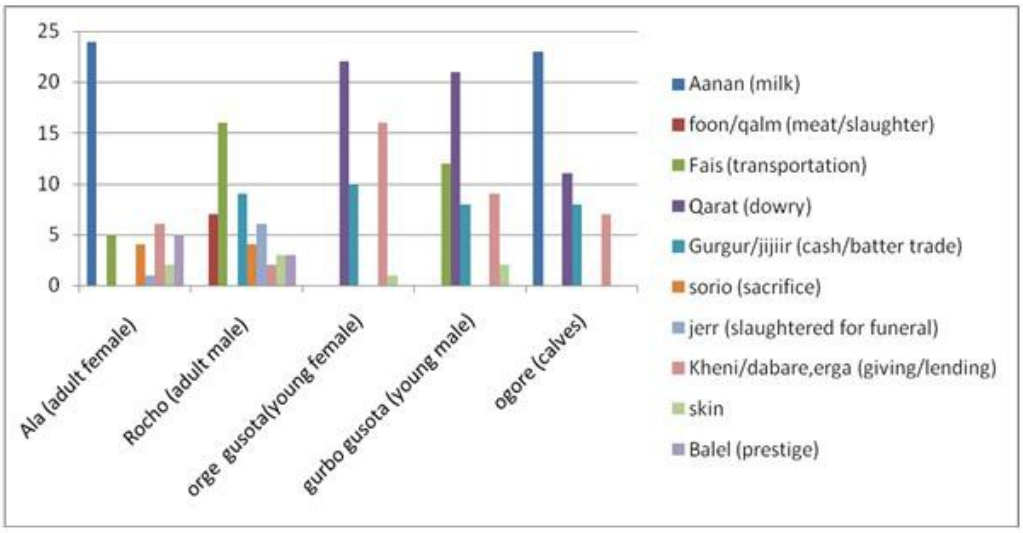


Figure 2: Benefits of and for camels by age group among the Garri pastoralists

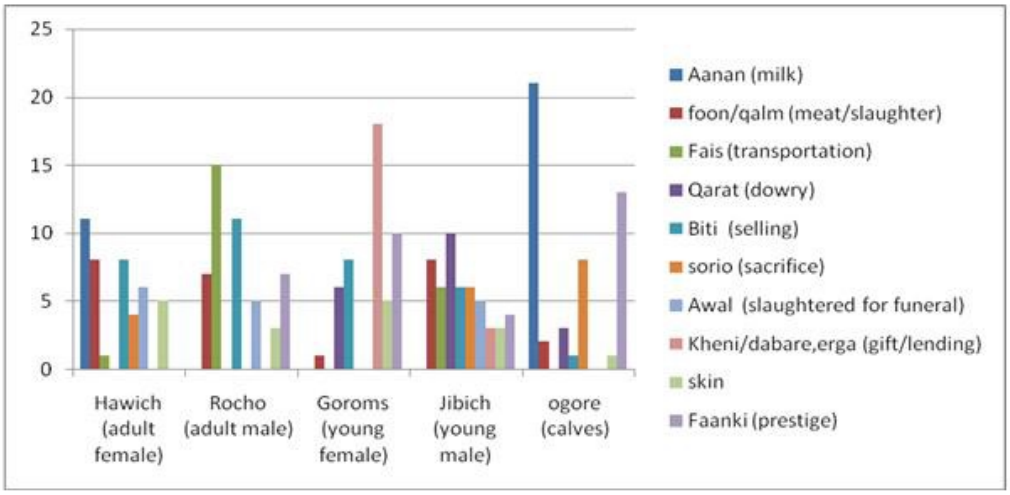
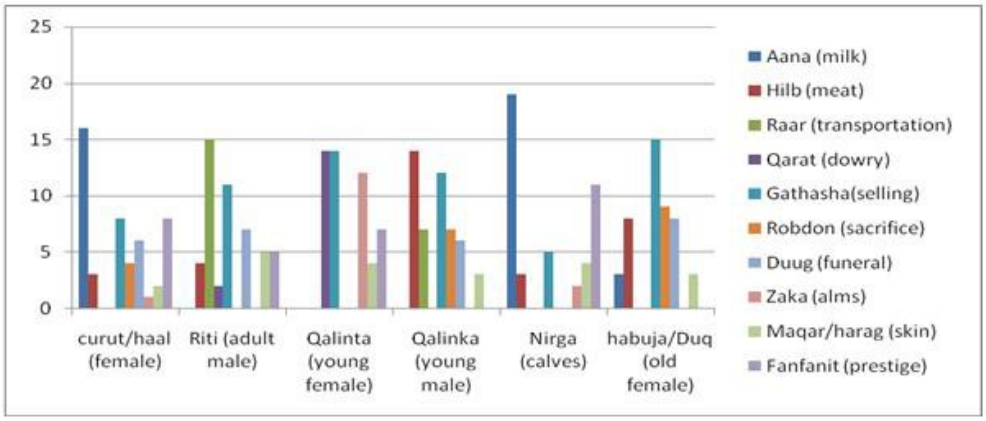


Figure3: Benefits of and for camels by age group among the Somali pastoralists



As demonstrated the importance of camels in these communities goes far beyond meat, milk and transport. There are numerous socio-cultural and even religious values attached to camels (Figure 1-3). For instance, in some clans of the Gabra community when an elderly person dies, an adult male or female slaughtered and the meat is thrown away;this is a very important event in respect of the dead. In the same community, marriage can never take place without 2 young males and 1 young female camel of about 2 to 5 years of age that are paid as dowry. The female should have never calved and

not being in-calf at that time. One male must be paid on the wedding day while the other two can be given later. To make the matter worse, the wedding can only take place on two specific dates in a year. In fact the bridegroom comes to the home of the bride not only at that specific date but also at a specific time, i.e. before noon. If you fail to produce this young male (*gurbo*) camel on these two days, no wedding will take place until the following year.

Even milk production of camel has some cultural aspects. For example, an activity referred to as *d'ibayu* (libation) by the Gabra is done by pouring milk on the ground to appease the ancestors. This is so important that one (head of the house) has to request clan members to help him with a lactating adult female just for this purpose. In case all the camels are dry, camel urine is used for libation. This *d'ibayu* is especially important during the mourning period when an elderly man dies.

Also transportation has more to it than just movement from point A to point B. If a sick person is carried on a camel, the Gabra believe that this has a therapeutic effect so that the person gets better. In times of conflicts, if all watering points are captured by the enemies, camel can evacuate an entire household without going through these watering points because it can resist thirst and can walk for long distances. This helps the families escape through dry and even desolate lands where enemies cannot reach on foot.

The Somali and Garri communities also have other socio-cultural and religious values attached to camels such as *ganax* (paying of fine for wrong doing), selling in order to go for *haji* (Islamic pilgrimage) and *sadaqa* (giving to the needy) by the Somali. The Garri also mention cashing camel for *haji* as important benefit from the camels. Other values accruing from the camel are for *duksi* (paying for the teacher of the Holy Qur'an), *deni* (paying debts) and *Khenni/dabare* (giving/lending to the needy). In most of these cases specific age-group are used for specific purposes. Therefore, it is against this background that the impact of diseases and droughts on the camel keepers should be judged. For instance in terms of impact of a disease, losses resulting from disease in a specific age group determine further and immediate socio-cultural impact on the community. This is why defining the socio-cultural values by age-group is of high importance.

This paper just highlights some of the socio-cultural importance attached to camels by the pastoralists of northern Kenya. The listed values/benefits are by no means exhaustive to report and discuss all is beyond the scope of this paper.

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72. The Economic Potential of Dromedary Camel Meat

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Introduction

Animal meat production has significant impact on nearly all aspects of the environment, including air and climate change, land and soil, water and biodiversity. The impact may be direct through grazing, or indirect through the expansion of feed production.

Among all animal meats, it is beef that is the most popular and widely produced in the world. Unfortunately it is also the most inefficient animal meat to produce in terms of the amount of inputs needed to produce it. Grain-fed beef production for example, takes 100,000 litres of water for every kilogram of food. In terms of energy, beef cattle require an energy input to protein output ratio of 54:1 (Pimentel and Pimentel, 2003). Furthermore, beef has the highest water footprint at 15400 m^3/ton, (Mekonnen and Hoekstra (2010), than sheep (10400 m^3/ton), goat (5500 m^3/ton) or chicken 4300 m^3/ton. FAO projects the global meat production to more than double from 229 million tonnes in 1999 to 465 million tonnes in 2050 (FAO, 2006). To meet the projected demand for meat by the year 2050 more land and water would be needed, consequently putting significant pressure on currently available land and water resources. In this backdrop, camel meat production seems to be the alternative, because among other things, camels require fewer resources in terms of land and water. This paper is arranged as follows: Section two provides a discussion on camel meat as a potential substitute for beef. Section three and four presents the strengths and weaknesses of camel meat respectively. Section five is the conclusion of this paper.

Camel meat as a substitute for beef

Most of the dromedary camels are found in the hot arid areas of the Middle East and Africa. Camels have great tolerance to harsh conditions of high temperatures, water scarcity and poor vegetation (Shalah, 1983; Kadim *et al*., 2008). In these harsh environments, camels feed on low quality feeds and fodder that are generally not utilized by other domestic species (Tandon *et al*., (1988) and Kadim *et al*., (2008). As a result, camels can be raised to produce meat at a comparatively low cost than other domestic animals such as goats, sheep and cattle.

Young camel, less than three years of age, produces high quality low fat meat (Kadim *et al*., 2006), which is also a good source of minerals. Age is therefore an important factor in determining camel meat quality and composition (Kadim *et al*., 2006). Health wise, camel meat has less fat as well as low levels of cholesterol compared to other animal meats (Kadim *et al*., 2006). Quality wise, meat from young camels is comparable to beef (Knoess, 1977; Kadim *et al*., 2006). Therefore camel meat could potentially be used as a substitute for beef meat.

The strengths of camel meat as a substitute for beef

Camel meat strengths are those positive attributes that give it an edge over other rival meats such as beef in the marketplace.

- Camel meat is lean and has been scientifically proven to be much healthier than many other animal meats. It is a low fat meat, low in cholesterol and high in protein. This makes it an ideal meat for those with dietary problems such as diabetics and high cholesterol.
- Camel meat is already a popular meat product in the Muslim world, Australia and in China.The global Muslim population trends indicate that there were 1.619 billion Muslims in the world in 2010. The world's Muslim population is expected to reach 2.2 billion by 2030 (Pew Research Centre, 2011). This huge increase in Muslim population, coupled with the recent increase in the popularity of camel meat in Australia and China creates an unprecedented potential for camel meat.
- Camel meat is less costly to produce and it is ecologically harmless**.** This is because camels are usually reared by nomads in arid regions, feeding mainly on annual grass, acacias, and dwarf bushes which are not costly. Even where camels are raised in commercial facilities, the production costs are lower than those for other meats. The production cost for camel ranchers in Riyadh, Saudi Arabia reported by Al-Khamis and Young (2006) range from 3279 Riyal/head/year (US$ 874.5 at 1 Saudi Riyal = 0.2667 US$) for medium herds to 2318

Riyal/head/year (US$ 618.5) for large herds. In Australia camels are mostly found in the wild. Ecologists stresses that camel grazing has very little, if any, damaging effect on desert vegetation and does not contribute to desertification. Its foraging habits are optimally suited to areas with a low carrying capacity (Köhler-Rollefson, 1994).

- There are many identified uses for camel meat as well as camel meat recipes. The availability of tasty and easy to prepare camel meat recipes makes it easier for potential consumers to try camel meat.
- Camel meat benefits from using the well-established beef terminologies and specifications. Establishing meat specifications and terminologies to represent the various specifications is important for meat buyers.

The weaknesses of camel meat as a substitute for beef

Camel meat weaknesses are the inherent disadvantages (negative attributes) it has over other meats in the marketplace. These weaknesses need to be addressed fully if camel meat is to realize its potential as a substitute for beef and other meats. The weaknesses include:

- Lack of consumer awareness regarding camel meat. Generally there is lack of consumer awareness with regard to camel meat aside from the Muslim world where camel meat is traditionally consumed. Elsewhere few people are aware of the nutritional and health benefits from consuming camel meat. In a survey of restaurants in Australia conducted by CM research (1999), 64% of restaurants surveyed indicated lack of customer awareness of camel meat in general as the reason for low customer demand for camel meat.
- Consumers tend to relate camel meat with the animal itself, which gives rise to concerns about hygiene and cleanliness and to negative perceptions that the meat is smelly and tough (Warfield and Tume, 2000).
- Camel meat has been described by consumers as being chewy and tough even though it is not different from beef in terms of flavour. This discourages potential consumers from buying camel meat. Recent findings (Kadim *et al*., 2006), indicates that young camels below three years of age produces high quality low fat meat that is comparable to beef.
- Lack of Halal certification. Since the Muslim world is the largest and most important market for camel meat. Halal certification is therefore, very important for meat slaughtered in any slaughtering facility across the globe to be accepted by Muslims. The lack of Halal certification for many of the camel slaughtering facilities outside the Muslim world automatically excludes their products from entering the global Muslim market.

Conclusion

This brief paper looks at the potential of camel meat as a substitute for beef and other meats. The strengths / advantages of camel meat over other meats are been presented. The most important strengths being that camel meat is healthier than many other animal meats in that it is low in fat and cholesterol. It also has a potential to benefit from the global Muslim market which is expected to reach 2.2 billion consumers by 2030. With regard to weaknesses, it has been observed that generally there is lack of consumer awareness with respect to the benefits of camel meat. Consumers also tend to relate camel meat with the animal itself. Most of the observed weaknesses could be addressed through public awareness and marketing campaigns.

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Meat and Products

73. Analysis of Camel Hides Production, Marketing and Utilisation by Local Leather Goods Manufactures in Kenya

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Introduction

In Kenya the hides, skins and leather industry contribute an estimated 4% to the National GDP. Recently, the country produced an average of 2.4 million hides, 6 million skins and 20,000 camel hides (Mwinyijah 2009). However, it has been observed that the full potential of hides and skins as a product has not been realized in Kenya and other African countries due to their poor quality, which is attributed to poor curing and flaying methods. According to Gitao (2006) camel hides are an important resource that could contribute a significant income to pastoralists if there is a reliable market and if they are properly cured. Foxwell (1999) observed that pastoralist use poor methods of curing camel hides leading to poor quality of hides as a result of this many tanneries have rejected camel hides. Camel hides have more fats than cow hides or goats skins and unless it is well removed, the hides rot (Foxwell 1999). For camel keepers to get maximum profit from camel hides proper curing methods, flaying and proper animal husbandry practices are paramount. In order to address the problems related to the quality of camel hides, KARI saw the need to come up with this study which had three objectives; to establish the production status of camel hides in Northern Kenya, to identify the marketing outlets of camel hides in Kenya and to identify and document on utilization of camel hides in Kenya.

Materials and Methods

The study was conducted in five tanneries in Nairobi and in five camel producing districts of Kenya namely Moyale, Marsabit, Isiolo, Garissa and Wajir. These regions were chosen as they are the major producers of hides and skins in Kenya and Nairobi as the major market outlets of the products.

A total of 506 respondents were interviewed which included 428 livestock keepers and 78 traders in hides and skins business. The units of study were household heads and traders.Various data collecting techniques were applied which included individual interviews with the help of semi-structured questionnaires. The other method applied in data collection was direct observation.This method was used to acquire data on different methods used for curing hides, flaying methods, and branding marks on the livestock. The researchers also visited the slaughters houses and stores where hides were stored. Another method used was gathering information from key informants.

Quantitative data was analysed through the application of SPSS software and descriptive statistics were used to generate the study findings.

Results and Discussion

Most of the camels producing communities are strongly attached to camels and therefore are rarely slaughtered. They are very important for subsistence, social and religious functions for camel keepers. In areas where camels are reared camel keepers prefer to slaughter small ruminants than either camel or cattle. This is reflected in the amount received from the sale of hides and skins as given by respondents in the study area. According to the findings the amount received from the sale of shoats skins, (Kenya shillings 21.954 millions) was leading cattle hides came second (Kenya shillings 9.35 million) and camels hides were last (Kenya shillings 1.322 millions).

Camel hides were sold in district town of areas where camels are reared and also in Nairobi. Many camel hides were sold from Mlolongo slaughter house based in Nairobi. The other major sources of camel hides included, Moyale, Garissa, Wajir, and Isiolo.

Camel hides are mainly cured using traditional methods i.e ground drying and suspension drying. Only few producers are using modern method of curing which is wet salting as a result of this the producers and small scale traders are offered low prices at the secondary and tertiary markets. Low prices also discouraged some livestock owners from selling cattle hides. The study revealed that traders prefer wet salted skins and their prices are better compared to sun dried ones.

Camel hides are important products but they are mainly used for domestic purposes and used by camel keepers to fulfill many functions. The hides were used to make the roofs for traditional

pastoral houses. They were also used for making ropes, guards, drums, seats, sandals, praying mats used by Muslims, and water and milk containers.

Vegetable tanned camel hides by pastoral communities were used to make hand crafts such as key holders, maps, belts, folders which are sold to tourists. Camel hides tanned in Kenyan tanneries into wet blues and large amount was exported to Middle East and to other African countries. A small percentage was used by domestic leather manufacturers, where they were used to make leather boots used by Kenyan army, shoes, saddles, bags and jackets among other products.

Kenya has 12 operating tanneries, processing hides and skins. This study found that some tanneries such as Alpha Rama are skeptical in dealing in camel hides. They sited poor quality as one reason which hinders them from buying camel hides. Most of the camel hides are sold to other tanneries such as Aziz Din, Mnasi, Zogo, Sagana, Bata leather tanneries (Limuru), and Leather Industries of Kenya in Thika. According to the study findings camel hides are tanned and sold as wet blues to Pakistan, India, Dubai and China.

The first problem facing the marketing of camel hides is poor quality attributed to poor curing methods, poor flaying and use of sharp knives which damage the skins. There is also damage of camel hides by ecto –parasites. The other problem is the competition with goods made with leather and as Kenya imports second hand products such as bags, shoes, jackets, belts, etc. The other constraint is the high taxes imposed by the municipal councils on camel hides as they are charged kshs 10 per hide.

In conclusion, there is a demand to train producers and traders on proper methods of flaying and curing of camel hides. There is also demand for the policy makers to consider putting a ban on importation of second hand leather goods and also lowering the taxes charged on hides.

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74. Quality Characteristics of *Infraspinatus, Triceps Brachii, Longisimus Thoraces, Biceps Femoris, Semitendinosus* and *Semimembranosus* Muscles of Dromedary (*Camelus dromedarius*) Camel

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Introduction

Quality characteristics of camel meat have received little attention and the marketing system for camel meat requires more information on meat quality characteristics of various muscles. According to Tschirhart-Hoelscher *et al*. (2006) characteristics of individual muscles of meat animals can be marketed more effectively. Therefore, identification of quality parameters of individual camel muscles can also be marketed. This will increase the demand for camel meat by improving the consistency of products and allowing processing technologies to be targeted toward maximum effectiveness of camel carcass value. Marketing camel muscles allows producing more attractive cuts with greater nutritional quality. Therefore, the objective of this study was to quantify characteristics determining the quality of *infraspinatus, triceps brachii, longissimus thoraces, biceps femoris, semitendinosus,* and *semimembranosus* muscles.

Materials and Methods

Six muscles; *infraspinatus, triceps brachii, longissimus thoracis, Biceps femoris, Semitendinosus and Semimembranosus* were dissected from 10 camel carcasses with 20 min. *postmortem*. Samples were kept in the chiller (1-3^{O}C) for 48 hr before quality traits were measured. Ultimate pH, expressed juice, cooking loss, Warner-Bratzler shear force, Sarcomere length, Myofibrillar fragmentation index, and colour *L**, *a**, *b** were determined following procedure of Kadim *et al*. (2006). The general liner model, ANOVA procedure within SAS (1993) was used to compare the six muscles on various quality properties.

Results and Discussion

Quality characteristics of muscles are presented in Table 1. Small variation in pH between the muscles might be due to variation in muscle fiber types, which contributed in differences in patterns of muscle metabolism (Swatland, 1982), and consequently differences in ultimate pH value. Expressed juice was higher in the *longissimus thoracis* and lower in *semimembranosus* 43.3- 34.8%. This value was slightly higher than values reported by Kadim *et al*. (2006, 2008a,b, 2009 and 2010; Suliman *et al*., 2011). Significant differences in shear force values between selected muscles might be due to functions and locations of each muscle and the connective tissue content (Asghar and Pearson, 1980). Shear force values for *longissimus thoracis*, *semitendinosus* and *triceps brachii* were higher than those reported by Babiker and Yousif (1990) for the same muscles. Variation in myofibrillar fragmentation index between muscles was ranged between 83.89 to 64.21%, *semimembranosus* and *biceps femoris*, respectively. This may be due to protein degradation and variation in muscle ultimate pH. Also, the differences in rates of fragmentation of myofibrillar proteins may therefore account for differences in the rate of post-mortem tenderization of meat (Thomson *et al*., 1996). The lightness (*L**) and redness (*a**) values were significantly ($P<0.001$) different between six muscles. The *L** value was high (33.48-27.95) and the muscles redness (*a**) was low. These finding were in line with results reported by Kadim *et al*. (2006, 2009, 2008a,b, 2010) for young dromedary camels. The *longissimus thoracis* muscle was lighter than the *biceps femoris* muscle due to the higher ($P<0.05$) value of redness in *biceps femoris* muscle. In the present study the lighter muscles was *longissimus thoracis*, *infraspinatus* and *biceps femoris*. The variation in colour between muscles may be due to differences in myoglobin concentration, pH and muscle fibre type (Faustman and Cassens, 1990).

Table 1. Meat quality characteristics of six muscles from dromedary camel

	Muscle[1]						
	IS	TB	LT	ST	SM	BF	SEM[2]
U ultimate pH	5.7	5.7	5.6	5.8	5.8	5.7	0.06
Expressed juice	34.8^{a}	42.1^{b}	41.8^{b}	36.8^{a}	42.4^{b}	40.2^{b}	2.90
Cooking loss %	31.6^{ab}	29.2^{a}	33.5^{b}	28.5^{a}	30.6^{ab}	29.5^{a}	1.17
W-B Shear force	6.3^{a}	6.7^{a}	6.5^{a}	9.0^{b}	12.9^{b}	10.3^{b}	1.09
Sarcomere (μm)	1.5	1.5	1.5	1.3	1.6	1.5	0.07
MFI	72.8	70.0	75.2	79.3	65.3	72.5	2.75
L^{*} (Lightness)	31.7^{bc}	29.2^{ab}	33.5^{c}	28.5^{a}	30.6^{b}	29.6^{ab}	1.17
a^{*} (redness)	12.7^{ab}	12.6^{ab}	14.0^{b}	10.5^{a}	13.6^{b}	13.3^{b}	0.83
b^{*}(yellowness)	2.6^{a}	3.7^{ab}	4.1^{b}	2.2^{a}	2.9^{a}	3.8^{ab}	1.17

[1]Muscle: IS; i*nfraspinatus*, LT; *longissimus thoraces*, ST; s*emitendinosus*, SM; *semimembranosus*, BF; *biceps femoris*. [2]SEM: standard error for the mean.

In conclusion, muscle locations had a significant effect on quality characteristics. Therefore, identification of individual muscle (quality and nutritive values) can be used for marketing camel meat.

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75. Comparative Chemical Composition and Quality Attributes of Camel Meat and Beef

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Introduction

The Sudan has about 3.9 millions heads of camels (Ministry of Animal Resources, 2006). Despite their numerical importance, camel meat is not widely consumed and has a low price compared with beef and mutton.

Camel production doesn‘t play an important role in the agricultural sector in Sudan. However, in arid, semi arid areas it provides food, fiber, transportation and social prestige to the herders. There is a general belief that camel meat is inferior to beef and mutton. Many studies that have been carried on camel meat and beef and suggested that camel meat is not inferior to beef (Babiker and Tibin, 1985; ELgasim and ELhag 1990). The aim of this study was to evaluate chemical composition and quality attributes of camel meat compared with beef so as to encourage camel meat consumption.

Materials and Methods

From ten camel-calves and beef-calves, 3-4 years old with an average weight of 260 kg were raised on a concentrate mixture composed of 15% sorghum grain, 10% wheat bran, 15% ground nut cake, 30% molasses, 1% urea, 27% ground nut hulls, 1% limestone and 1% common salt plus green alfalfa (*Medicago sativa*) at a daily rate of 1 kg per head. Ten carcasses were obtained from each species, chilled for 24 h at 4°C and then split along the midline into two sides. *Longissimus dorsi* and *Semimembranosus* muscles were dissected, from all camel and cow carcass sides at 24 h post-mortem. *Longissimus dorsi* muscles from both sides were frozen-stored for panel evaluation while *Semimembranosus* muscles from one side were trimmed from external connective tissue and fat for determination of chemical analysis and water-holding capacity. Corresponding muscles were oxygenated for two 2 hrs at 4°C for color determination. Subsequently they were frozen –stored for shear force and connective tissue measurements.

Proximate muscle composition was determinated on fresh muscle samples according to AOAC (1991). Protein fractionation was performed according methods of Babiker and Lawrie (1983). Water-holding capacity was carried out according to methods of Grau and Hamm (1953). Color measurements using a Hunter lab Tristinulus Colorometer Model D 25 M .2; Hunter lightness (L), redness (a) and yellowness (b) were recorded. An Instron Model 1000 was used for determinate shear force and connective tissue strength. Muscle samples were thawed at 4°C for 24 h, trimmed of external fat, cut to 5 × 5 × 7 cm and cooked for one hour in a water bath at 80°C . Rectangular samples (cross section 1×1cm) 7cm long with fibers parallel to the long axis, and 10 mm cubes were cut from the cooked meat. The former samples were used for shear force determination while the cubes were used for connective tissue strength.

For sensory evaluation *Longissimus dorsi* muscle samples were thawed overnight at 4°C and roasted, wrapped in aluminum foil, in an electric oven at 175-180°c for one hour according to Griffin *et al*, (1985). Semi-trained panelist (n=9) evaluated each sample for color (1=extremely dark-brown, to 5=brown), juiciness (1=dry, to 4 very juicy), flavor intensity (1=extremely intense, to 4=bland); tenderness (1=tough to 4 =tender) and overall acceptability (1=unacceptable to 5= acceptable).

General linear models (GLM) procedure of Statistical Analysis System (SAS.1990) were used for data analysis.

Results and Discussion

Results obtained from this study are given in Table 1 and 2. Camel meat had significantly less fat than beef ($P< 0.05$) which is in agreement with the finding of Babiker and Tibin (1985). Moisture level was high in camel meat but not significantly different from beef. Protein, ash content, myofibrillar proteins and NPN were similar in the two species. Sarcoplasmic proteins were significantly different ($P< 0.05$) lower in the muscles of camels than beef. Differences in sarcoplasmic proteins might be due to the species differences in muscle composition (Lawrie, 1979).

Meat quality attributes of camel meat and beef are presented in Table 2 and 3; Hunter color values indicated that beef was darker than camel meat. The higher concentration of sarcoplasmic proteins and the expected decrease of muscle myoglobin as intramuscular fat increased might contribute to muscle's color differences between the two species (Janicki *et al.*, 1963). Shear force and connective tissue strength were significantly (P< 0.05) lower for beef (Kumer *et al.*, 1974). Also fat content in beef was higher than in camel meat which causes a dilution of connective tissue and reduce shear force of muscles (Lawrie, 1991).

Table 1: Chemical composition of camel meat and beef

Parameters	Camel meat	Beef	Significance level
Moisture	74.9	74.75	NS
Protein	21.5	21.3	NS
Fat	2.65	3.62	*
Ash	1.22	1.17	NS
Sarcoplasmic protein	5.07	6.6	*
Non-protein nitrogen	0.48	0.47	NS

Water-holding capacity was significantly (P<0.05) lower and cooking loss was significantly (P< 0.05) greater in beef. This is in agreement with findings of Babiker and Tibin (1985). Panelists indicated that the color of cooked beef was darker than that of camel meat. Flavor score was significantly (P<0.05) lower for camel meat. Tenderness and juiciness were lower for camel meat than beef which was possibly due to differences in fatness.

Overall, the acceptability among panelists was similar between the two meats. In this study, results confirmed from the point of quality and chemical composition. That camel meat is benefit for human health due to its lower fat content than beef. Generally due to its low price it can replace beef particularly among low-income groups.

Table 2: Meat quality parameters of camel and beef

Parameters	Camel	Beef	Significant Level
Color			
L	32.36	36.86	*
A	18.93	23.43	*
b	6.52	7.11	*
Water Holding capacity	2.09	2.86	*
Cooking loss %	35.38	37.8	*
Shearforce (kg/cm2)	2.42	2.37	NS
Connective tissue strength (Kg/cm2)	4.32	4.18	NS

NS: not significant; * significant (P<0.05)

Table 3: Sensory evaluation

Parameters	Camel meat	Beef	Significance level
Color	3.79	3.5	*
Flavor	2.5	2.88	*
Tenderness	2.6	2.87	*
Juiciness	2.7	2.91	*
Acceptability	3.78	3.85	NS

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76. Some Aspects of the Nutritive Value of the Dromedary Camel (*Camelus dromedarius*) Meat

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Introduction

Sudan has the second place largest population of camels in the world after Somalia with 4.5 millions heads of camels and with camel meat production of 49,880 tons (FAOStat, 2009). Recently, the local consumption of camel meat had increased especially from young camels due to tender meat. The demand for camel meat appears to increase due to reasons related to human health. They produce meat with relatively less fat than other animals (Dawood and Alkanhal, 1995, Kurtu, 2004; Kadim *et al*., 2008). Meat from young camels has been reported to be comparable in taste and texture to beef (Elgasim & Alkanhal, 1992, Kadim *et al*., 2008). Fatty acid profile of camel meat was found to be comparable to other camelids like llama (Polidori *et al*., 2007). Similarly, amino acids were similar to those reported for bovine, lamb and goat meat (Dawood and Alkanhal, 1995; Elgasim and Alkanhal, 1992). The present study aimed to address some aspects of nutritive value in meat from Sudanese male and female desert camels (*Camelus dromedarius).*

Materials and Methods

Longissimus dorsi (LD), muscle was removed between the 1st to the 5th lumbar vertebrate from the right carcass side of 14, two to three year old camels (7 males and 7 females). Connective tissues and visible fat were removed muscles were placed in plastic bags and kept for 24 h at 2-3° C. The samples were then vacuumed and stored in -18°C until analysis. Collagen determination of the LT samples were carried out according to the procedures reported by Listrat *et al*., (2001). Hydroxyproline content was determined according to the procedures of Woessner, (1961) and optical densities were read at 557 nm. For amino acids determination, four different conditions of protein hydrolysis have been applied. Three acidic hydrolysis (HCL 6N, 110°C) : 24 h, 24 h after performic oxidation for the sulphur amino acids, and 48 h for branched chained amino acids. One basic hydrolysis ($Ba(OH)_2$, 4N, 110°C, 16 h) for tryptophan determination was carried out. Total lipids were extracted according to the method of Folch *et al*., (1957). Fatty acid analysis was achieved by gas–liquid chromatography (GLC) using the Perichrom 2000 chromatograph (Perichrom, Saulx-les-Chartreux, France) fitted with the CP-Sil 88 glass capillary column (length: 100 m, i.d.: 0.25 mm) with H_2 as the carrier gas.

Data was analyzed using student-*t* test to determine significances of difference in the studied parameters (carcass weight, collagen content, amino acids and fatty acids) between male and females. Multiple means were separated by Least Significant Differences (LSD) where appropriate and differences were considered significant at $P \leq 0.05$.

Results and Discussion

Insoluble OH proline (2.5 and 2.4) µg/ DM and total OH proline (3.5 and 3.3) µg/ DM, which estimate insoluble and total collagen contents, were found to be similar in male and female LD muscles. Babiker and Yousif, (1990) reported 2.37% for OH proline solubility in camel LD muscle which was lower than that for males (26 %) in the present study. This may be explained by different analytical methods. In bovine, Stolowski *et al*., (2006) reported high values of insoluble and total collagen compared to our results. However, strong correlations between insoluble collagen content and raw Warner– Bratzler peak shear force values were reported in bovine by Riley *et al*., (2005) and Stolowski *et al*., (2006).

Amino acid analysis in camel LD muscle showed that leucine, lysine and argnine were the most abundant essential amino acids (1937, 1868, and 1440 mg/ 100g muscle for males and 2010, 1909, and 1604 mg/ 100g muscle for females, respectively). Glutamic acid, aspartic acid, alanine and

proline were the highest non essential amino acids (4268, 2298, 1330 and 1164 for males and 4251, 2246, 1347 and 1074 for the female camel muscles). This is in contrast with the results of Kadim *et al*., (2011) who reported that lysine was the major essential amino acid in male camel LT muscle. The concentration of amino acids in the present study was higher than that reported by Dawood and Alkanhal, (1995), Kadim *et al*., (2008) for male muscles. These differences could be attributed to age or breed differences. Females showed high values of amino acids, but they were not significantly different from males. No differences were observed between sexes for total SFA (48.2 and 51.4% in males and females, respectively), total MUFA (36.9 and 35.1%) and PUFA (13.6 and 12.3%) proportions. The study revealed significant differences between male and female camels for some specific MUFA: 18:1 delta 10-11 *trans*, x1.51, (*P=0.05*), CLA *trans*11, *cis* 9 18:2, x1.33% (*P=0.11*) and *trans*10, *cis* 12 18:2, × 5.7, *(P=0.03)* in muscles from females compared to males. The PUFA/SFA ratio was higher than that of beef (0.5 *vs.* 0.1-0.15) and close to the recommended value for human nutrition (0.45). As in grass-fed bovines, the n-6/n-3 ratio in camel meat is lower (around 3) than that of concentrate-fed bovines (more than 7), and thus lower than the recommended values of human health diets (4.0).

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77. Levels of 25-Hydroxyvitamin D3 in Meat of Moroccan One-Humped Dromedary Camels (*Camelus dromedarius*)

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Introduction

The dromedary camel is a good source of meat especially in areas where the climate adversely affects the performance of other meat animals. In the one-humped camel, lean meat contains about 78% water, 19% protein, 3% fat, and 1.2% ash with a small amount of intramuscular fat, which renders it a healthy food for humans (Kadim *et al*., 2008). In man, diet is an important determinant of plasma 25-OH-D concentrations which is lower in vegetarians than in meat and fish eaters (Crowe *et al*., 2011). However, the information available on nutritional value of camel meat is very limited, and to the best of our knowledge, there is no report evaluating the amount of vitamin D3 amount in the meat of camels. Therefore, this study was undertaken to determine the 25-OH-D3 levels in serum and tissues of camel.

Materials and Methods

Samples of blood, muscle *longissimus thoracis* (between the 10th and the 13th rib of the left side), liver and kidney were collected from ten 4-5 years old male Moroccan dromedary camels *(Camelus dromedarius)* weighing 300–350 kg. The 25-OH-D3 levels were analyzed by radioimmunoassay method in the National Center of Science and Nuclear Technical Energy in Maamoura, Morocco. Validation for 25-OH-D3 assays included limits of detection, and precision in standard curve following sample dilution, inter- and intra-assays. Values were expressed as mean and standard error (SE) and analyzed by the student test for comparison between samples, and $P<0.05$ was seen as statistically significant.

Results and Discussion

Levels of 25-OH-D3 in serum (ng/mL), liver, kidney and muscle (ng/g) in dromedary camels were 390±45; 7.071±1.003; 6.154±1.067 and 4.241±1.045, respectively (Table 1). Levels in liver were significantly higher than those in muscle ($p< 0.05$; Table 1). Despite the circulating levels of 25-OH-D3very higher in camels than those of domestic ruminants, the amounts of 25-OH-D3 in the various tissues of the camel (muscle, liver and kidney) are similar to the amounts reported for this constituent in the corresponding tissues of several domestic ruminants (Table 1).

Table 1. Circulating (ng/mL) and meat levels (ng/g) in camel and bovine species.

Cow	Liver	4.5±2.6	Cho *et al*., 2006
	Kidney	4.2±2.0	
	Muscle	1.83±0.24	
	Serum	88±7.1	
Beef	Liver	2.59±0.73	Foote *et al*., 2004
	Kidney	3.02±1.13	
	Muscle	1.68±0.37	
	Plasma	62.66±16.74	
Camel	Liver	7.071±1.003	Present study
	Kidney	6.154±1.067	
	Muscle	4.241±1.045	
	Serum	390±45	

Only a limited number of foods naturally contain vitamin D such as fish, meat and offal, eggs, milk and dairy products. Dietary vitamin D is absorbed in the small intestine and hydroxylated in the

liver to form 25-OH-D3, the major circulating form of the vitamin, which is further hydroxylated in the kidney to form 1, 25-dihydroxyvitamin D3, the active form of the vitamin (Holick et Chen, 2008). Other factors, such as vitamin D supplementation, degree of skin pigmentation, and amount and intensity of sun exposure have greater influence on circulating 25-OH-D than diet. The low concentrations of serum 25-OH-D are associated with rickets, osteoporosis, heart disease, cancers, diabetes, autoimmune diseases, depression, and chronic pain (Holick and Chen, 2008). Camels are good potential meat producers especially in arid regions where other meat-producing animals do not thrive. Camel meat contains a 25-OH-D3 amounts similar to those of ruminant meats, thus it‘s acceptable for human consumption and may replace meat from other animals.

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78. Nutritional Value and Organoleptic Qualities of Camel Meat Marketed by Butchers in Tunisia

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Introduction

Data on nutritional and organoleptic qualities of camel meat are rare hence the importance of studies on camel meat in Tunisia (Kamoun, 1995, 2003 Kamoun *et al.,* 2009). These studies have shown that the organoleptic qualities of camel meat are similar to those of cattle slaughtered at comparable ages, but nutritional and dietetic qualities are superiors to those of red meat consumed in Tunisia. This work has focused on the comparison of nutritional and organoleptic qualities of camel and beef meat marketed in the same shop.

Materials and Methods

Seven muscles: *Psoas major* (PM), *Longissimus dorsi* (LD), *Semimembranosus* (SM), *Semitendinosus* (ST), *Vastus lateralis* (VL), *Triceps brachii caput longum* (TB) *and Glutéobiceps* (GB), were removed from carcasses of seven non fattened young camel males. The young animals were purchased from Gafsa cattle market by butchers in Kairouan and Tunis. These muscles were compared with those of beef marketed in the same shop.

Muscles samples were trimmed of visible connective tissue and minced for chemical analysis. Moisture and ash were determined according to AOAC (1975). Fat fraction was determined as described in Randhall methods (1974). Tenderness was appreciated by determination of Total collagen by extraction and measurement of hydroxyproline according to the method of Bergman and Loxley (1963) adapted by Bonnet and Kopp (1984). The pH was at 4 ,12, 24, 48, 72 and 84 hour post-mortem made using a pH meter (Précisa type). The color was studied according to two methods: Myoglobine content by Horsney (1956) method and instrumental color as well as L*(lightness), a*(redness), and b*(yellowness) values by Chroma Meter (Minolta, Type CR-410). The nutritional quality of the meat was studied through chemical composition of the fatty acid. The method used is the gas phase chromatography (GPC) (ISO 5508, 1990).

Results And Discussion

Table 1 shows the postmortem meat quality traits and sensory attributes of the fresh camel and beef meat. The analysis of samples reveals that the meat of dromedary is richer in water than that of the beef. The moisture differences between the two species of meat are significant ($P < 0.001$). Camel and beef meat had similar protein and ash content ($P > 0.05$). However, the fat content in both types of meats reveal that the dromedary meat is leaner, the difference was highly significant ($P < 0.001$). The organoleptic qualities of meat were assessed by determining the tenderness and color. The color of the meat is mainly dependent on the concentration of myoglobin and tenderness is inversely proportional to the amount of collagen in the muscle. In terms of instrumental color, expressed by the physical parameters L*(lightness), a*(redness), b*(yellowness) and the content of myoglobin, both meat are similar. However, the collagen content is significantly lower ($P <0.001$) in the camel muscle.

The Muscles pH was measured at 4, 12, 24,36, 48, and 72 h postmortem. At 4h post-mortem the pH is 6.60. The monitoring of pH fall shows that the ultimate pH is reached between 24 and 48 hours post-mortem. However, the pH stabilizes after 48 hours. The evolution of pH is almost identical for both types of meat ($P<0.001$).

The lipid analysis revealed that the fatty acid profile differs according to anatomical muscles location. Overall camel meat is rich in polyunsaturated fatty acids than beef, with the difference being highly significant ($P <0.001$). However, the saturated fatty acids and monounsaturated fatty acids proportions were not significantly different ($P>0.05$). Camel meat was rich in polyunsaturated fatty acids of ω3 and ω6 series and contains less cholesterol. These high nutritional and dietary qualities make the camel meat an ideal healthy local.

Conclusions

Comparing the chemical composition and organoleptic and nutritional qualities of beef and camel, showed that the camel meat is leaner but contains more water, protein and minerals compared to beef. In terms of organoleptic characters, camel meat has a similar color to beef but was more tender. On the other hand, the richness of camel meat in polyunsaturated fatty acids low levels of fat and cholesterol provide additional benefits that classifies it as lean meat and recommended it included in diets to reduce the risk of cardiovascular disease.

Table 1: postmortem meat quality traits and sensory attributes of the fresh camel and beef meat

Meat Characteristics	Dromedary	Beef
Moisture (%)	78.14±0.73	76.52 ± 0.7
Dry matter (%)	21.85±0.33	23.48±0.99
Ash (%)	1.44±0.21	1.07±0.12
Fat (%)	0.43±0.21	2.00±0.89
Protein (%)	20.03±0.27	20.41±2.09
Myoblobin (mg/g 100g)	3.87±0.94	3.47±1.34
Collagen (mg/ g 100g)	6.67±0.73	9.40±0.61
pH 24 (h PM)	5.73 ±0.13	5.61±0.16
pH 48 (h PM)	5.63±0.2	5.57±0.11
L*(lightness) 48 (h PM)	42.62±2.04	42.68± 1.58
a* (redness) 48 (h PM)	18.29± 0.75	18.53 ±0.65
b*(yellowness) 48 (h PM)	3.66±0.65	3.42 ±1.22
SFA (%TFA)	36.16 ± 8.47	38.24 ± 5.84
MUFA (% TFA)	45.57 ± 3.97	54.67±6.62
PUFA (% TFA)	18.43±11.55	6.97± 3.22
Oleic acid (C18:1) (% TFA)	33.17±1.89	41,95 ± 4,82
Palmitic acid(C16:0) (% TFA)	19.65 ± 3.83	22,1±1,37
Linoléic acid C18:2 ω 6) (% TFA)	13.99±11.75	4.44 ±2,54
Alpha-linolénic acid (C18:3 ω 3) (% TFA)	1.20 ± 0,22	0.90±0,32
Total ω 6 % (% TFA)	15.16±10.68	5.20±2.86
Total ω 3 (% TFA)	2.87±0.89	1.52±0.56
PUFA/SFA	0.61±0.53	0.19±0.09
ω 6/ ω 3	5.56 ±4.52	3.36 ±1.20
Cholesterol (mg/100 g FM)	6.10 ± 4.45	42.49 ± 19.13

FM: Fresh Muscle; h PM: hour Post Mortem; TFA: Total fatty acids;
SFA : Saturated fatty acids; MUFA : Monounsaturated fatty acids; PUFA : Polyunsaturated fatty acids

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79. Distribution and Measurements of Bone in the Omani Camel Carcass

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Introduction

The camel can survive and thrive under harsh environmental conditions and provide animal protein for deprived segments of society. It may also be raised under intensive management to produce good quality carcasses and meat for the modern supermarket industry. Skeletal growth is essential for body growth and carcass quality. Growth in length affects bone and muscle characteristics (Mahgoub, 1988). Proportions of bone in the carcass influence other edible components (muscle and fat). Carcass tissue distribution especially bone, is not well studied in camels. Camel carcasses are unique due to the animal‘s shape with a large variable size hump and shallow sloping hind limb. This study aimed at studying the distribution of bone in the camel carcass.

Materials and Methods

Ten Omani camels were raised under intensive management and slaughtered over a range of 218-322 kg body weight. Carcasses were dissected to individual carcass tissues (muscle, bone, fat and waste). Individual bones were dissected out, cleaned of adhering tissue then weighed to nearest g on a digital scale. Individual bones were measured in length using a caliper to the nearest centimeter. They were also measured in diameter using a caliper to the nearest mm and circumference using a string to the nearest cm. basic statistical analyses was carried out using Excel, Microsoft package.

Results and Discussion

Approximately one quarter of the camel carcass weight (24.1%) is made of bone. The camel carcasses also contained 56.4, 9.0 and 10.5% muscle, fat and waste. The proportion of bone in the carcass is important as it affects other components particularly muscle and fat thus affecting carcass conformation and quality. The axial skeleton contained 45% of the camel carcass bone (Table 1) whereas the forelimb and hindlimb contained similar proportions (27 and 28 % of the side total bone). The forequarter (cervical and thoracic vertebrae plus ribs, sternum and forelimb) constituted about 62% whereas the hindquarter (lumber and sacral vertebrae plus pelvis and hindlimb) constituted 38% of the carcass bone. Most of the extra weight comes from the long heavy neck.

Table 1. Weigh of bone and percentage of bone in the total bone of Omani camels

Parameter	Mean	SD	Max	Min
Slaughter weight (kg)	257	32.28	322	218
Carcass weight (kg)	121	21.26	169	95
Total vertebral column	22	1.64	24.5	19.7
Ribs	9	0.82	10	7
Sternum	7	1.14	9	5
Axial skeleton	45	2.61	48	39
Scapula	5	0.47	6	5
Humerus	10	0.52	11	10
Radius and ulna	10	0.50	10	9
Carpus	2	0.58	2	1
Forelimb	27	1.02	29	26
Pelvis	6	0.38	6	5
Femur	10	0.74	12	10
Tibia	8	0.78	9	6
Patella	1	0.08	1	1
Tarsus	3	0.56	4	2
Hind limb	28	1.88	32	26
Forequarter	62.3	2.11	63.2	64.7
Hindquarter	37.7	2.11	36.8	41.1

The forequarter is larger in the camel carcass (Kadim *et al*., 2008). This affects the distribution of other tissues in the carcass. Muscle, bone and fat content were 59.3, 4.5 and 36.2% in the forequarter and 66.5, 14.9 and 17.3% in the hindquarter (Kamoun, 1995).The tibia was the longest and thickest bone in the carcass followed by the femur (Table 2). Camel bones are longer than those of Omani Dhofari cattle of 210 kg body weight (Mahgoub *et al*., 1995). However, bones of both species appear to be of comparable width. This study indicated that bone is variably distributed in camel carcass which would affect carcass conformation and quality.

Table 2 Measurement of individual bones in Omani camel carcasses

Parameter	Mean	SD	Mode	Median	Max	Min
Femur length (cm)	44.4	2.37	43.2	44.2	49.6	40.2
Humerus length (cm)	34.0	0.96	34.3	34.2	35.4	32.4
Radius and ulna length (cm)	41.7	0.96	40.9	42.0	42.8	40.0
Tibia length (cm)	51.9	1.05	52.9	52.3	53.1	50.4
Femur width (mm)	33.6	1.99	N/A	34.0	36.9	30.7
Humerus width (mm)	39.0	3.14	N/A	38.9	43.2	34.5
Radius and ulna width (mm)	35.8	4.93	N/A	37.5	40.7	24.7
Tibia width (mm)	41.3	4.70	N/A	42.1	47.4	32.8
Femur circumference (cm)	11.0	0.61	11.0	11.0	12.0	10.2
Humerus circumference (cm)	13.6	0.82	13.0	13.4	14.8	12.7
Radius and ulna circumference (cm)	11.4	0.52	11.7	11.6	12.3	10.8
Tibia circumference (cm)	12.2	0.84	11.4	12.0	13.4	11.0

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80. A Review of Camel Meat as a Precious Source of Nutrition

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Introduction

Camel meat is very popular and readily available in certain places of the world. Camel meat is not well known in the Western and Far-East communities such as Europe and South East Asia. The dromedary camel is a good source of meat especially in areas where the climate adversely affects the performance of other meat animals. This is because of its unique physiological characteristics, including great tolerance to high temperatures, solar radiation, water scarcity, rough topography and poor vegetation (Kadim, *et al*. 2008). Camel meat is more consumed in some Middle Asia, North Africa and Middle-eastern countries, which are considered poor in both their agricultural land and water resources as the desert is covering huge parts of the total area. Those countries are self-sustained in camel meat production. However, they continue to make strides towards achieving self sufficiency in relation meat products by using new agricultural technologies. Hence, food security will remain at the top of their priority list of which securing sufficient animal protein is the most challenging task, compared to all the other nutritional requirements. Camel production in both the commercial and rural sectors can provide a quick and a most cost effective solutions for this nutritional problem. However, camels are one of the underlying elements of the national economy and food security for many regions in the world such as Middle-East, Africa, some Asian countries and Australia. Camel husbandry has been slightly improved, and the domesticated camel in the world tenuously increased from 1978 to 1999 at the rate of 17.0 to 19.0 million heads, respectively (Hertrampf, 1997). In other words, the rate of camels‘ growth is around 0.5% per year.

Quality and nutritional background

From the quality point of view, camel carcasses are slender and have less amount of fat when compared to other red meats. The edible meat tissue from camels also contains less cholesterol than beef or lamb, which suggests that camel meat is healthier (Kadim, *et al*., 2008). The taste of camel meat is generally appreciated, slightly tender something between beef and veal if they slaughtered as young as yearling (Huwar). The camel meat color is dark to red (particularly the meat of old camels), in raw condition it is somehow fibrously and requires a special, adequate manufacturing in process.

Most recently, the fact that meat quality has evolved further from just implying lean yield percentage and back fat thickness. For example, quality now refers to all or some of the following: (i) carcass characteristics and composition, such as carcass uniformity and consistency, lean yield, (ii) meat characteristics such as colour, marbling, pH, DFD (dark, firm and dry) score, (iii) eating quality characteristics including tenderness, juiciness and flavour, (iv) nutritional characteristics such as protein, vitamin and mineral contents (Grunert, et.al 2004). Camel meat is a good supplier of protein, vitamin A and D and also contains rich amount of efficient fatty acids. Regarding the relative camel species, Alpaca meat appears to be not only suitable but also attractive for human consumption, from both the chemical composition and technological meat quality points of view. More specifically, (1) proximate composition of alpaca muscle was characterized by a relatively low intramuscular fat content (2%) and a high ratio of protein to fat, (2) mineral and amino acid compositions, PUFA:SFA ratio and CLA content were similar to those of beef and sheep meat (Salva, et.al 2009).

A little attention has been paid for the benefits of camel meat, especially the chemical composition and its value, although camel meat have shown that it has some distinct qualities which perceive it from other red meat types such as mutton and beef. The most highly considerable characters of the camel meats are its low fat matter and high moisture content and also considered as rich in protein content and a multivitamin commodity. Camel meat contains a high ratio of good quality of protein. Generally, vitamin A plays many critical functions, both preventive and therapeutic. Vitamin A helps keep human skin and mucus membrane cells healthy and stimulates immune system response, which helps fight outer infections. Another important function of vitamin A

is that it acts as an antioxidant, helping to protect cells against cancer and other diseases. Vitamin B1 is needed to help convert the carbohydrates into glucose. The following B Vitamins are needed at a cellular level to convert glucose into energy. The vitamin B complex is essential for the healthy functioning of the nervous system. A deficiency in any of the vitamin B complex vitamins can lead to feeling stress, anxious and depressed. Excluding camel, all red meat naturally contains more fat, saturated fat and cholesterol than any other food. A chronic access intake to these lipids in the body is directly responsible for numerous cardiovascular diseases, including coronary heart disease and high blood pressure. As camel meat contains less fat, we therefore suggest that eating camel meat is a great factor helps reducing risk of developing life-threatening diseases, such as obesity, cholesterol disease and colon cancer.

Meat and fish provide valuable sources of protein for many populations around the world. Furthermore, meat and fish proteins offer huge potential as novel sources of bioactive peptides (Ryan, *et al*, 2011). The meat protein tended to have a higher percentage of the amino acidproline than the literature values for other red meats, and lower values for tryptophan, aspartic acid, and tyrosine (Dawood, and Alkanhal, 1995). Since camel meat contains high level of protein compared to beef, it may have many biological active peptides after it is being degraded by the human digestive system. Bioactive peptides from food proteins offer major potential for incorporation into functional foods and nutraceuticals (Royan *et al*., 2011). Moreover, camel meat is believed by Somali and Indian people to have remedial effects for as many as 13 different diseases, including hyperacidity, hypertension, pneumonia and respiratory diseases and also to be an aphrodisiac (Kurtu, 2004).

Reasons contributed to consider camel meat as precious nutrition and healthy muscles food lie in (1) high in protein content and its uniqueness, (2) low in fat and cholesterol, (3) multivitamin muscle food (especially tocopherol group), (4) provides the essential amino acids (arg, his, ile, leu, lys, phe, thr, trp, val, met), (5) distinguished meat from other red meat types (tender and easy to chew, which is good for elderly people; juicy that enhances flavor for soups; tasty in which considered as umami substance enhancer).

Conclusions

The consumption of meat has a cultural value. A respectful and careful treatment of all animals for slaughter belongs to the quality of meat. As for the camels, it seems that this requirement is less fulfilled than for other animals with some negative hypothesis remains, which must be overcome gradually. The authors of this article are engaged to positively review and to further propagandize nutritional value of the camel meat. We suggest that camel meat may have remedial effects for many different life-style related diseases, including, hypertension and cardiovascular diseases.

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81. Machine Separation of Guard Hair from Fine Fibre of Camel Fleece

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Introduction

It‘s well established that, camels provide a considerable quantity of hair. Traditionally, this natural fibre is used in clothes, bedding, and in some utilitarian objects of pastors. Camel hair is widely known for its softness, lustre, natural tan color and warmth without weight.

The fleece of camel consists of two fibre types guard hair and down fibre (Millar, 1986). Guard hairs are coarse and typically form a protective coat over the underlying fibre. Down fibre is finer (19–24 μm) than the guard hair (20–120 μm) (Petrie, 1995). In fact, importance of each class of fiber varies greatly from camel to camel and from age to age. Fine fibre is used in soft clothes and guard hair is used in bedding and utilitarian objects.

In Tunisia, the shearing of camels and collection of fibre start to be limited and the main produced hair is lost. Very little local craft activities using camel hairs exist. This negligence is, in part, due to the difficulties of the hand preparing, picking and separation between guard hair and down fibre operations of the fiber before carding, milling and spilling. Picking operation is done by teasing small amounts of hair with fingers so dirt and vegetation falls out. After that, guard hairs are manually picked out. These operations take time and is the most difficult task requiring a great visual concentration. In fact, this work is no longer practiced by young artisans and is conducted only by the old craftsmen. This study aimed to develop machine separation of camel hair.

Materials and Methods

The main objectives of the development of this machine are:

• Replace the manual separation which represents a handicap for the development of camel hair craft.
• Achieve a high efficiency separation between the 2 classes of fibre limiting to less than 1% the amount of guard hair (diameter > 30 μm) in the hair.
• Minimize damage to the length and the mechanical properties of fibers.
• Provide maximum flexibility to allow the machine to have a large number of set points and even the possibility of changing the layout of parts of the machine.

The machine operating is based on:

- A feeding device comprising cylinder and table (Photo 1). The role of the feeding device is the progress of the hair by sliding on the smooth table by the rotation of the cylinder at a low speed breaker.
- A device with double-breaker:

The breaker is a drum which is mounted on a rigid trim sawtooth, helically wound along its entire periphery. The breaker, which having 230 mm and 600 mm of diameter and length respectively, rotates at speed of 800 tr/min. The two breakers have the same size but rotate at a different speed. The first breaker which works at lowest speed allows a gradual working of the material. It acts as an opener sawtooth, allows the sheet of fibers and brings them to the second breaker. The penetration of the breaker teeth in fibers is gradually: first in the outer layer above the sheet, then gradually as it advances, the penetration continues and the sheet is falling apart.

Hairs are tangentially projected by the centrifugal force; coarse debris and guard hair fall into the first container while the lighter fibres (down fibres) are driven by the air stream to the perforated drum.

The suction equipment is a perforated cylinder which collects the fibers separated from the breaker by the action of the upper cutter and deposited on its surface as a light layer; the dust is sucked through the perforations of the drum.

The collection containers of the fibre are in the form of drawers easy to open and away from the machine to eventually empty and clean. The drawer located at the front of the machine is reserved for the recovery of waste and guard fibre while the second tray is placed at the back to collect the fine fibre.

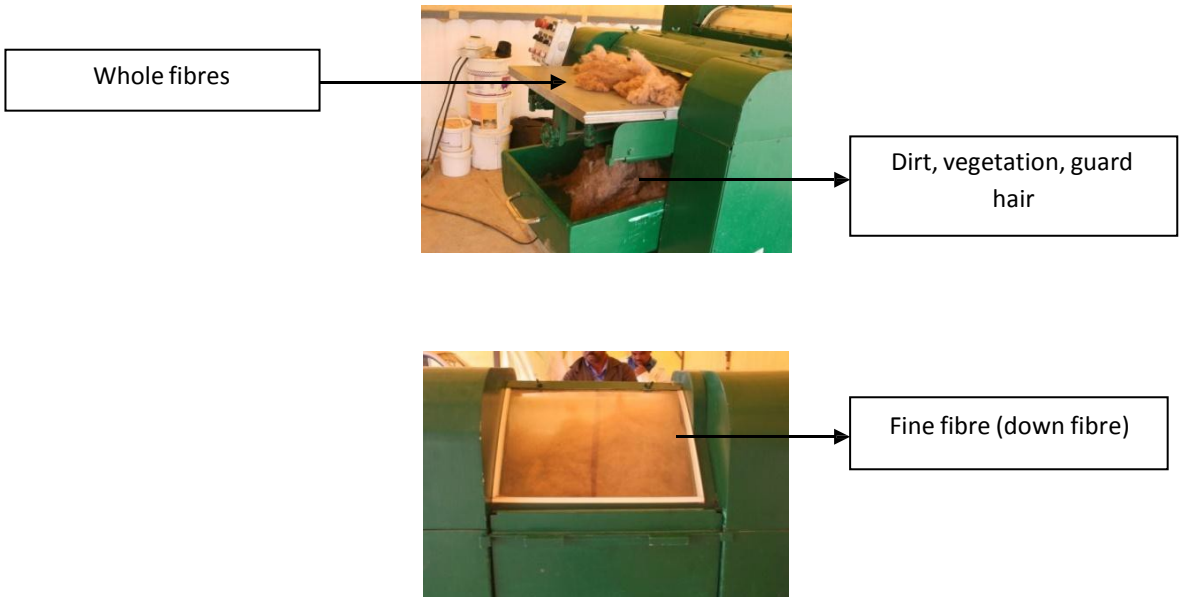

Photo 1: Machine for separation between guard hair and down fibre of camel fleece

The hair designated for separation was obtained from camel calves aging no more than 18 months. The weight of the fleece was about 1 kg which could be improved if sharing is done in early summer.

The yield of mechanically fine hair is about 42%. However, it is still lower than the manually separation which could reach 60% and with higher quality in terms of fiber length and the proportion of the guard fibre.

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82. Characteristics of the One Hump Camel Leather

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Introduction

The hide of camel is considered to be as one of the heavy type of skins and its leather is used mainly for making shoes and sandals. The size of Tunisian camel hides are about 10-16 sq ft and the thickness is 1.0 -22 mm (leather com. Austria, 2006). At present, the camel leather is processed using methods defined for cattle skin. Developing methods based on hide characteristics can improve the quality of camel leather. Few studies have been carried out on skin characteristics, processing and its usage in domestic species. This information is required in order to utilize the camel leather for specific purposes. The objective of this study was to evaluate the hide and leather characteristics of the Iranian one hump camel.

Material and Methods

Fourteen male and female dromedaries camels were slaughtered and skimed at the age of 21 months. The hides were transported to tannery house and the chrome-tanning were conducted to make leather. The thickness at shoulder, flank and rump of both left and right sides and the thickness of neck were measured using a manual thickness gauge. Breaking force, tensile strength and elongation at break of leather were measured (ISO 3375).

The data obtained were analyzed statistical using general linear model (GLM) using SAS software package (SAS / STAT User‘s Guide, 1987).

Result and Discussion

The thickness of dried hide and leather in this study was 3.5 ± 0.1 and 1.8 ± 0.1 mm, respectively. Adel (1994) reported that the thickness of the skin differed and was dependent on the breed, types, age, sex and different parts of the body. The average thickness for hide and leather of Egyptian camels recorded were 3.5 and 1.9 mm, respectively (Abdelsalam and Haider, 1993) which is similar to the results of present study.

Results indicated that, there was no significant difference in right and left sides' thickness of camel hides ($P > 0.05$). The thickness of various parts of camel hides (shoulder, flank and rump) did not show any difference but there were significant differences in the thickness between hides around neck ($P < 0.05$). Salehi *et al*., (2010) reported the thicknesses of skin of native Iranian goats was 0.8 - 3 mm. Moreover, they reported significant effects of sex, age, genotype and area of sampling on the thickness.

According to the standards of BSI, 6853 the characteristic and specifications of leather clothes for sheep and cattle, the tensile strength (kgf/ $cm^{2)}$ and the elongation (%) at break should be in the range of 150 to 180 and 50 to 90 and 40 to 90 respectively. Based on BIS norm that Sivasubramaniana *et al* (2009), reported the range of the strength for leather of goat and cattle were 152.96 to 254.93 and 203.94 to 305.92 kgf/cm^2. They also reported the elongation at break was 40 – 80 and 60 - 80 % for goat, and cattle color crust based on the Indian standard respectively. In this study the sex did not have any effect on any of the physical characteristics of the leather (Table. 1). The average and range of breaking load and tensile strength was 38.1 ± 3.39 (19.7 to 63.6 %) and 214.7 ± 25.4 3 (80.8 to 394.1 kgf/cm^2) and the results for the elongation at break were 61.0 ± 3.7 (37.0 to 87.3 %). These data were in accordance to Iran and Indian standard.

Table 1: Effect of sex on least square means and standard errors for physical leather characteristics of one hump camels

Characteristics	Body part	Male	Female	SE	P value
Hide thickness (mm)	Neck	3.5	3.9	0.2	0.2
	Shoulder	3.3	3.6	0.2	0.4
	Flank	3.4	3.6	0.2	0.7
	Rump	3.4	3.4	0.1	1.0
Crust thickness (mm)	Neck	3.3	3.7	0.1	0.02*
	Shoulder	3.01	3.06	0.08	0.67
	Flank	3.1	3.4	0.1	0.17
	Rump	3.2	3.3.	0.1	0.39
Split leather thickness (mm)		1.75	1.8	0.05	0.59
Breaking load (kgf)		36.2	39.9	4.9	0.69
Tensile strength (kgf/cm^2)		204.5	224.9	37.1	0.70
Elongation (%)		58.4	63.7	5.3	0.49

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83. Evaluation of Physical and Chemical Characteristics of Crossbred (*Dromedarius* and *Bactrianus*) Camel Meat in Different Parts of the Carcass

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Introduction

Camels are an important food resource for people living in dry and semi dry regions. However, the potential of the camel as a meat producer has received little attention. Camel meat is a good source of protein and in arid zones its meat is preferred. In recent studies the quality of camel meat products for human consumption was evaluated (Kadim, 2008; Shariatmadari, 2003 and Kurtu, 2004). Kadim (2006) indicated that camel meat is healthy and nutritious as it contains low fat, as well as being a good source of minerals. The main objective of the present work was to determine the meat characteristics of crosses of the Iranian dromedary and Bactrian camels.

Material and Methods

Eleven male and female crossbred camels (*Dromedarius* and *Bactrianus*) at approximately 20 months of age were slaughtered according to Islamic procedures. Camel carcasses were kept in cold storage at 4^0C for 24 hours and were divided to six cuts of carcass: leg, shoulder, breast, loin, flank and neck. The composition of meat such as dry matter, crude protein, crude fat, ash, mineral matter (Ca, K, Mg, P, Na, Zn and Fe), NPN, pH and energy content of six parts of carcass were measured. The proximate physical and chemical composition of the muscle tissue was determined according to standards methods of AOAC (1995).The general linear model (GLM) within SAS (1995) was used to compare the differences in physical and chemical characteristics of crossbred camel meat. Significant differences between means were assessed using the least-significant difference procedure.

Results and Discussion

The mean and range of physical and chemical characteristics of crossbred camel samples are given in Table 1. Protein, NPN, fat of meat were significantly different *(P≤0.05)* in six cus of carcass. Total carcass meat protein was 63.6±3.12 % of dry matter. The percentage of protein in leg and neck was 77.1±3.12 and 73.9±3.12 respectively, which was higher than the other parts *(P≤0.05)*. The percentage of protein (50.2±3.12) and fat (33.0±3.21) in loin were higher than leg, shoulder and neck. The NPN percentage of meat in different parts was affected by sex with females having higher levels than males *(P≤0.05)*. There was no differences between groups in mineral content of meat.

Table 1: Means and standard errors of meat composition of crossbred camel meat (percentage of dry matter)

Factors		Dry matter	protein	NPN	Ash	Fat	pH	Energy Cal/g
Sex	Male	34.5±1.72 ^{a}	62.9±1.71 ^{a}	0.277±0.01 ^{b}	6.7±0.26 ^{a}	26.4±1.77 ^{a}	5.8±0.04^{a}	6279±89 ^{a}
	Female	33.1±1.89 ^{a}	64.4±1.88 ^{a}	0.311±0.01 ^{a}	7.4±0.28 ^{a}	24.0±1.94 ^{a}	5.7±0.05^{a}	6349±98 ^{a}
Parts	Neck	29.6±3.13 ^{a}	73.9±3.12 ^{a}	0.276±0.01^{bc}	7.2±0.47^{a}	15.6±3.21^{c}	5.9±0.08^{a}	6171±162^{a}
	Shoulder	32.1±3.13 ^{a}	70.8±3.12 ^{ab}	0.337±0.01^{a}	7.1±0.47^{a}	15.6±3.21^{c}	5.6±0.08^{a}	6274±162^{a}
	Loin	39.2±3.13 ^{a}	50.2±3.12 ^{cd}	0.278±0.01^{bc}	6.6±0.47^{a}	33.0±3.21^{ab}	5.7±0.08^{a}	6435±162^{a}
	Flank	38.4±3.13 ^{a}	48.9±3.12 ^{d}	0.239±0.01^{c}	6.6±0.47^{a}	45.3±3.21^{a}	5.8±0.08^{a}	6594±162^{a}
	Breast	32.7±3.13 ^{a}	61.0±3.12 ^{bc}	0.295±0.01^{ab}	6.4±0.47^{a}	31.3±3.21^{b}	5.7±0.08^{a}	6450±162^{a}
	Leg	30.8±3.13 ^{a}	77.1±3.12 ^{a}	0.336±0.01^{a}	8.3±0.47^{a}	10.3±3.21^{c}	5.6±0.08^{a}	5957±162^{a}
	Carcass average	**33.8±3.13**	**63.6±3.12**	**0.293±0.01**	**7.0±0.47**	**25.2±3.21**	**5.7±0.08**	**6313±162**

* a,b,c,d Within columns, mean without a common superscript differ at p<0.05

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84. ffect of Age on Fiber Characteristics of Semnan Dromedary Female Camels

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Introduction

Presently one hump camel population in Iran is 150,000 heads. Production of fibre from various world dromedaries (one humped) camels has been reported (Petri, 1995). The fleece of camels consists of two major fibre types; guard hair and down fibre (Millar, 1986). Guard hairs, which grow from primary follicles, are coarse, medullated fibres, which typically form a protective coat over the underlying down fibre. Down fibre grows from secondary follicles in the skin (Mitchell *et al*. 1991, Nixon, *et al*. 1991, Restall *et al*. 1994) and is finer (19-24 microns) than the guard hair (20-120 microns) and non-medullated fibre (Petrie, 1995). There are no detailed descriptions of Iranian camel fibre characteristics. The aim of this study was to evaluate the fibre characteristics of one hump camel in Semnan province in Iran.

Materials and Methods

A total of 28 one hump female camels from Semnan Province representing 3 groups: young (<2 year-old) adult (3-7 year-old) and old (8-25 year-old) were used in this study. Sampling date was early spring (mid-April 2010), just prior to the seasonal moult and regular shearing period. About 10 grams of fiber from the left mid-side site was clipped from a 5 × 5 cm square using regular scissors. The fibre diameter, fiber diameter standard deviation of the washed wool sample was measured using a projection microscope (Chapman, 1960). Down fibre staple length was obtained to the nearest 0.1 cm as the mean of three staples. Analysis of variance was performed using a general linear model (GLM) of SAS package (SAS, 1996). All values were expressed as least square means ± SEM with $P<0.05$ was considered to be statistically significant.

Results and Discussion

Staple length and down fibre percentage in young camels were significantly higher than adult and old camels. Average fibre diameter of old camels was significantly higher than young and adult camels (Table 1). Age did not have any effect on fibre diameter coefficient of variation of fibre diameter, and medullated fibre type. In a study with Indian one hump camel it was found that breed had significant effect on fibre characteristics (Champak *et al*. 2001). In agreement with the present study,Salehi et.al. (2003) found that young Iranian camels from Yazd and Mashad provinces had significantly lower fibre diameter and longer staple length.

Younger camels had significantly higher percentage of down fibre, a similar finding was reported with Mashad and Yazd one hump camels (Salehi *et al*. 2003). In conclusion with increasing age of camels the quality of fibre characteristics decreases.

Table 1. Mean and standard errors of different fibre characteristics of Semnan one hump camels.

Characteristics / Age	Young (<2 years)	Mature (3 to 7 years)	Old (8 to 25 years)	P value
No	7	13	8	-
Staple length (cm)	4.2 ± 0.2^{a}	2.4 ± 0.2^{b}	2.8 ± 0.3^{b}	*
Mean fibre diameter (µm)	18.7 ± 0.6^{b}	18.6 ± 0.3^{b}	20.7 ± 0.7^{a}	*
Fiber diameter CV	26.4±1.07	26.3±0.8	26.1±1.26	N.S
Cashmere %	84.2 ± 2.2^{a}	82.7 ± 1.3^{b}	82.4 ± 1.9^{b}	*
Hair %	15.8 ± 2.2^{b}	17.2 ± 1.3^{a}	17.6 ± 1.9^{a}	*
None medullated fibre %	81.5±6.6	82.3±1.6	81.7±2.5	N.S
Medullated fibre %	18.5±6.6	17.7±1.6	18.8±2.4	N.S
Efficiency %	79.7 ± 1.6^{b}	73.6 ± 2.5^{c}	81.3 ± 1.5^{a}	**

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