PORTRAYAL OF CAMELIDS IN PASTORAL ECONOMY OF NORTHEASTERN HERDERS OF BALOCHISTAN

By

Abdul Raziq
M.Sc.(Hons.) Animal Nutrition

A dissertation submitted in the partial fulfillment of the requirements for the degree of Doctor of Philosophy in Livestock Management

DEPARTMENT OF LIVESTOCK MANAGEMENT
FACULTY OF ANIMAL HUSBANDRY
UNIVERSITY OF AGRICULTURE
FAISALABAD-PAKISTAN

2009
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2009
To

The Controller of Examinations
University of Agriculture
Faisalabad

We the Supervisory Committee, certify that the contents and form of dissertation submitted by Mr. Abdul Raziq, Regd. No. 91-ag-1374, has been found satisfactory and recommend that it be processed for the award of the degree.

**Supervisory Committee:**

1) Dr. Muhammad Younas (Chairman) ____________________________

2) Dr. Arshad Iqbal (Member) ________________________________

3) Dr. Muhammad Sajjad Khan (Member) ____________________________
DEDICATION

I dedicate my work to the camel herders, who care, manage and breed the camel herds in terrain and rugged mountains of Balochistan. They contribute a lot for the welfare and betterment of livestock breeds especially camel in the situation where life facilities are rarely available. They are the custodians and guardians of the national animal genetic resources and always do better for the pleasant and friendly environment by caring the vegetation, on which their animals thrive. They contribute much and abundant, but never demand for reward in return. In short they are the unseen guards for the betterment of environment, camel herds and the nation, since centuries. Their contribution is never praised and they are sinking under the poverty and no one is aware about the situation, they face in their lives.
ACKNOWLEDGEMENTS

I have sense of obligation to my learned Supervisor Dr Muhammad Younas, Professor and Dean, Faculty of Animal Husbandry, University of Agriculture, Faisalabad Pakistan, for his keen interest, skillful guidance, valuable suggestions and constructive criticism, during my studies, research project and writing of this manuscript.

I have the honor to express my heartiest gratitude and profound indebtedness to Dr Arshad Iqbal and Prof Dr Muhammad Sajjad Khan, members of the Supervisory Committee, for their skillful suggestions and painstaking care during the research and finalizing this manuscript.

In the study area, all the Baloch and Pashton pastoral tribesmen, I met during my fieldwork and their selfless support of it. To the elders who patiently answered my never ending questions about their camels. To the people of Musakhel especially Maghdozai tribe for making me feels at home in the middle of nowhere, particularly Haji Khanan and Pastha Khan. Special thanks to Sohrab Khan Buzdar and Master Qaiser Khan Marri who faithfully told me time and tell me all the camel related things sincerely.

Very special thanks to Dr Muhammad Azam Kakar, Dr Ameer Hamza, Muhammad Yahya Musakhel, Dr Abdul Razzaq and Mr Javid Habib Kakar for their guidance and help during my research and data collection in the field.

My special thanks are due to many international researches and workers who helped me during this study in providing me literature and latest information I needed to update my dissertation.

I would like to thank all the friends and colleagues who helped me during this study at University of Agriculture Faisalabad. I would also like to thank the staff at the Dept of Livestock Management, University of Agriculture, Faisalabad, in particular for extending me help round the clock.

With love and affection, I pay homage for the help and encouragement to my family members who motivated this plan of study and exhibited great patience and good will throughout the period.

ABDUL RAZIQ KAKAR
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ABSTRACT

Balochistan is the largest province of Pakistan; which makes about 44% of the total geographical area of the country. The livestock sector is very important with the province housing about 20% of the national stock. At present national camel herd comprises about one million heads of camels, and 13% growth rate has been observed since 1996 to 2006. Out of the total national camel population 41% found in Balochistan province alone. The country produced 38.69 billion liters milk in year 2006-2007 and made its place as one of the higher milk producing country in international ranking but per capita milk availability (170. liter) is still very low. The share of different species has been reported as buffalo 25.04 billion liters, cow 13.33 billion liters and goats 0.32 billion liters. In spite of 0.92 million camel populations, camel milk has not been documented in the grey record and has never been appreciated, valued and estimated properly.

No doubt the automobile and machine transportation decreased its draught role, but it is still an important food animal and indigenous animal genetic resource. Camel is a hardy animal and has proved his worth in the long prevailing droughts in Balochistan, remained almost for 10 years (1994-2004). According to camel herders, the only cause was the hardiness of camel and long traveling ability enabling him to access to feed sources and water points. It was revealed that camel still play important role, provide cash earning, transportation, food and wool, etc. The camel herds in the northeastern Districts of Balochistan are mostly practice semi-nomadic livestock keeping system, therefore, they follow a regular pattern of seasonal migration according to the season, foliage availability and agricultural operations. Women perform all management practices at home, and take care of young and sick animals. Camel is the major player and the food and livelihood earning source in the existence of pastoral people of Suleiman mountainous region. Mangrota camel fair (Mela) is one of the largest socioeconomic activities of camel herders of the said region, which is held every year in the month of October, in Mangrota town. Mangrota is a town of tehsil Thonsa, District Dera Ghazi Khan in the Punjab province of Pakistan. It was found that the camels are brought mainly by the people of
Suleiman mountainous region, bought mostly by the people of NWFP (North West Frontier Province) and Western and Central Balochistan. The herders avail a good opportunity for the sale of their animals on one hand and exchange their expertise, vision and social chit chat on the other hand. Camels are a potential milk animal and produce more and quality milk than any indigenous cattle breed in Pakistan, but their potential have never been realized and couldn’t be harvested as a prospective milk producing animal.

A study on milk production ability was conducted on 40 lactating camels in northeastern Balochistan and samplings were done at the end of each second week (level) for a whole lactation in 2006. The daily milk yield ranged from 6.045-11.732 kg/day with a mean daily yield as 10.22±0.43 kg/day (mean±SE). The lactation length ranged from 231-275 days with a mean of 259±7.02 days. Many factors found affecting daily and lactation yield i.e. affect of age and parity, stage of lactation, season of production, type/breed of camel and calving season on milk production. Among parities, 5th parity (13.50 year) of age had the highest lactation yield (3168 kg) of milk followed by 3rd parity (8.75 year) of age with (3051 kg) of milk and 4th parity (11.45 year) of age with (3010 kg) of milk and lowest milk was produced in the 1st parity (4.5 year of age) with (1566 kg) (p>0.05).

Six multiparous camels regularly milking were selected for the study of milk composition, and the milk was analyzed for two stages of lactation (2nd and 7th month of lactation). The study revealed that the Kohi camel milk contains average of fat, protein, lactose and ash contents as 2.63, 5.05, 4.01 and 0.70%, respectively. The parity affected the milk fat, protein, lactose and ash contents. The fat and protein contents increased with the advancement of the parity but to a certain level (parity 5). Stage of lactation also affected the milk composition and fat percentage was higher (2.70%) in the second stage of lactation than (2.57%) those of first stage. protein was higher in the first stage of lactation (5.56% and 4.15% respectively) than second stage of lactation (4.54% and 3.87% respectively). Lactose was higher in the first stage of lactation (3.67%) than second stage of lactation (2.55%), while the ash was higher in the second stage of lactation (0.73%) than first stage of lactation (0.68%). Average mineral profile of the milk samples was observed as Na (49.42 mg/100g), Mg (15.04 mg/100g), Fe (0.55 mg/100g), Mn (0.066 mg/100g), Cu (0.22 mg/100g) and Zn (1.42 mg/100g). All minerals

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except Na had showed a very minute variation among parities. An irregularity was found in the chemical composition of the camel milk based on the parity and stage of lactation. Not only the parity and stage of lactation but also the age of the animal, continuous herd’s movement, nutritional management and the seasonal difference might have contributed in the cause of all irregularities.

Keeping in view the important roles camel play and its future importance as a valuable animal genetic resource, authorities are stressed upon to reconsider this animal specie in the research and development plans of the country. The potential of camels as a dairy animal was demonstrated under traditional management, to further elucidate factors affecting the milk yield capacity, studies under different management and controlled environment were recommended.
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To

The Controller of Examinations
University of Agriculture
Faisalabad

Subject: Revision of Dissertation after the HEC evaluation

Dear Sir:

We the Supervisory Committee, certify that the PhD dissertation of Mr Abdul Raziq, Regd No. 91-ag-1374, has been revised in the light of the observations and suggestions of the Higher Education Commission (HEC) Islamabad. May I request your goodself to proceed for external evaluation.

Supervisory Committee:

1) Dr Muhammad Younas  (Chairman)  

2) Dr Arshad Iqbal  (Member) 

3) Dr Muhammad Sajjad Khan  (Member)
CHAPTER I

INTRODUCTION

Balochistan is the largest province of Pakistan; which makes about 44% of the total geographical area of the country. However, only 4.9% of the national population lives there. Most of the area is rangelands with only 5% arable. The livestock sector is very important with the province housing about 20% of the national stock. However, with the little manufacturing and under developed infrastructure, the province economy lags far behind than other part of the country (FAO, 2002).

The Northeast part (Suleiman Region) of Balochistan province in Pakistan is well known for its animal agriculture, especially the large herds of camel. The dromedary camel (Camelus dromedarius) is one of the main livestock specie raised in the region. Studies have revealed that camel plays a pivotal role in the socioeconomic life of the pastoral people in Balochistan especially the northeastern part (Jasra and Aujla, 1998). Camel is a part of socioeconomic culture and is well suited to marginal, arid and semi arid ecosystems of Balochistan (Knoess, 1977). Camel is a multipurpose animal performing as source of income, transport, food, recreation, prestige, manure, fuel and clothing, etc. The camel alone having all the qualities in one body, all the other domestic animals have dispersal. The following Table 1.1 shows the worth of camel as one in all.

The camel (dromedary or Bactrian) has been serving millions of people living in the driest (hot or cold) areas of the World for centuries. It provides food, fiber, transportation and social status (Djemali and Alhadrami, 1998).
Table 1.1 Domestic animals produce in Pakistan

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<td>Camel</td>
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<td>Horse</td>
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<td>Goat</td>
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<td>Cattle</td>
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<tr>
<td>Yak</td>
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(Adapted from Faye and Esenov. 2005)

The camel of the area (mainly composed of Kohi breed) is well adapted to the climatic extremes and is well appreciated for its’ significance in the pastoral economy (Raziq and Younas, 2006), also reported by other worker (Köhler-Rollefson, 2005) that camel is well suited for the low input system of the region and intake per unit production is very low compared to other domestic species especially cattle. The camel being an important livestock species uniquely adapted to hot and arid environments (Schwartz, 1992), like in Balochistan, and therefore contributes significantly to the food security of the nomadic pastoral households.

No doubt the automobile and machine transportation decreased its draught role, but it is still an important food animal and indigenous animal genetic resource. Camel is a hardy animal and has proved his worth in the long prevailing droughts in Balochistan, remained almost for 10 years (1994-2004). The Relief Commissioner’s data and other reports indicated that the draught has caused great damage to livestock sector but a lesser number of camels was affected as compare to other livestock species proportionally (Ali et al, 2004; Shafiq and Kakar, 2007; Ahmad et al, 2004). According to camel herders, the only cause
was the hardiness of camel and long traveling ability enabling him to access to feed sources and water points as reported by some workers that camel can walk more than 100 km for feed and water (Wilson, 1984) and can survive 15-20 days without any water (Schwartz and Dioli, 1992).

At present national camel herd comprises about one million heads and 13% growth rate has been observed since 1996 to 2006 (Economic Survey, 2007-08). Out of the total national camel population, 41% found in Balochistan province alone, while 27% of the camels of Balochistan are found in the Suleiman region. (ACO, 2006).

Camel is slaughtered on religious rituals like Eid ul Azha and Sadaqa (Alms giving). The meat of camel is traditionally dried (Landie) and used during the winter in Pashtoon dominant part of the region. In recent years the importance of camel increased many folds due to various factors like drought, high male calf prices, demand in the neighboring countries, and local awareness about the camel products.

In the country generally and especially in the province of Balochistan, less attention has been given to camel improvements for many years when planning national development. In spite of their invaluable importance, little is known about camel and its products, which is considered as corner stone in understanding the pastoral subsistence economy in the province. The scientific study on the camel in the area is very scarce; therefore, the following research project was designed. The socioeconomic information was obtained from owner survey through a special questionnaire designed for this purpose on the following three tiers.

A. Animal: Body measurements and condition score, milk production, composition and medicinal value, draught ability, reproductive efficiency grazing behavior, adaptation and drought tolerance.

B. Herd: Herd dynamics and management systems, benefits derived from the herds, indigenous knowledge (IK) about the herd management.
C. Herder: Management problems, effect of camel on their social life consumption and marketing.

Results obtained from this study were subjected to statistical analyses and the role and importance of camel was estimated in their interwoven socioeconomic system of the camel herders of the area under study.
CHAPTER II

REVIEW OF LITERATURE

Camel being an integral part of socioeconomic and pastoral economy of the camel herders in developing countries, has invited much attention on research and development in the recent past. The attributes of this species have been much appreciated by the scientists in the Western world and has been a source of encouragement for the Middle astern and sub-continental scientists. The research work conducted on this specie much related to our study has reviewed in the ensuing pages, indicating various attributes and qualities of this species and suggesting its future needs and potentials.

2.1 Socioeconomic Importance

International scientists have taken camel as subject in their study carried out in Balochistan and reported that camel is a part of socioeconomic culture of the province and is well knitted to marginal, arid and semi arid ecosystems of the province (Knoess, 1977). He further added that camel plays a pivotal role in the socioeconomic life of the herders in all camel habitats of the northeastern Balochistan. Other workers while dwelling on Balochsitani camel (Aujla et al, 1998) reported that despite their small number in comparison to the other ruminants, dromedary is most economical and efficient animal and its socioeconomic value is widely recognized, particularly in province where most of the total camel population of Pakistan resides.

The worker from University of Agriculture, Faisalabad (Iqbal, 2002) concluded that the camel is unaccounted animal species in its qualities for its valuable services with low inputs rendering to the human being in almost all types of environments within the highly
marginalized ecosystems. Pelant et al (1997) reported from the Indian state of Rajasthan, that camels play many significant roles in social and economic development in the desert ecosystem of that area. While working in the same state, Shackley (1996) reported that the ever increasing safaris industry plays an important role in the socioeconomic life of the camel driver, and the isolated desert city of Jaisalmar receives over 200 000 visitors per year, mainly as the result of the promotion of camel safaris to the Thar Desert. In the Somalian pastoral lifestyle, camels play multiple roles and camel ownership is an indication of social status (Guliye et al, 2007).

The camel herders are almost illiterate and deprived of education. Like in many other parts of the world, camel herders in Balochistan are illiterate and ignored (Jasra and Mirza, 2004). The family of the camel herders ranges from some person to many individuals and Baars (2000) from eastern Ethiopia reported that the average household comprised 11.5 persons, of which 55% were younger than 15 years of age. The household head had an average 1.4 wives. Nomadic households were the largest.

2.2 Herd Size and Dynamics

Many factors govern the herd size in the camel. In Balochistan, on average a nomadic herd of 24 camels (72% females and 28% males) usually has 15 breeding camels and 6 calves (Aujla et al, 1998). They further reported that an average nomadic family would own 24 heads of camel along with 95 sheep and 32 goats, while transhumant flock size ranges from 1-5 camels along with 5 sheep and 15 goats. From the same area Buzdar (1989) reported that transhumant flock size ranges from 1 to 5 camels along with 5 sheep and 15 goats.

Another worker reported from the same area revealed that number of camel owned and their age group showed that the farmers had between 5-6 camels at any given time and these were mostly in the 5-10 years of age (Sabir et al, 1991). In highlands of Balochistan, farmers have between 5-6 camels at any given time and they are mostly in the 5-8 years age class (Keatinge et al, 1992).
Khanna et al (1990) reported from India, that female constituted 66.5% of the camel herd. Animals above 4 years of age had the higher percentage (47-52) of the herd, whereas those belonging to the age group of 3-4 years made up the lowest percentage (6.5-8.6). While reporting about the Raika pastorals of South India, Albrecht (2005) revealed that a Raika pastoralist might own a herd of 20 camels. One breeding male, twelve calves, eight productive female and four of them were pregnant and did not produce any milk at the time of the study.

In Egypt, El-Zubeir and Nour Ehsan (2006) investigated, that the ratio of female camels was particularly higher than that of males. While Elmi (1989) reported from Somalia that in fifteen camel herds, the average number of camels per herd ranged from 50 to 60 head excluding burden camels. Herd size is managed according to the family size, which is helpful in the family planning. Typically, there were four herds per household, one each for camels, cattle, adult goats and sheep, and kids and lambs, but the number of herds ranged from 1 to 8. Polygamous households had separate herds of goats and sheep for each wife, but the camels and cattle were combined (Baars, 2000). Bekele and Zeleke (2001) worked on the productivity aspects of camels (Camelus dromedarius) kept under pastoral management conditions at Errer Valley of Ethiopia reported that the average annual herd growth and commercial animals off take rate of the monitored camels were 10.66% and 4.65%, respectively. Studying in Nugal region of Northeast Somalia Farah et al (2007) reported that the herd structure plays an important role in camel management. He further reported that the herd size depends upon the rains, season, area of grazing and part of the year. In the surveyed herds almost a quarter was young camels with less than 2 years, the biggest share (67%) was of female animals and only a small percentage (10%) was that of bulls. Almost 2/3 of the female animals were dry during the period of the survey, mainly due to pregnancy.

The growth rate in the camel herd is low due to many factors like late maturity, long gestation and lactation period and high calf mortality as reported by Wardeh (1990) from Middle East that the slow growth rate of camels herd was because of high calf mortality in field condition.
2.3 Management

2.3.1 Production Systems

Many production systems are practiced both national and globally for camel production. Three main management systems are reported in Pakistan and Ethiopia i.e. (1) sedentary, in which the households were permanently settle in the same grazing area; (2) transhumant, in which the households shifted between two grazing areas every year; and (3) nomadic, in which the households shifted between three or more grazing areas every year (Aujla et al, 1998; Baars, 2000; Iqbal, 2002; Raziq and Younas, 2007a). Housing is rarely provided in the country and camels generally do not need elaborate housing facilities. In Sindh province of Pakistan an ordinary type of local housing (Khori) is provided, which only is being used in the severe cold and rainy days (Iqbal, 2002).

Sedentary system is mainly practiced in irrigated plains and to a limited extent in coastal areas of Sindh in Pakistan (Iqbal, 2002). Approximately 50% of the camel herders living in southwestern mountainous areas raise camels under sedentary system. Transhumance or semi-nomadism is also basically a production system differing from nomadism. It usually involves shifting of tillage operations among rain fed areas during certain seasons of the year. Transhumant system comprises of small landless, peasants or pastoralists whose movement is through specific routes in search of feed and water (Iqbal, 2002). A study conducted in Balochistan (Buzdar, 1989) revealed that overall, 23% of camel herders raise camels as transhumant flocks. They are co-owners of common tribal rangelands, and in most cases their movements take place only within the limits of their tribal land. Nomadic system is mainly practiced in Balochistan, and is associated with the onset of winter season when there is scarcity of feed and return to their destination on the arrival of spring season when there is enough vegetation (Aujla et al, 1998). The movement is along traditionally fixed routes. Movement of herds is the survival strategy of this system. Nomad who depends entirely on natural rangelands for livestock feeding had no land for cultivation of crop (Ali et al, 2004).

Baars (2000) reported that out of the above systems nomadic system is more beneficial from economic point of view. He conducted a survey in Ethiopia and reported that Sedentary and transhumant grazing management systems showed similar levels of
income, but nomads had a 2.6-fold higher overall net income. But such a study is lacking while browsing literature for Pakistan.

2.3.2 Calving and Calf Care

Calf management is considered important by herders and is given considerable attention. Farah et al (2004) reported that camel calving is difficult, and may occur at any time of the day. Therefore, as soon as the signs of imminent delivery are seen, herders take a careful watch. The importance of the calving was revealed by the fact that 96% of the calving was attended to so as to intervene in case of problems such as dystocia. Normally first suckling was taking place between one and three hours post calving, but unfortunately camel herders (especially in Africa), did not allow their calves to access initial colostrums, but instead milked it out. The herders consider high amounts of colostrums ingested by the calf to cause digestive problem.

The mortality rate of calves below one year was higher than the mortality rates of immature camels and adults (Kaufmann, 2005). He further reported that calf mortality rate averaged 25%, in Kenya, while in Tunisia it was lower than that reported from Kenya as depicted in a report by Djellouli and Saint-Martin (1992). The report revealed that calf mortality rate between birth and 1 year of age was of 17%. The very shocking mortality was reported by Saley (1990) from Niger that the mortality ranged from 10–25% only at the age of 0–6 months.

One cause of high calf mortality is possibly attributed to this practice of denying the calves’ access to colostrums (Hussein, 1993; Schwartz and Dioli, 1992). Colostrums is very rich in immunoglobulin and imparts passive immunity to the otherwise unprotected newborn calves (Paul Murphy, 1989; Yagil, 1994; Tibary & Anouassi, 1997a). Walker and Tibary (1999) reported that camelidae are born agammaglobulinemic because of the lack of placental transfer of immunoglobulin. They rely exclusively on passive immunity absorbed from maternal colostrums for their protection against during the first week of their life. The lack of transplacental transmission of immunoglobulins and the importance of colostrums intake is well illustrated in the new born camelid by the increase in protein and serum 1Gg and 1gM concentration by 24 hours after birth.
Calf weaning depend on many factors and ranging from 8-18 months. These factors are browse situation, milk production, growth of calf and ultimate use of the calf in future. Several different systems of weaning are practiced by the Somali camel herders, of which the most prominent are: tying the dam’s teats with a softened bark (maraq); making a small incision in the skin of the calf’s nose-tip and inserting Acacia thorns that will prick the dam (Farah et al, 2004).

2.4 Milk and Meat preference

The camel’s milk is a gift from God for the Arab Bedouins. In the Holy Quran the true worth of the camel has been described. According to Khan (1974) the desert dwellers when turned to God in complaint about the climate and lack of food, God heard their pleas and came to their aid; “He sent them the she camel to drink her milk and they became well”. In Ethiopia it is it is usually drunk fresh, while in India some camel milk, which is not drunk fresh, is fermented to produce Kumiss. It has been reported that some times surplus camel milk is given to the horses and foals. Butter, ghee, curd and cheese can be prepared from camel milk, but most of it consumed fresh (Knoess, 1984). In Syria, camel milk is consumed as fresh raw or soured with dates and usually it meets the household needs (Wardeh, 1994). Milk was the prime source of benefit to the pastoralists, and camels contributed 59% to this source (Hussein, 1993). Camel milk in particular is regarded as a valuable food product. The importance of milk in the diet of the Somalis is clearly shown by their adage, ‘apart from milk, everything else is raw’. It is regarded as superior to all other kinds of milk, and can be used fresh, slightly sour and sour (Guliye et al, 2007).

Camel meat is praised for its good quality, especially if it is derived from the calf. The major meat contents i.e. moisture, protein, fat and ash are reported as 71, 21.4, 4.4 and 1.1% respectively by Kadim et al (2006). In a review study Kadim et al (2008) reported that camels are good potential meat producers especially in arid regions where other meat-producing animals do not thrive. They grow well and yield carcasses of a comparable weight to beef cattle if optimal management conditions are provided. Camel meat, especially from young animals, contains low fat with low cholesterol as well as
being a good source of amino acids and minerals. They further stated that some reports that camel meat is less tender than beef are probably due, at least in part, to the higher average animal age. They recommended that more research work in areas of meat production, technology, marketing, and social awareness is needed to exploit the potential of camels as a source of meat.

Many factors drive the slaughtering rate of camel. Though camel meat is preferred in some countries, but not often slaughtered due to high prices and slow herd growth rate. Camel is mainly slaughtered in Ethiopia on special occasions, like festival, wedding, mourning, physical damage of the animal, for preying and arrival of guests (Mehari et al, 2007). Other studies done in Ethiopia (Matekaire and Gebreah, 2001; Negatu, 2002) reported that mutton was preferred to camel meat, which came second in popularity. They further said that owing to their poor reproductive performance, camels are not efficient for producing meat. They further reported that camel meat is rarely eaten in Ethiopia; rather they prefer to have live animal.

While in Somalia, camel herders never slaughter a camel for meat unless compelled by circumstances (Farah et al, 2004). They slaughter camel, especially a male calf, for meat during periods of drought when there is huge competition for milk. Other occasions when camels may be slaughtered are during very important religious ceremonies and weddings, or when camels are either crippled by predators or seriously injured. In northern Kenya, camel meat is readily eaten by the Somali nomadic pastoralists, regarded as a high-quality food, and was preferred to that of other livestock (Kurtu, 2004). However, in pastoral production systems, they are generally too valuable to slaughter and are therefore not eaten frequently. Even on such occasions, female camels are rarely slaughtered.

The slaughter rate of camels in Balochistan is 3%. Camel meat is generally not preferred by the majority of local people, due to its salty taste and low quality because aged camels are usually slaughtered (Aujla et al, 1998). It is not necessarily true that camel meat is not preferred due to its salty taste but general know how about camel meat on overall basis is lacking in the country (Iqbal, 2002). A comprehensive study about camel slaughtering and meat use is still lacking, but a good number of camel is slaughtered only at the
occasion of Eid-ul-Azha while in very rare cases like religious festivals and marriages, some individuals are slaughtered.

Camel is mainly raised in the pastoral way of production in Asia and Africa and slaughtering for beef is very rarely reported, therefore studies on the camel beef cuts and meat quality are very scarce, moreover, Abouheif et al (1990) divided the carcass side into forequarter and hindquarter by cutting between the 11th and 12th ribs. The forequarter is usually divided into five wholesale cuts (neck, shoulder, brisket, rib and plate), while the hindquarter into three wholesale cuts (loin, flank, and leg). In another study Muhammad and Apkan (2008), while working in 10 Nigerian camel studied the meat cuts at the Kano municipal abattoir and reported the cuts i.e. neck cut, back cut, left forequarter cut, right forequarter cut, left hind leg cut, fore right leg cut, viscera, and hide.

2.5 Medicinal value of camel products

Pastoralists have indigenous knowledge in treating their animals and themselves. Due to the fact that they are living at periphery and very remote area where social services are in scarce or even absence, pastoralists depend on traditional remedies. Camel milk, meat and urine are among the materials used as traditional medicines (Mehari et al, 2007).

2.5.1 Camel Milk

According to the pastoralists the therapeutic property of camel milk is attributed to the fact that camels browse on various plant species and active agents with therapeutic properties from these plant species are secreted into the milk of camels (Rao et al, 1970). Camel milk in is supposed to cure dropsy, jaundice, spleen trouble, tuberculosis and asthma in many parts of the world, where camel rearing is practiced. In part of Ethiopia, camel milk is considered to have an aphrodisiac affect (Knoess, 1984). While in a later study it was further confirmed that camel milk has special medicinal properties, especially for dropsy, jaundice and conditions affecting the lungs and spleen (Tezera, 1998).
Consumers appreciate camel milk for its medicinal properties. It is reputed to be an anti-infectious, anti-cancerous and anti-diabetic. More generally, it is regarded as an energy-giving product for convalescents. Camel milk is commonly used to treat infectious diseases such as tuberculosis in humans (Konuspayeva and Faye, 2005). The positive effect of camel milk on diabetic patients has been studied in India. With the consumption of 0.5 l of camel milk per day, the insulin demand decreased in diabetic patients and glycaemia was better balanced (Agarwal et al, 2005).

Recent studies also indicated that camel milk is used in the treatment of diabetes, liver diseases, and general fatigue in old people and as feed supplement in milking mothers (Bengoumi et al, 2005b). As camel milk does not contain β-casein and β-lactoglobulin, camel milk does not lead to autism symptoms. In addition, camel milk contains protective proteins, including the immunoglobulins necessary for maintaining the immune system and nutritional advantages for brain development (Shabo and Yagil, 2005).

In Ethiopia that camel milk was used as therapy for different diseases with the major diseases as gastritis, asthmatics, viral, tuberculosis, urinary problems, hepatitis, jaundice, constipation and diabetics. For some diseases even dosages were indicated (Mehari et al, 2007). In eastern Ethiopia, that camel milk is believed to be well for the treatment of jaundice, malaria, constipation, to clear the stomach, postpartum care of women, to detoxify snake venom and Flatulence among the camel herders. The majority of the respondents reported that camel milk is used to treat jaundice, malaria and constipation (Seifu, 2007).

2.5.2 Camel meat therapy

According to respondents in Ethiopia, camel meat is important for treating fracture, asthmatics, HIV, tuberculosis, draft (birdbeshita), and gastritis at least in one of the study woredas (Mehari et al, 2007). In another study from Somalia, Kurtu, (2004) stated that camel meat is claimed to have a remedial effect for at least 13 different kinds of diseases, including hyperacidity, hypertension, pneumonia and respiratory diseases and also to be an aphrodisiac.
The urine of the camel has also therapeutic peculiarities. An Ethiopian study (Mehari et al, 2007) narrated that urine of camel also having medicinal value. About 35 and 63.33% of respondents (pastoralists) answered that camel urine have therapeutic properties in Babilie and Kebrìbeyah zones of Ethiopia respectively. According to these respondents, it is useful for treating scabies, ekek, yewefbeshita and some other diseases with corresponding treatment procedures.

2.6 Draughtability of Camel

The ever rising oil prices are another tight spot of the modern economic system. Almost all the world economies are under pressure due to the rise in the oil prices. Within one year the oil price crossed the cost US$ 140/barrel. The same problem was also indicated by (Heston et al, 1985), who reported that the oil prices rise itself has raised the price of motor transport, increasing the demand for animal transport. Camel and other draught animals still perform an active role in many agricultural and other operations and save fossil oil energy worth of several thousand barrels annually. In Balochistan camel as draught power is traditionally being used for ploughing, sowing, threshing, transporting farm inputs and products, lifting from deep wells, transporting drinking water, riding, etc (Jasra and Aujla, 1998). In a recent study Baloch (2001) reported that camel performing various on and off farm operations (load carrying on back, pulling cart load, drawing water from the wells, drawing Persian well and oil extraction mills etc. have also been assessed. In Pakistan camel is primarily raised for draught purpose and secondarily for meat, milk, hair, etc. The traction and carrying ability of Pakistani camels has been admired and they can carry/pull a load of about 600 and 4600 kg, respectively at the maximum (Younas and Iqbal, 2001).

Camel is an important draught animal in the horn of Africa and is used since centuries for nomadic migration and farm operations. In Ethiopia the regular and occasional type of work of camels was packing, transportation, ploughing and traction (Mehari et al, 2007). Another African study also revealed that the role of a mature male camel is to transport water, nomadic houses and utensils, very young children, weak or sick persons, and lambs and kids in the process of nomadic movement (Baars, 2000).
Age of the camel is kept under consideration while using for the draught purpose. In Balochistan where majority of the country camel places and use for the work because of the poor infrastructure, camel does not reach sufficient maturity to be functional for draught purpose (Sabir et al, 1991). The semi-nomadic camel pastoralists usually do not use female animal for work especially for heavy work. But some Pakistani camel handlers also use female for all type of work except carting, though usually less frequent than male. An exception to this is the riding camel, where the female is often preferred (Heston et al, 1985).

The camel has an important use as a means of transport in the Somali pastoral system, which other domestic animals lack, apart from the donkey. Surplus milk for sale is often transported to market centers on the backs of camels. Similarly, drinking water for both humans and young stock is drawn from distant watering points using camels (Hussein, 1993). In Somalia, three categories of transport were distinguished: (1) long-distance trade; (2) shifting the household; and (3) short-distance transport. About 30% of the households were involved in long-distance trade (Baars, 2000).

Raghvendar et al (2003) reported that the major use of the camel in Rajasthan is carting, along with agricultural operations and water transport depending upon season and requirement. The camel carts are used to transport a variety of items, viz. water, sand, gas cylinders, and food grains, building material, fuel wood, feed and fodder. Mostly male camels are used in carting for heavy transport rather than females. Guliye et al (2007) reported that in northern Kenya, the camel has an important use as a means of transport. Surplus milk for sale is often transported to market centers on the backs of camels. Similarly, drinking water for both humans and young stock is drawn from distant watering points using camels.

While studying the one humped camel Wilson (1989c) reported that packing is a regular work for entire camel, and transportation of different utilities on the back of camels is also regular feature Schwartz and Walsh (1992) in Africa, who reported that different items are regularly transported on back of camels. Similarly Mehari et al (2007) also reported that transportation is a regular work for entire male followed by castrate and female camels. Camels are also used to transport the elderly and sick people, young
children and young animals (mainly small stock) when families are shifting. Without pack camels, households are restricted in their mobility and therefore herds have less advantage or opportunity to make use of dispersed water points and patches of pasture in the expansive rangeland (Schwartz, 1989).

2.6.1 Work load

Gillespie (1962) stated that in the Sudan riding camels could attain speed of 8 km and 16-32 km/hr when trotting and running, respectively. The baggage camel travel at a walking pace at just over 4 km/hr and can carry a full load for 24 km/day for an indefinite period (Payne, 1990). Typical safari would not cover more than 20km per day, and many would do considerably less (Shackley, 1996). in Balochistan, Rees et al (1988) compared the per acre ploughing charges for a tractor, a pair of bullocks and a camel, which were Rs. 80, 64 and 56, respectively. Hence, the camel being an economical source of draught power for cultivation is a preferred animal for various agricultural operations over tractor or bullocks. In India, the comparative study between camel and bullock carting systems revealed that pay back period is almost double in case of bullock carting as compared to camel carting, whereas benefit cost ratio is 3-4 times higher in case of camel carting. Due to short pay back period and higher benefit cost ratio, camel carting is profitable and advantageous over bullock carting for small farmers (Bhakat and Sahani, 2006).

A single camel could also plough a hectare of land in 20 hours (Wilson, 1984). A series of experiments conducted on camel draught power evaluation have indicated that the Indian adult male camel could easily haul 1.5–2 tones (15–20 quintals) load on a two-wheel cart for 8 hours a day covering a distance of 30–40 km without showing signs of distress (Raghvendar et al, 2003). The draught force generated by a camel ranges from 17–22% of body weight. The heart girth, height at withers and body weight and length of a camel are positively correlated with power output and draught. The work-rest cycle indicated a 2 hour rest to be sufficient after 4-5 hours of continuous work. The indices formulating a fatigue index card have been identified which will be useful in the management of long distance transport of rural goods using the research camel cart.

A study conducted in Balochistan revealed that on average a riding camel traveled 12 km per hour with a range of 8 to 20 km. The respondents in the study area revealed that on
average, a transporting camel could cover 60 km in a day. It was estimated that camels carried average of 280 kg with a range of 220 to 370 kg, depending upon type of commodity and distance to cover (Jasra and Aujla, 1998).

In an Indian study it was found that slender riding camel can cover up to 100 km/day at an average speed of 15-20 km/hr over long period and stocky pack dromedary camel can cover 20-25 km/day at an average speed of about 5 km/hr and can carry burden of 200 kg on its back. The camel can travel 950 km in 29 days and can cover distance ranging from 24 to 70 km/day at an average of 43 km/day in a camel safari across the desert of Rajasthan (Khanna et al, 1996).

2.6.2 Feeding and Management of draught camel

In Balochistan during the scarcity period, especially winter, transport camels are supplemented with 1-2 kg of crushed wheat and barley mixture (Rees et al, 1988). Camels appear to be at least as efficient as other traction animals in producing draught power but their main work output is in the form of pack transport. Energy is the main nutrient loss in any form of work and these needs to be replaced by food (Wilson, 1989b). Feeding costs were lower for one camel than for one pair of oxen. Considering the lower cost of meeting the nutrient requirement of a work camel, and taking into account that the dromedaries have a wider scope for utilization for other income-generating activities in the dry season, it is more profitable for a farmer to own a work camel than a pair of oxen (Mohammed and Hoffmann, 2006). They further reported that besides the initial investment in the procurement of the draught animals, meeting the feed requirements of work animals is the most important management problem in northwestern Nigeria. Practices include free grazing and the utilization of crop residues in the dry season. Chaudhary et al (2003) reported that draught camels working 6–8 hr a day are fed an additional allowance of concentrate which is generally limited to the work season only. The concentrate ingredients generally consist of gour korma (*Cyamopsis tetragonoloba*), moth bran (*Phaseolus aconitifolius*), crushed Bajra (*Pennisetum typpoides*) grain, barley (*Hordeum vulgare*), groundnut cake, wheat bran and 500–700 g Gur (Molasses).
2.6.3 Earning

The age at which male camels were first used for transport, 5.4 years on average (range 4-7), depended on the number of camels available and on the load. Females were rarely used for transport (Baars, 2000). Camels are trained for work at 4-5 years of age for a period of 2-16 weeks. Professionals change Rs. 1500-2000 (26-34 US $) per camels for this purpose (Iqbal, 2002).

Heston et al (1985) revealed that camel is competitive in Karachi and a few other cities, where camels can easily compete on cost, and often on time, for many commodities over short distances. The economic viability of the camel will be dependent on feed costs. The camel cart operating in Karachi, working 250 days brings in about US $ 1,250 a year. After the feeding cost and other items, including yearly camel depreciation, are subtracted, the camel cart driver gets about $ 500 a year (Tempest, 1986).

2.6.4 Camel as a Game Animal

Camel as a game animal has got an enormous return in the Gulf countries; therefore, the economic importance of camel as a game animal is increasing. Race camels have relatively low heart rate as compared to race horses and the camel skeletal muscles have high oxidative ability as reported by Salhab and Al-Merestani (2002). Considerable profits are generated for camel owners and safari operators in Indian state of Rajasthan (Shackley, 1996). The camel has locomotive efficacy with less oxygen cost per kg per km as compared to other race animals. They further reported that in desert and steppe regions, camel play an important role as a riding animal. It may carry up to 4 persons and walk at the speed of 6-10 km per hour and can cover a distance of more than 20 km (Chaudhary et al, 2003).

2.7 Socio-cultural Importance and Social Believes

Besides its economic importance, the camel has a social and cultural importance for its herders. The camel is strictly and tightly interwoven in the lifestyle of camel herders in almost all part of the camel habitats of the globe. Somali pastoral people of the horn of
Africa have strong social and cultural relationship with their camel, stronger than any part of the world. Camel is not only the source of earning but also plays an important role in the lifestyle, symbol of wealth and prestige and payment of bride wealth.

Among the Somalis, camels are regarded as a medium for regulating most aspects of social and religious lifestyles. For instance, because of its great value and its importance as a means of survival in marginal areas, the camel has become a symbol of wealth and prestige (Hartley, 1984). In the Somali pastoral system, the wealth of a family, a herding group or a clan is measured mainly according to the size of its livestock herds, and camels are the most important source of status, influence and prestige. The owners of large herds of camels become opinion leaders within the community, so that their opinions and advice are quite often sought (Hussein, 1993). Beside its economic importance, the camel has a social and cultural importance for the Somalis (Farah et al, 2004). Apart from their value in terms of milk and meat, and as transport animals, camels are prized according to their role in traditional social relations (Hussein, 1993). In another African study Guliye et al (2007) revealed that in addition to its economic importance, the camel has a social and cultural importance for the Somali pastoralists of northern Kenya.

The Somali culture forbids women, especially those in menstruation, to approach a camel in labor for fear that either the calf will die or the camel will contract udder infection or retain the placenta. If a woman approaches a camel during labor or immediately after delivery, she is compelled to let the newborn calf smell her sweat or clothing as a kind of vaccination against any misfortune. The colostrums would not allow to the calves, because the Somali camel herders believe that colostrums would result in ill-health to newborn calves (Farah et al, 2004). Many social believes have been tied with camel. To see a camel in your dream denotes that you need to be more conservative; you are carrying too many problems on your shoulders. You tend to hold on and cling on to your emotions instead of expressing and releasing them. You need to learn to forgive and forget. Alternatively, it represents you potential for handling big problems, responsibilities, and burdens (Amazing.com, 2007).

Women of the pastoralist’s community is playing a significant role to run the camel production systems, but are badly deprived for their numerous basic rights by the society.
They are not even permitted to communicate with men other than their social groups (Iqbal, 2002). Women were rarely involved in the marketing of the camel and their products and were mostly not consulted in decision making (Jasra and Mirza, 2004). But in another study reported from the Suleiman mountainous region of Balochistan Raziq and Younas (2007a) revealed that woman play a pivotal role in camel production and husbandry and that woman care the young and sick animal at home.

2.8 Constraints of the Camel Production

The camel herder faces much type of complex problems in camel production. Lack of veterinary services accompanied by disease problems were the most commonly encountered problems facing camel pastoralists in Northeastern Sudan. Lack of pasture and water resources, security problems, reoccurrence of droughts and reduced fertility of female camels were extra limiting factors (Agab, 2007). While the expanding agriculture, deforestation, tribal disputes, droughts and marketing are reported as the major constraints of the camel breeders in the Suleiman mountainous region (Raziq and Younas, 2007a)

2.9 Marketing of Camel

Camel is the important source of earning for herders in Balochistan. The marketing system of camel has been explored by Jasra and Aujla (1998), whom reported that camels are marketed in weekly, monthly and annual markets in different regions of the country mainly centered in Balochistan and Sindh province. In fact, there is no established marketing infrastructure at either site. In Balochistan 48% of the gross income is constituted by the sale of live camels and camel services, 30% by marketing small ruminants and 8% by the off farm employment. In another study Jasra and Aujla (1998) reported that farmers keep camels and other livestock as security against crop failure as a means of saving and to have a source of supplementary income. Despite their small number in comparison to the other ruminants, camels provide an important source of subsistence and income to the people residing southwestern mountainous areas.
In Balochistan, it was revealed that about 70-90% of the total income of the livestock farmers in Loralai and Zhob respectively come from livestock (Ali et al, 2004). Because of the joint family system, a large number of families had members engaged in more than one enterprise. A thorough analysis of the camel marketing systems and margins is required to understand properly the current marketing systems. However, middlemen in mountainous areas are reported to make a profit as high as 35 to 40% and it is in reality a big loss to the producer (Mahmood and Rodriguez, 1993).

Camel is selling and marketed on different occasions and various types of markets in the country. Iqbal (2002) also confirmed that reported that camels are marketed in different areas of country on weekly, monthly or annual basis. In addition to these markets, camel marketing is also common at annual celebrations locally called Melas/Uris and at annual animal show held at Sibbi (Balochistan) well know as Sibbi Mela. Prices of camels are assessed depending upon their breed, type, utility, phenotypic appearance etc (Aujla et al, 1998). The famous annual camel fairs in Pakistan are Mangrota, Anayath shah, Karorr, Jalsa, Sakhi Sarwar, Sibbi, Shahjamal, Thandla, Rosthum and Lakki. Out of which, Mangrota fair is very famous, which held before the onset of the camel breeding season in the Suleiman region.

In western part of Rajashtan in India, camel marketing through livestock fairs has opened new avenues for farmers. Marketing of camel is considered an important trade in Rajasthan where it is widely used as draft animal. Camels are mostly marketed at big animal fair such as at Nagour, Pushkar, Tilwara, Phalodi and Gogameri in Rajasthan (Bhakat and Sahani, 2006).

A Somalian study (Hussein, 1993) reported that camels can be seen in Somalia as a banking system or security against drought, disease and other natural calamities that affect cattle and smaller stock more seriously. Baars (2000) studied through a questionnaire survey the costs and returns of camels, cattle and small ruminants in pastoral herds in eastern Ethiopia and reported that milk production was the most important source of revenue (66% of the total) followed by sale of livestock (17%) and transport (16%). African study (Guliye et al, 2007) reported that camel act as a store of wealth, earning interest by way of offspring, in an inflationary situation with limited
investment possibilities. Furthermore, in the dry lands there are no other investment opportunities, and the camel, due to its hardiness and adaptability, is seen by most pastoralists to be the safest investment.

In another study Farah et al (2004) revealed that camels play an important role in the local economy of the Somali community. There is little agricultural land in most of northern Kenya and, therefore, most of the area is devoted to an extensive form of nomadic pastoralism. In general, in pastoral production system camel milk is not sold. El-Zubeir and Nour Ehsan (2006) also reported from Egypt that camel milk produced was found to be for family subsistence and offered free for the others; for medicinal purposes.

Camel hide and leather has also been explored by some researcher (Aujla et al, 1998) in Pakistan and reported that, a hide is commonly sold at Rs. 300 to 550. Its value goes as high as Rs. 3,000 to 5,000 when used for manufacturing table lamps. These products have great export potential. The hide of the dromedary is not of good quality and is mainly used for making whips and other products like a container for water and milk. In a recent Indian study (Bhakat and Sahani, 2006). reported that camel hide was used for making various type of leather goods and fancy items of public interest viz.: shoes, sandals, purse, bag, stool cover, rope, jewelry box, toys and various decorative items, etc. In earlier era, camel hides were utilized to make containers for storing and carrying water, oil and ghee, etc. This hide is well suited for application of color and in Rajasthan there is a tradition of making elaborately painted small container (kuppi) by using camel hide. They further reported that the entire above item has good export potential

2.10 Breeding Management and Reproductive Aspects

The reproductive efficiency of camels under natural conditions is generally regarded to be low (Farah et al, 2004; Skidmore, 2005), which seems to be characteristic for camel production (Mukasa-Mugerwa, 1981; Wilson, 1989a; Al-Eknah, 2000). Studies on camel reproduction carried out at research centers or experimental stations by different workers (Yagil and Etzion, 1980a; Khanna et al, 1990; Aboul-Ela, 1994) led to overdrawn expectations in their reproductive potential (Yagil and Etzion, 1980a), because of the
optimum conditions available at the farms. Reproductive performance of camels in pastoral herds was only rarely assessed (Wilson, 1989a) and then usually based on small animal numbers (Abbas et al, 2000), except for the studies of Planchenault (1984) in Niger and Maillard (1992) in Sudan.

The reasons for these low reproductive rates are due to delay in the onset of puberty, a gestation period of 13 months, a prolonged period (8–10 months) of lactation-related anoestrus leading to a long interval between births, high incidence of genital tract abnormalities resulting in failure of and finally increased rates of early embryonic deaths especially during the hotter months of the year (El-Wishy, 1987; Arthur, 1992; Musa et al, 1993; Tibary and Anouassi, 1997b; Sghiri and Driacourt, 1999; Al-Eknah, 2000; Skidmore, 2003). A relatively short breeding season, an excessive number of females to be mated by one male, and poor semen quality cause herd infertility under range conditions (Hafez and Hafez, 2001).

The rut stage of a male can last from 50 to 100 days (Tibary and Anouassi, 1997c). Rutting activity in the male is characterized by a change from a docile to aggressive temperament such that it may often bite strangers. A prominent feature of rutting behavior is frothing from the mouth with loud, vocal gurgling, typically accompanied by the protrusion of the markedly edematous and mobile soft palate. Another noted feature of rutting is a profuse secretion of foetid fluid from the pole glands (Yagil and Etzion, 1980b; Noakes et al, 2001).

Access to long-term data is difficult because of the remoteness of the area, the low animal population density and the mobility of the herds. Collecting such data can be feasible when livestock keepers are involved in data collection, as shown by Bekele et al (2002). So there is a need to study reproductive parameters of local camel populations kept under pastoral management system.

2.10.1 Selection for breeding animals

Observations and discussions with camel herders revealed that selection and breeding are the most important husbandry techniques in camel management (Skidmore, 2000). Breeding management usually focused on bull selection and pastoralists selected their
breeding bulls according to specific criteria (Evans and Powys, 1984; Elmi, 1989). Selection of the breeding male depends on appearance and behavior, physical strength, and characteristics of ancestors (such as milk production, color, resistance, etc) reported from Somalia by Elmi (1989). The best male is chosen on the basis of his vigor and is judged by the performance of his parents and 56% of the breeders kept breeding bulls born in their herd In Kenya (Evans and Powys, 1984). While in Somalia 70% of the breeding bulls were selected from within the herd. Only a few bulls were borrowed (17%) from outside. Thus, limited new genetic material is introduced into the camel population (Farah et al, 2004). The selection is traditional in Somali herds of camels. This means, the bull or his father should have had predominantly female progeny with good milk performance and it should be fully grown and strong (Farah et al, 2007).

While in Pakistan, the farmers who do not have their own bull hired one at a cost of Rs. 2,000 to 3,000 for a breeding season (Jasra and Aujla, 1998; Iqbal, 2002). The majority of the herders usually keep only one bull in the herd for reproduction. The progeny of these males are judged by Somali standards like milk production, color, size etc (Farah et al, 2007). Consideration was given to the bull’s dam (milk production, fitness), bull’s sire (fitness) and bull’s performance ranking (body confirmation, fitness, docility, disease, and drought tolerance) in Somalia (Elmi, 1989). Once a bull was selected, he usually served as long as possible. Some herders have reported periods of up to 18 years. Such long active breeding is also common in especially in Somalia (Farah et al, 2007).

Regarding the selection of breeding females, all females were used fro breeding. This can be explained by the fact that, in general, there is hardly any possibility to select among females in larger livestock species. This is particularly so due to high calf mortality, long gestation periods, and the need to build stock size (Farah et al, 2004).

2.10.2 Sexual maturity

Camels mature late. Sexual maturity in camels may be correlated not only with absolute age and condition but also with other factors such as nutrition and climate. It depends on many factors, like breed, nutrition and health (Wilson, 1984). Inadequate body weight caused by lack of sufficient food appears to be the cause of delayed puberty in the camel Chatty, 1972. Nutrition seems to play a vital role in the various physiological events for
the attainment of sexual maturity and in the reproductive process. The faster an animal grows, the earlier it will reach sexual maturity (Maynard et al, 1979).

The female camel usually reaches puberty at 3-4 years of age (Leese, 1927; Evans and Powys, 1984; Schwartz, 1992; Musa et al, 1993; Matekaire and Gebreah, 2001). In another study Musavaya (2003) reported that sexual maturity reached at the age of 43 months in females. However, females are not bred until they are 5-6 years old (Matharu, 1966).

Male camels reach puberty at about 3 years, but full reproductive activity is not developed until they are 6-7 years old (Novoa, 1970; Arthur et al, 1985). In a comparatively recent study Hafez and Hafez (2001) revealed that most males reach puberty at 4 years of age, long before physical maturity; reasonable sexual activity 5-6 years of age. Breeding activity in nomadic herds starts 5–6 years of age according to breed and geographical location. Well looked after males and females attain breeding age at 4 and 3 years, respectively as reported by Khanna et al (1990). Table 2.1 indicates the age at puberty reported by different authors from different part of the world.

Table 2.1 Age at puberty reported by different authors from different part of the world

<table>
<thead>
<tr>
<th>No</th>
<th>Age of Puberty (yr)</th>
<th>Authors</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Female</td>
<td>Male</td>
</tr>
<tr>
<td>1</td>
<td>3-4</td>
<td>-</td>
</tr>
<tr>
<td>2</td>
<td>3-4</td>
<td>4</td>
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<td>3</td>
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<td>5</td>
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<td>6</td>
<td>3.5</td>
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<td>7</td>
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<td>3</td>
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<td>9</td>
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<td>10</td>
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<td>4</td>
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<tr>
<td>11</td>
<td>-</td>
<td>3.4</td>
</tr>
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</table>
While the age of puberty in camel bull camel has been reported as 5 of age in Somalia and reached rutting vigor at the age of 9 years (Matekaire and Gebreah, 2001). While in Pakistan and Kenya male is used for breeding at 4 years of age (Yasin and Wahid, 1957; Evans and Powys, 1984; Musavaya, 2003). A study conducted in Saudi Arabia, revealed that male Najdi camels reached sexual maturity at an average age of 173 weeks, as indicated by production of mature sperms (Abdel Rahim, 1997).

One male (bull) is adequate for 30-35 females in Pakistan and Kenya (Yasin and Wahid, 1957; Jasra and Aujla, 1998; Iqbal, 2002; Evans and Powys, 1984). While in another study (Elmi, 1989) reported from Somalia that a rutting male normally breeds about 50 camels. Some owners believe that it can breed up to 200 camels in each season; but the expected breeding life of the male would then be reduced. In the same country majority of the herders usually keep only one bull in the herd for reproduction as reported by Farah et al (2007).

2.10.3 Age at first calving

The age at first calving (AFC) of 57.4 months was reported from rationally managed camel herds in Kenya (Simpkin, 1985). While Wilson (1989a) reported a wide variations in a retrospective study from Niger in which the age at first calving reportedly varied from 24 months to 32 months. The implication of the wide variation in age at first calving presents a wide scope for improvement. The age at first calving in Ethiopian camel was reported as 5 years (Matekaire and Gebreah, 2001).

Kaufmann (2005) reported from Kenya AFC was 58.4 months, 63.0 months and 68.4 months for the Somali, Rendille and Gabra camels, respectively. A study in central Somalia, (Moallin and Mohamud, 1990) conducted on 19 females of a herd showed an age at first calving of 6 year. Farah et al (2004) revealed that the age at first calving was 57.4 months. Yagil (1994) states that it is possible to shorten the pre-pubertal period by hormone treatment as a result of which the females give birth at the age of 3 years. The Indian workers (Khanna et al, 1990) reported a significant improvement in AFC from 1882±29 days during 1961-85 to 1489±23 days during 1989-90.
2.10.4 Gestation period

Gestation period from Pakistan was reported as 380 days (Jasra and Aujla, 1998), while in another study from the same country a range of 375-385 days was reported by Iqbal (2002). Different workers from different part of the world had reported gestation period varied from each other. Somalian workers Moallin and Mohamud (1990) reported gestation length as 380 days, while Khanna et al (1990) reported gestation length as 389±0.08 days in India. The varying time of gestation reported by different workers not significantly different and the length of pregnancy usually averages one year (308-440 days) but will be affected by the herders who determines the date it conceives (Yagil, 2006).

2.10.5 Calving interval and calving rate

Calving interval determines the productivity (Kanoess, 1984). Pakistani workers Jasra and Aujla (1998) reported calving interval as 24 months, while another scientist from the same country revealed that she camels calve every second year (Iqbal, 2002). A study conducted in Somalia (Farah et al, 2004), reported calving interval as 27.4 months. Indian workers (Khanna et al, 1990) reported a significant improvement in calving interval from 770±4 days during 1961-85 to 713±20 days during 1989-90. The mean calving interval reported by Kaufmann (2005) from Kenya was 840 days, but Moallin and Mohamud (1990) reported a calving interval of 730 days from the neighboring Somalia. While studying the performance traits of the Ethiopian camel Matekaire and Gebreah (2001) indicated that the calving interval was 840 days.

She camel calved generally once in a two years period, is a managerial problem and not an endocrinological one (Cossins, 1971). For example, in Tunisia, Djellouli and Saint-Martin (1992) reported an annual calving rate of approximately 40% for 679 exposed females in 30 herds. Saley (1990) reported calving rates as low as 45% in East and central Niger.

Musavaya (2003) from Kenya reported that birth weight was 37.5 kg for both male and female camels. Khanna et al (1990) revealed that the average birth weight was 41.0±0.21 kg. Weaning takes place at 14 months with an average weight of 204 ± 3.6 kg for females
and 212 ± 3.8 kg for males. In Suleiman mountainous area of Balochistan, the birth weight and weaning weight both for male and female were reported as 32-40 kg and 160-180 kg respectively (Raziq and Younas, 2007a).

2.10. 6 Miscellaneous aspects

Earlier work done on camel by Yasin and Wahid (1957) reported that a female with a life span of 30 years would produce about 6 to 8 calves in her lifetime.

While studying the performance traits of the Ethiopian camel Matekaire and Gebreah (2001) indicated that there was one active bull camel for 25 females and the reproduction span was 10 years.

Moallin and Mohamud (1990) reported fertility rate in the 15 herds as 58.9% in central Somalia while Khanna et al (1990) revealed that the conception rate was 91.9% and calving percentage was 77.1 and 1.94 services were required per conception. Farah et al (2004) reported an abortion rate as calculated from progeny history for the herds of the respondents was 11.9%, calving rate was 50%, and the reproduction span was 10-15 years. In a recent study El-Zubeir and Nour Ehsan (2006) reported from Egypt that incidences abortion's incidences, although high but it showed non-significant differences.

Sign of heat in female camel are restless, swollen valve and sit for mating, and when they pregnant, they usually raise their tail 25 days post mating when the male gets closer to them (Abdel Rahim and El-Nazier, 1992). Raising tail behavior can be taken as a useful sign of pregnancy (Al-Sobayil, 2003).

Moallin and Mohamud, (1990) revealed that the poor reproductive performance which appeared in central Somalia was lower than in ranch herds of Kenya and milk herds of Saudi Arabia and Israel. Kaufmann (2005) reported usual and unusual variation in the reproductive parameters over different years and in the different systems. It was concluded that eliminating unusual variation is a promising way to enhance herd development and reduce risk in the production systems. Farah et al (2004) reported that proper husbandry and sound management techniques are the reasons for the success of Somali camel pastoralists in an environment characterized by erratic rainfall and frequent
droughts. Infectious diseases may lead to abortion and abortion rates due to infectious diseases vary from 10% to more than 70% in some areas (Tibary et al, 2006).

2.10.7 Breeding season

Male and female camels have a well-defined and restricted breeding season lasting from mid December through April in many parts of the world. This period varies with the geographic location, rainfall, vegetation and genetics makeup of the animal. Certain factors in the herd like, presence of females and other males in the herd, and the prepuce smells greatly increase the rutting behavior of the male camel (Hafez and Hafez, 2001). Both the Dromedary and Bactrian camels are regarded as seasonal breeders, with a relatively short breeding season (Novoa, 1970) and breeding season is confined to the cooler months of winter, when the days are shorter (Shalash, 1987). The decreasing day length results in decreasing temperature and change in seasonality (Merkt et al, 1990; Musa et al, 1993). But in camels near the equator, the affect of seasonality may be overlapped by the factors such as rainfall (Bono et al, 1990; Arthur, 1992) and nutrition & management (Wilson, 1984), therefore breeding occur throughout the year (Arthur et al, 1985). It is therefore recommended that with a continuous supply of sufficient food camels can be truly polyestrous (Arthur et al, 1982). But in arid and semi-arid areas like Balochistan the main factor for sexual receptivity is rainfall, cool and humid weather and abundance of fodder as reported by Cristofori et al (1986).

There are conflicting reports as to the beginning and length of the seasonal breeding activity in the dromedary. The breeding activity has been reported to occur in March to August in Sudan (Musa and Abusineina, 1978), December to March (Yasin and Wahid, 1957), February-April in mountainous areas while November to January in plains (Jasra and Aujla, 1998, Iqbal et al, 1994) in Pakistan, December to April (Shalash, 1980, 1987), spring (Abdel-Raouf and El-Naggar, 1964) in Egypt, November to April in most of Arabia (Shalash, 1980, 1987), November to February in India (Khan, 1971) and from mid-January to the end of May in the Turkmen dromedary (Abdunazarov, 1970). The detailed breeding season along with their regions has been reported (Table 2.2) by various workers.
2.10.8 Rutting male

The male exhibits rutting behavior in the cool rainy days of the year in most of the camel rearing regions. Higher testosterone levels and active poll glands have been found during the rutting season (Yagil and Etzion, 1980b; Tingari et al, 1984; Agarwal and Khanna, 1990) and exhibits morphological, behavioral and endocrinological changes (Marie, 1987). Seasonality in the male is evidenced by changes in sexual behavior, morphology and function of the genital organs (Khan & Kohlli, 1972; Tingari et al, 1979; Tingari et al, 1984), as well as changes in endocrinological profiles. Given the wide geographical distribution of the camels the breeding season is very variable but generally coincides with the period of low humidity, low temperature, and increased rainfall (Gombe & Oduor-Okelo, 1977; Yagil & Etzion, 1980b). The rut is confined to the cooler and wetter seasons; corresponding to the availability of food when the calf is born. This is generally during the period of low climatic temperature, rain and better grazing conditions (Yagil, 1982; Farah et al, 2004).

Table. 2.2 Breeding season reported by various authors

<table>
<thead>
<tr>
<th>No</th>
<th>Breeding period</th>
<th>Country</th>
<th>Author</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>March-August</td>
<td>Sudan</td>
<td>Musa and Abusineina (1978)</td>
</tr>
<tr>
<td>2</td>
<td>December-March</td>
<td>Pakistan</td>
<td>Yasin and Wahid (1957)</td>
</tr>
<tr>
<td>3</td>
<td>November-March</td>
<td>India</td>
<td>Matharu (1966)</td>
</tr>
<tr>
<td>4</td>
<td>December-May</td>
<td>Egypt</td>
<td>Shalash (1965)</td>
</tr>
<tr>
<td>5</td>
<td>December-March</td>
<td>Tunisia</td>
<td>Minoia et al (1992)</td>
</tr>
<tr>
<td>6</td>
<td>October-April</td>
<td>Saudi Arabia</td>
<td>Abdel-Rahim and El-Nazier, 1990;</td>
</tr>
<tr>
<td>7</td>
<td>January-May</td>
<td>Turkmen dromedary</td>
<td>Abdunazarov (1970)</td>
</tr>
</tbody>
</table>

Sunlight, ambient temperature and nutrition are the most common causes influencing the lower reproductive performance of camels during the summer and fall months contributing directly or indirectly to the psychological-neurological-endocrinology of camel reproduction. Outside the breeding season matting activity ceases and the ovaries are inactive or only have a few, small follicles (Musa and Abusineina, 1978). Moreover
spermatogenesis continues throughout the year in male camels, but at a higher rate during the cooler months of the breeding season (Abdel-Raouf et al, 1975). Hyperprolactinaemia has been proposed to cause reduced libido and fertility during the nonbreeding seasons of the male camel, due to the suppressive effect of the high prolactin levels on secretion of FSH and LH (Azouz et al, 1992). GnRH treatment has been used to stimulate sexual activity in normal males outside the breeding season (Moslah et al, 1992).

2.10.9 Hormonal profile

In the rutting season, endocrinological evidence is shown by the increase secretion of androgen, especially testosterone. In Morocco, for example, testosterone level increased in breeding bull from 2 ng/ml in October to 24 ng/ml in January and return to 4 ng/ml in May (Marie, 1987). There is limited information on the endocrinological aspects of seasonality focusing mainly on estrogen and LH levels. Concentrations of LH are higher during the breeding season than during the nonbreeding season. During the breeding season the pituitary is more sensitive to and releases more LH after gonadotrophin Releasing Hormone (GnRH) challenge (Bono et al, 1990).

Indian workers (Bhakat et al, 2005) used ten adult male camels of 8-10 year aged for hormonal study and reported that testosterone and cortisol level significantly increased in bull exposed to female. Testosterone is the main sex hormone controlling most of the reproductive functions including libido, later stages of spermatogenesis and the activity of accessory sex glands in male animals (Hafez and Hafez, 2000). In Jaisalmeri camel in India, Testosterones were low during hot months of April-September. Average Testosterones concentration increased in October and November, continued to increase further during December and peaked in January and February (Deen, 2008). The hormonal profile of camel as reported by many workers has been summarized in Appendix Table 2.1

The higher testosterone levels in the rutting season may be due to the increased synthesis and release of testosterone hormone either by an increased sensitivity of lyding cells to LH, or an enhanced secretion of LH from the pituitary gland or both (Agarwal & Khanna, 1991). Testosterone concentration in peripheral plasma is low during the pre-rut period. Onset of rut activity is associated with significant rise in testosterone concentration,
which is maintained for 11-18 weeks followed by decline to basal levels. The onset of rise as well as decline varied individually (Deen, et al, 2005). Pituitary and circulating follicle stimulating hormone (FSH) levels are significantly affected by season. The highest concentrations reached during winter and tend to drop reaching a minimum in summer before increasing again in autumns (Marie, 1987).

Azouz et al (1992) while working on dromedary camel in Egypt, compared basal hormone production rates during the rutting (breeding season) and non-breeding seasons in male. He reported that FSH, LH, testosterone and cortisol levels were higher significantly in rutting season while depressed during the non-breeding season. On the other hand the prolactin was higher in non-breeding season with depressed levels of FSH, LH, testosterone and cortisol. In Pakistan a study revealed that serum levels of testosterone, progesterone and triiodothyronine:thyroxine (T4:T3) ratio were higher in the rutting animals when compared to the non-rutting ones, while the reverse was true for serum T3, T4 and corticosterone levels (Zia-ur-Rahman al, 2007).

Tibary and Anouassi, (1997c) revealed that camelids are induced ovulators, i.e. under natural conditions they only ovulate in response to mating; there is no cyclical appearance of a corpus luteum in non-mated females. Corpora lutea are, therefore, only present in the ovaries of recently bred or pregnant females. Therefore it is necessary to study the hormones affecting the male ability for breeding. The female camel is seasonally induced ovulator, with an estrus cycle instead of spontaneous ovulation during the breeding season (Zhao et al, 1990). The stimulus like injection of seminal plasma, coitus or artificial insemination causes the Bactrian camel to ovulate with a mature follicle. Meanwhile, the luteinizing hormone (LH) and follicle stimulating hormone (FSH) increased in blood plasma rapidly, 2.6 and 2.5 times more than the basic level respectively (Li et al, 2002).

The female usually show lesser breeding behavior compared to male. The camel is seasonal polyestrous, in mature female the ovarian activity is in association with the breeding cycle. It is interesting fact that the pastoral people practice to force mating, whenever a rutting bull is available, the same exercise is common in some camel tribes of East Africa (The herders believe that by the virtue of force mating, either the female will
conceive or will come in heat naturally after one week) and other parts of the camel’s world (Schwartz and Dioli, 1992, Yagil, 2006).

2.11 Milk Production Potential of Camel

Realizing the importance of camel’s milk Epstein (1971) reported that the ability of camel to convert desert vegetation into valuable food items was the only reason for its domestication. Camel lactates in adverse conditions (Yagil, 1984) and significantly superior to other livestock animals in terms of food production (Stile, 1987). Many camel breeds have been identified as potential "dairy" breeds and could be used as a source of protein in drought stricken areas (Tibary and Anouassi, 2000).

The camel produces reasonable amount of milk in harsh environmental conditions combined with feed scarcity. Some studies in North Kenya showed that a camel can produce one liter of milk from about 2 kg of vegetation dry matter consumed; while for equivalent milk production a cow will need more than 9 kg of dry matter (Stiles, 1983). In the arid areas camel is a much better provider of milk than cows (indigenous and exotic), sheep and goat, due to its adaptation for that environment (Kiwuwa, 1973). In Pakistani province of Punjab, well-fed dromedary camels produced more milk than even high-merit exotic cattle and their crosses. Camel produced more milk per kg body weight than Sahiwal cattle, Friesian×Sahiwal cattle and buffaloes (Knoess et al, 1986). The daily milk yields represent 3.3-8.9% of the body weight; have been observed (Knoess, 1984). Also in a similar environment, camels produce more milk for a longer period of time than any other species, while their requirement for feed is modest (Wilson, 1989a). The camels produce more milk for longer period of time than any other domestic animal held under the same harsh conditions (Farah et al, 2007).

2.11.1 Milk yield

The milk yield reported from the various parts of the world varies from each other. This difference might be because of many factors. Milk yield reported by many authors from the different parts of the world is the better indicator to know these differences. In a pioneer study from Pakistan Sial (1950) reported a milk yield of 8-10 kg/day, while
working on the riverine camel in the Province of Punjab. In another study in same part of the country Yasin and Wahid (1957) reported a daily yield of 3.5-13.5 kg/day. These findings depicted that variation in the milk yield exists even within the same area of the country. In another study conducted in the same province of Pakistan Leopold (1978) reported a milk yield of 6.7-10 kg/day. A yield of 15-35 kg/day reported by Knoess et al (1986), while working on the heavy riverine camel in Punjab province of Pakistan. In a survey study while working in the arid and semi-arid conditions of Balochistan Aujla et al (1998) reported a milk yield of 4-12 kg/day. Balochistan province is mountainous in nature and majority of the camel belong to the mountainous category. Pakistani worker Iqbal (2002) reported a milk yield of 11.66 kg/day, while working on farm rearing mountainous Cambelpuri camel in Barani Livestock Production Research Institute (BLPRI), Kherimurat, Attock.

As discussed earlier the milk yield reported from the same country or even from the same region varies to each other. Indian worker Rao (1974) reported a milk yield as 6.9-18.2 kg/day as a national camel yield of the country, while reporting from the Indian state of Rajasthan, Raghvendar et al (2005) reported a yield of 6 kg/day. While Albrecht, (2005) reported from Rajasthan, India, that the pastoralist has a total daily milk yield of 12 kg.

In the majority of the cases camel is raised in pastoral way of livestock production in almost all the African countries, where camel is raised. The horn of Africa having almost the same environment, vegetation and production systems with rarely exceptional cases, but the milk yield reported differ to each other. Working on Ethiopian camel Knoess (1977) reported a yield of 5-13 kg/day, while reporting from the same country Reta and Mekonnen (2002) revealed a milk yield of 3.24-5.39 kg/day. In the neighboring country of Somalia a different portrayal has been observed and the famous camel scientist Yagil (1982) reported a milk yield of 5 kg/day, while a yield of 3-10 kg has been reported by Farah et al (2004, 2007) from the same country. Dell’Orto et al (2000) reported that camel can produce 1.8 to 4.5 kg of milk in Kenya, while in a recent study working on Kenyan camel; Mehari et al (2007) reported a yield of 4-7 kg/day.

The milk yield of Arabia reported as 3.5-4.5 kg/day by El-Bahay (1962) from Egypt, predicted a lowest milk yield has been reported among the Arabian camel. In another
study reported from Tunisia, Burgemeister (1974) reported a yield of 4.5-9.1 kg/day while working on the camel rearing in the pastoral livestock production system. A survey report submitted by GEFL (1977) revealed a yield of 8.3-10 kg/day in Libya. While under the farm condition with optimum production system a yield of 8-9 kg/day has been reported by Wernery et al (2004) from UAE. The yield of the Emirates camel is lower if compare to the other camel breeds of the world keeping in mind the incentives provided while in the optimum farm conditions and this might be because of the race type of the camel breed.

2.11.2 Milking Pattern

The milking pattern differs from area to area and depends upon the production systems. Differences in the milking pattern also results in the different milk yield as reported by many workers in the former paragraph. While increasing or decreasing the milking frequency, milk yield is affected, as reported by Al-Shaikh and Salah (1994), who revealed that increasing the milking frequency improved the daily milk yield and the same findings had been reported by other workers (Knoess, 1976; Wernery et al, 2004). In a study Yagil (1982) revealed that the daily milk yield was lower (1.26 kg) for one time milking to (6.77 kg/day) for four times milking. The phenomenon of difference in milk yield with the milking frequency is that, the size and storage rates, there are no larger storage cisterns in the camel udder as seen in the cattle (Simpkin, 1998), which results build-up intra-mammary pressure and ultimately results in reduction of secretion rate.

The camel is milked according to the need of the pastoral family in most of the nomadic types of production systems. But in some sedentary herds, she camel was milked twice a day (Jasra and Aujla, 1998) in the Midwestern part of the country (Balochistan). In another study reported from the province of Punjab, Pakistan, (Qureshi, 1986) the milking frequency was same as reported from Balochistan, but some camel herders do 4 times of milking per day.

The Somali pastoral people are one of the well known camel milk users in the world and they usually milk the camel twice a day (Farah et al, 2004). But in another study reported from the same country, Mehari et al (2007) revealed a mean milking frequency of 3.47
per day at early stage of lactation, constantly decreasing and reaching to 2.33 at late stage of lactation. A Syrian study revealed that camel is milked 2-4 times a day (Salhab and Al-Merestani, 2002).

2.11.3 Lactation length

Lactation length of she camel depend on various factors comprises of the artificial lactation length control, dam and calf status, availability of the vegetation and the decision of the herders (Wilson, 1989c; Ahmed, 2002). Some pastoral communities are solely rely on the camel milk (Qureshi, 1986; Schwartz and Dioli, 1992; Farah, 2004) and therefore, they do not dry the animal, which results in the lengthy lactation period, even higher than 18 months. Artificial control of lactation is practiced more in Kebrbeyah and in Babilie tribes of camel pastorals in Ethiopia (Mehari et al, 2007) and the reasons for the shortening of the lactation length are when the feed for the calf is plenty or safeguard the she camel.


The long lactation length is mainly reported from the horn of Africa, where mainly the Somali camel herders reside and they mainly depend on camel milk for their family use. Most of the husbandry and the management practices of the Somali camel herders are geared towards the improvement of milk production and the continuous supply of milk for the family need throughout the season (Farah et al, 2004).

2.11.4 Lactation yield
The lactation yield reported by various workers is also differing as the daily milk yield.

The highest lactation yields were reported mainly in the studies from Pakistan. The following findings are good example in this regards. A lactation yield of 4,179 kg was reported by Sial, (1950), 2700-3600 kg of mean lactation yield reported by Leopold (1978), 5475-12775 kg by Knoess et al (1986), 12000 kg reported by Schwartz (1992), 1894.93 kg reported by Baloch (2001) and 4260 kg by Iqbal (2002).

A lactation yield of 2430-4914 kg was reported by Rao, (1973) from India, is lower than that of lactation yield reported from Pakistan. A Libyan report revealed a lactation yield of 2700-4000 kg (GEFL, 1977). Generally about the camel lactation yield efficiency Knoess, (1977) reported a yield of 1872-2592 kg. Syrian study conducted by Wardeh, (1994) reported a lactation yield of 2550-2900 kg and a yield of 1244-2009 kg per lactation was reported by Belay and Getahun (2002) from Eastern Ethiopia. Daily and lactation yield and other related information reported from the different parts of the world with their authors are presented in the Appendix Table 2.2.

**2.11.5. Factors affecting the milk yield**

There are many factors affecting the camel milk production i.e. calving season, age, parity, type and season of the year.

**2.11.6 Affect of parity**

Many scientists are agreeing that the party significantly affected the milk yield in camel (Yagil, 1982; Bekele et al, 2002; Mal et al, 2006; Zeleke, 2007). They further reported that the number of lactation affect the mean daily and lactation yields. The study reported from Israel, camels in the fourth parity showed the highest mean daily yield, whereas camels in the last parity had the lowest daily and lactation yield Yagil (1982). Another study reported by Simpkin (1998) revealed that the camel in first lactation yielded much less the subsequent lactation and Kebebew and Baars (1998) indicated that the later parities yielded a significantly lower milk yield than the mid parities. In an Eastern Ethiopian study the peak daily milk yield was recorded at the 3rd parity to the parity 5th gave the highest lactation yield and the parity 1st and 7th with the lowest lactation offtake than the others (Bekele et al, 2002)
An Indian study revealed that daily milk yield was highest in 3rd parity followed by parity 1st and 2nd (Mal et al, 2007). Whereas in a Kenyan study parity of camels significantly influenced daily milk yield (Zeleke, 2007), and camel in the third parity yielding the highest volume of milk per day whereas camels at the first and sixth parities producing significantly lower milk volumes compared to the rest of the parity groups.

2.11.7 Affect of month (stage) of lactation

Month (stage) of lactation affects the milk yield and camel scientists agree that the daily milk yield was different at different stage of lactation and milk production was significantly decreased over time (Shalash, 1979; Knoess, 1984; Wernery et al, 2004).

A Kenyan study revealed a peak production in the 10th week of lactation (Hartley, 1979), which is the early peak ever reported from the other parts of the world. Indian studies revealed a peak yield in 6th month of lactation (Sahani et al, 1998) and 5th to 6th months of lactation (Raghvendar et al, 2005). In another study El-Hatmi et al (2004) reported that milk production was lower in the start of lactation, highest at the 3rd month, showing an irregular pattern in the following months and lowers in the end of lactation in Tunisia.

The stage of lactation reported by Zeleke (2007) also revealed that significantly affected their daily milk yield and there was no significant reduction in the milk yield until the 9th month of lactation.

2.11.8 Affect of season and breed

Season of the year significantly affect the milk yield in camel and that daily milk yield was significantly higher during wet months as compared to dry months of lactation. In wet season the weather is mild and the feed is abundant and this significantly higher milk yields recorded in the wet season might be due to better availability of the vegetation (Shalash, 1979; Zeleke and Bekele, 2001; Bekele et al, 2002; Farah et al, 2004; Mehari et al, 2007 and Zeleke, 2007).

In Somalia the daily milk produced was higher (6.5 kg) in wet season and lower (3.6 kg) in dry season (Hussein, 1993). The daily milk yield was significantly higher during the wet season than during the dry season in Ethiopia Zeleke and Bekele (2001). During the
rainy season when the pasturing is good, the camel will give an average of about 10 liter of milk a day and in dry season the camel will continue throughout to give 2-5 liter a day (Stile, 1987). In Kenya, Rendille camel produced as much milk as four Samburu cows in the wet season and in the dry season the cow’s milk fall to minimal volumes and the camel continue its milk production (Spencer, 1973).

Many authors (Shalash, 1979; Wilson, 1984; Schwartz and Dioli, 1992; Farah et al, 2004; Mal et al, 2006) reported that the breed of camel also the milk yield and Sahani et al (1998) reported that affect of breed was significant on milk yield, while working on the Bekaneri, Jaisalmeri and Kachchi camel in the Indian state of Rajasthan.

2.11.9 Affect of calving season on milk production

Camel scientists from Africa (Zeleke and bekele, 2001; Bekele et al, 2002; Zeleke, 2007) reported that calving season imparted significant effect on the milk yield and that highest peak yield was observed in the dams that calved in the wet season as compare to the dry season.

2.11.10 Milk composition

The camel milk composition reported from the different parts of the world, revealed a wide variability in its contents due to many reasons like available vegetation, feeding pattern, topography, breed and the methodology used for the analyses. According to some scientists, not only environment but the need of the young calves themselves dictates the quality of the milk (Yagil and Etzion, 1983). They further stated that the milk in the arid areas could contain more water than the milk in cold or temperate climates, the water availability and intake also affect the composition of the camel milk.

The milk composition of 14 freshly calved dromedary camels maintained on natural grazing at Barani Livestock Production Research Institute (BLPRI) Kherimorat, Punjab Pakistan was determined by Iqbal et al (2001a) and revealed that the average percentage values of protein, fats, total solids and titrable acidity were 2.85, 3.57, 9.00, 12.36, and 0.20 respectively. In Morocco Kouniba et al (2005) analyzed the milk composition of camel (*Camelus dromidarius*) and reported that average percentage milk composition
was 10.8, 2.7, 3.3, 4.1, 0.83 and 0.24 for total solids, fat, protein, lactose, ash and chloride respectively, and specific gravity was 1.032.

Bengoumi et al (2005b) reported camel milk as having moisture 85-88%, dry matter 8-15%, lactose 3.4-5.6%, fat 2.5-6.2%, crude protein 3.5-4.5% and minerals as 0.7-0.9%. While in Bactrian camel Zhang et al (2005) conducted a study in Chinese Mangolia and reported that composition of colostrums and milk as; 14.23% protein, 4.44% lactose, 0.27% fat, 0.77% ash, and 20.16% total solids in colostrums at 2 hour postpartum, and the respective mean values were 3.55, 4.24, 5.65, 0.87, and 14.31% for regular milk on day 90. The chemical composition and nutritional quality of camel's milk was studied in UAE and the results showed 11.49% total solids, 3.0% protein, 3.45 fats, 4.17% lactose, 88.48% moisture, 0.82% ash, 0.13% acidity, 1.027 density and a pH of 6.53 (Ahmed, 1989).

Ohri and Joshi (1961) reported camel colostrums composition as 15.5 specific gravity, 0.1-0.4% fat, 15.8-19.5% protein, 3.98-5.13% lactose and 1.44-2.80% ash. Not only environment but the need of the young calves themselves dictates the quality of the milk. The milk in the arid areas could contain more water than the milk in cold or temperate climates (Yagil and Etzion, 1983). The water availability and intake also affect the composition of the camel milk. Yagil and Etzion (1980c) reported an average percentage as fat 4.3%, protein 4.6%, lactose 4.6% and ash 0.6% from Israel. (Sawaya et al (1984) studied the chemical composition and nutritional quality of camel milk and the results showed 11.7% total solids, 3.0% protein, 3.6% fat, 0.8% ash, 4.4% lactose, 0.13% acidity and a pH of 6.5. Raghvendar et al (2005), reported from India that the composition was as follows: moisture 89–91%, total solids 8–11%, fat 1.5–3.1%, protein 2.1–2.5%, lactose 3.8–4.3%, vitamin C 0.134–0.154%, pH 6.3–6.6. Despite camel’s selectivity and unique adaptation to the arid conditions, the milk lactose and fats content were significantly affected by the nutritional scarcity during the dry season (Abdoun et al, 2007).

Guliye et al (2000) studied the milk composition of camels from the Bedouin breed and the gross composition indicated 6.5 pH, 2.79% protein, 4.81% lactose, 3.39% fat, 0.77% ash, 11.5% dry matter, 313.3 mOsmol/ kg osmolality and 47.2 mequiv/l chloride. The
effects of month of lactation groups on milk composition were not significantly different. However, parity groups showed significant difference for dry matter and chloride values. In another study from Saudi Arabia Al-Sultan and Mohammed (2007) reported that the number of lactation (parity) had no effect on pH, specific gravity, water contents, protein, fat, lactose and minerals (Ca and P). Milk composition of the camel reported by various workers from the different parts of the world is presented in Appendix Table 2.3.

Milk composition can vary between different geographical locations and is probably due to differences in diet and management; however the composition of the milk is not effected by stage of lactation, lactation number or body condition score. But in dromedary camels, variations in milk fat and protein have been attributed to breed, nutritional management, stage of lactation and milk sampling techniques (Al-Shaikh and Salah, 1994). The chemical composition of milk during early and late phases of lactation indicated that pH, fat% and total solids were significantly higher during late phase of lactation. However, the proteins were also higher but not at significance level (Bekele et al, 2002). The contribution of parity on month of lactation was significant (Sahani et al, 1998b). The two-humped camel lives in cold climate; hence their milk fat can reach levels of 8% which serves as an energy source for the newborn. The one-humped camel lives in hot climate zones, hence the fat content is low, but the water content is high (Wernery, 2006).

In Ethiopia, the overall mean daily yield and composition of fat, protein, lactose and dry matter of milk were 3.75 liters, 2.47%, 2.67%, 4.67% and 10.44%, respectively. Stage of lactation, parity and season of the year had significant effects on daily milk yield, composition of fat, protein and dry matter (Zeleke, 2007). The amount of protein, fats and lactose are in the range of Friesian cow. The contents for the buffalo and sheep and goat are higher (Knoess, 1984). Many studies indicated that camel’s milk contains comparatively more fat, protein, phosphorus, thiamine, riboflavin and vitamin C than that of a cow (Wardeh, 1994). In Aral region of Kazakhstan, it was found that Fe and Zn occur in greater quantities in camel milk and shubat than in cow’s milk (Konuspayeva and Faye, 2005).
Camels can produce sufficient quantities of milk without any supplementation, both under extensive and semi-intensive management conditions. The composition of camel milk is comparable to that from other domesticated animals. The keeping quality of camel milk is very good and the milk is a rich source of vitamin C. The calculated average lactation length is 305 days. The average daily yield varies from 3.5 to 4.5 liters. The camel milk contain fat 2.9 to 3.5%, lactose 3.4 to 5.8%, protein 3.5 to 4.6%, ash 0.7 to 0.9% and water 81.4 to 87.0% (Bhakat and Sahani, 2006).

2.11.11 Factors affecting the milk composition

Indian workers Bekele et al (2002) reported that the fat% were significantly higher during late phase of lactation in the camel milk. The higher fats contents in the second stage of lactation might be due to many factors i.e. the lower average milk yield in the second stage of lactation with mild ambient temperature and vice versa as reported by Lakosa and Shokin (1964) and Knoess et al (1986). But some scientists vary with this statement and said that the stage of lactation have no significant affect on the milk composition (Al-Shaikh and Salah, 1994; Guliye et al, 2000). A study from Ethiopia also revealed that seasons of the year and yields of the milk, affects the fat percentage in camel milk (Zeleke. 2007), he further reported that season of the year had significant effects on daily milk yield and composition of fat.

In the dry season the milk quantity decreased and increases in the wet season which affects the milk composition (Wernery, 2006). He further reported that that one-humped camel lives in hot climate zones, hence reducing the fat contents with water contents being high. Sheriha (1986) also reported negative correlations between milk yield and fat contents in camel. In the hot weather the calves need more water and the milk is one of the important sources of water for these growing calves. Another study conducted in Israel reported not only the environment but the need of the young calves themselves dictates the quality of the milk (Yagil and Etizion, 1983). Variations in milk fat have been attributed to nutritional variation because of the available vegetation of the area (Al-Shaikh and Salah, 1994).

Some findings revealed that the parity had a significant affect on the composition of the milk and that milk fat was significantly higher in parity 3 as compared to other parities
(Zeleke, 2007). While the other scientists reported that the number of lactation (parity) had no effect on fat (Al-Sultan and Muhammad, 2007; Al-Shaikh and Salah, 1994).

Proteins were higher in the first stage of lactation in camel milk (Bekele et al, 2002; Zeleke, 2007; El-Hatmi et al, 2004). The variation might be the state of the calf needs high protein contents in the start of the life for speedy growth and solely depends on the dam’s milk. With the advancement in growth the calf start browsing and they take some of the protein requirements from the vegetation. Therefore the protein requirements decrease with the advancement of the age (Yagil and Etizion, 1983).

Zeleke (2007) reported that parity had significant effects on daily composition of protein and milk protein was significantly higher in parity 3, as compared to other parities, while a study from Saudi Arabia (Al-Sultan and Muhammad, 2007) reported that the number of lactation (parity) had no effect on protein. Composition of the milk is not effected by lactation number and that variations in milk protein have been attributed to nutritional management (Al-Shaikh and Salah, 1994). Al-Sultan and Muhammad (2007) from Saudi Arabia reported that the number of lactation (parity) had no affect on lactose contents of camel milk. El-Hatmi et al (2004) reported that the ash contents increases at the 30 weeks of lactation and continue its increase in the commencing weeks and reached to its peak (1%) at 40 week of lactation.

2.12 Camel Wool Production and Characteristics

In past camels were used primarily for the transport of people and merchandise in the desert and semi arid areas. Milk, meat, hair and hide were by-products of this primary function (Payne, 1990). He further reported that hair was not the very important product in dromedary camel production. In Africa camel is primarily raised for provision of milk and meat but also used as a beast of burden for transporting milk, water and household belongings (Mehari et al, 2007; Guliye et al, 2007; Farah et al, 2004). In Balochistan camel has been traditionally used for transportation, milk, meat, hides and fiber (Knoess, 1977). Camel wool is used for making ropes, bags, mats, carpets and blankets. Camel hides are used for making shoes and saddles in Balochistan. The wool produced annually
ranged from 1.5 to 3 kg (Aujla et al, 1998). The annual production of hair from dromedaries is probably of the order of 1.0 to 1.5 kg (Wilson, 1984). The products of hair, hides represent the raw materials for the cottage industries in Africa. The average hair production per head is estimated as 3 kilograms per year (Sghaier, 2004).

In Syria, dromedary camel hair is being utilized for making carpets, fancies, bags, blankets, wall hangings, rough clothing and items of tourist interest. However, most of these products are made to meet family needs and very few for commercial use. Syrian camel produces 0.5 to 2.0 kg course hair per year (ACSAD, 1983). A study conducted in Indian state of Rajasthan, on the effect of the breed, sex, site and age on the hair quality attributes. The wool collected from 4 important body sites of camel (shoulder, mid, hump, and neck region) of individual camel were compared for staple length, hair diameter and hair types, viz. pure, hetro, hairy and kemp. The body sites and age significantly influenced the staple length whereas sex had a no significant effect (Bhakat et al, 2001). Camel hair is widely used in rural cottage industry of Rajasthan and Gujarat for preparation of common utility items viz blankets, bags, mattresses, ropes, floor rugs, etc. Blended products are prepared with sheep wool, goat hair and cotton. It is worthwhile to blend camel hair with polyester, wool or silk waste (Bhakat and Sahani, 2006). Bactrian camel produced more wool than dromedary. Wool yield in adult she-camel and castrated male is 5.2 kg/year, while wool production in bull-camel averages 8.1 kg, but can reach 16-18 kg (Wei, 1984).

In South American camelids, fiber is tested for fineness by international recognized tests. Fibers fineness, expressed as means fiber diameter, is the most important parameter to define fiber quality in relation to the comfort and lightness of textile product. At the same time the coefficient of variation (CV) of the diameter defines the homogeneity of the product, very important for the processing efficiency (Renieri et al, 2004). They further reported that the presence of modulated fibers and kemp is important dye resistance and light reflectance qualities. Modulated fiber has an abnormally large diameter; a high degree of medulla is probably responsible of low comfort of products (low resistance and “piercing” effect). However fiber length has less importance in Llama and Alpaca with respect to other fine fiber producing animals.
Dromedary wools’ fiber length ranges from 3.5 to 6 cm or 12 cm (shoulder and hump). The fineness of hair ranges from 61 to 82 µ (ACSAD, 1983). The fineness of hair of Indian camels ranges from 25 to 40 µ. The proportion of modulated fibers ranges from 50 to 80%. The fiber length ranges from 5 to 7 cm. The vegetable matter contents are from 4 to 5%. The pH is 7.02. The single fiber tenacity is better than wool which ranges from 15 to 17 gm/tex (Bhakat and Sahani, 2006).

In Bactrian camel, the fiber diameter and lengths for under coat from she camel are reported to be 20.8 µ and 81.2 to 98.4 mm respectively, for outer coat-22.69 µ and 73.4 to 140.4 mm. The diameter of wool in camels becomes coarser according to their age. Clean yield of wool varies up to 84.3 to 94.2% (Wei, 1984).

Renieri et al (2004) reported fleece weight, fineness and variation of fineness, percentage of modulated fibers, fiber crimp, fiber length, morphological evaluation (linear methodology) as the quantitative characteristics of the camelids wool. They furtherer reported that coat color variation in Llama and Alpaca flocks is generally very large and no color selection has been carried out, except for full white in some Peruvian alpaca and Argentine Llama flocks (Lauvergne, 1994; Renieri, 1995). The earlier studies (Renieri et al, 2004) reported that, great color fleece variability is one of the main SAC characteristics. In the industrial cards color it is possible distinguish 22 different types from white to all brown variable and black.

2.13 Vegetation and Feeding Behavior

The digestive system of the camel (Tylopoda) differs from that of true ruminant (Ruminantia) in that it lacks an omasum but its rumen contains glandular sacs having a similar function. Camels utilize protein from low quality plants better than sheep and goats due to urea recycling (Wardeh, 1991).

The work of the plants species preference (feeding behavior) is in its beginning in Pakistan. In literature the only study conducted on this aspect were done by (Khan, 1996; Iqbal, 2001b). Moreover, plant specie preference is well studied in other parts of the world. Several studies have reported on various aspects of the grazing behavior of the
Dromedary camel (*Camelus dromedarius*) (Wardeh, 1991; Khorchani et al, 1992; Kassilly, 2002). According to information reported by Wardeh (1991), Dromedary camels consume from 1.4 to 12.5 kg dry matter d−1 and are selective feeders that do not concentrate in any area but move up to 70 km daily to obtain forage when vegetation is scarce. Camels may derive all their water requirements from plants in the winter when their cooling demands are removed (Nielsen, 1959) and have reportedly gone without water for 17 days during the hot season when crossing the Victoria desert (MacFarlane, 1964). To know the biological availability of the feed stuffs and the efficiency of the camel to digest, the first step is to know the feeding behavior (plant species preference) and later on the chemical composition of the preferred plants (Towhidid, 2007).

It is necessary to understand the foraging behavior of herbivores in order to predict their impact on the vegetation and their nutrient requirements (Mengli et al, 2006). Assessment of its nutritional requirements remains very empirical and often inferred from cattle requirements (Wilson, 1989b). A study conducted in Balochistan (Aujla et al, 1998) revealed that camels take 30 to 70% of their feed from rangelands and average daily intake was 6 to 7 kg of dry matter. In the same province, camels can thrive for months by eating only 5 kg of dry matter a day. Starvation and malnutrition of animal is probably not as important a factor in mortality issues of camels, as it is in small ruminants often fall substantially in dry years such as 1987-88 (Nagy et al, 1991).

Under open range conditions camels tend to move rapidly from one feeding station to the next and they are thus able to exploit a wide variety of plants. Ingestion rates can be rapid where preferred or selected browse is plentiful but are much slower on thorny species that have little leaf. Feeding times required may be as much as 15 or more hours per day, as recent studies have shown that total dry matter intake needs to be about 4 percent of the body weight (Wilson, 1989b). Camels rarely overgraze and are constantly moving and taking only small portions of each plant. They prefer grazing in early morning and late afternoon, which are the coolest times of day for foraging. They obtain about 44% of their feed requirements from forage averaged over the whole year (Rees et al, 1988). Guerouali and Wardeh (1998) reported that the heat exposure did not affect the feed intake or the basal metabolism of the camel. Under dehydration conditions, camels were
able to maintain their appetite up to 15% of body weight loss and to allow their basal metabolism to decline in order to maintain a positive energy balance.

Young camels spent more time on browsing than adults. The adult camels spent more time resting and on other activities, as compared to the young camels in eastern Ethiopia. Browsing/grazing was the dominant daytime activity, followed by walking, resting other activities and ruminating (Dereje and Uden, 2005a). Significantly less time was spent on feeding and walking during the green /growing season compared to the dry season. On the contrary, idling and ruminating times were significantly higher during the growing season compared to the dry season. Feeding patterns dovetailed seasonal changes in forage quality. Feeding time was significantly negatively correlated with the dietary CP and DMD levels but significantly positively correlated with NDF, ADF and ADL. It was concluded that forage quality influences feeding patterns in camels and that under adverse pasture conditions, the time available for grazing would be a limiting factor to their DM and nutrient intake (Kassily, 2002). During the field observations in inner Mongolia, it was found that Bactrian camel spent time on browsing was made over 10.3, 12.2, 11.4, and 12.0 h in winter, spring, summer, and autumn, respectively. Total rumination time among seasons was longer in autumn than in spring and summer. Only about 14% of the total time spent ruminating occurred during the day (Mengli, 2006). A study conducted on five camels fed on a hay-based diet on stall feeding, revealed that on an average, the duration of rumination, feeding and resting was 8.3, 5.6 and 10.1 h per 24 h, respectively (von Engelhardt, 2006). The camels spent 39% of their time ruminating, 29% eating and 32% resting. About 97% of the eating activity occurred during daytime versus 44.4% for ruminating and 45% for resting (Hedi and Khemais, 1990). In another study El-Aich et al (1989) reported that the resting time increased with the advance in season. Crude protein remained high all year-long because of the larger proportion of the shrubs in the diet. Dromedaries avoid grazing during hot hours (Kamoun and Steinmetz, 1989).

2.13.1 Plants preference and composition

In Pakistan, camel generally depends on the natural grazing rangelands for feed. They are fed green fodder and hay straw in the irrigated plains along with concentrate feed. In
mountainous areas top feeds (like Acacia nilotica, Morus alba, Zizyphus jujuba etc.) are also offered (Iqbal, 2002). Feeds selected by camels are usually high in moisture, nitrogen, electrolytes and oxalates. Acacias, Balanites, Salsola and Tamarix are important constituents of the dromedary diet wherever these plants are found (Wilson, 1989b).

There is a common saying in Rajasthan that the camel eats everything except Aak (Calotropis procera) and the goat eats everything except Dhak (Butea frasdosa). Camels eat such species of plants that are high in moisture like Prosopis sineraria, Zizyphus nummularia, Callygonum polygonodes during summer, and plants that are high in electrolytes and oxalate content like Capparis deciduas and Lasirus sindicus during the rainy season (Chaudhary et al, 2003). The camels selected a total of 21 species of plants in the dry and 30 in the wet season. On average, 0.79 and 0.83 of the camels’ diet was comprised of perennial woody plants in the dry and wet season (Dereje and Uden, 2005a). El-Aich et al (1989) revealed that crude protein remained high all year-long because of the larger proportion of the shrubs in the diet.

The NDF content of the simulated diet was the lowest early and late in the season, probably because of the selectivity of leaves and twigs in the higher layer of vegetation (trees). Ingestion of ADF was similar to NDF. The camel selected plants rich in protein and consume 1 kg of dry matter per 100 kg of live weight (Kamoun and Steinmetz, 1989). Wilson (1989b) observed that dromedaries take as much as 90% of their diet from browse plants, many of these being leguminous trees, shrubs and salt bushes. Feeds selected by camels are usually high in moisture, nitrogen, electrolytes and oxalates. Acacias, Balanites, Salsola and Tamarix are important constituents of the dromedary diet. In Balochistan, camel took 30 to 70% of their feed from grazing on rangelands. The average daily intake was 6 to 7 kg of dry matter. Camels can thrive for months by eating only 5 kg of dry matter a day (Knoess, 1977).

Other studies reported from the different parts of the world are presented in the ensuing lines. In an Australian study Newman (1975), reported Euphorbia tannenis & Trichodesma zyelanicum as the preferred camel’s plants, while Schwartz (1992), from East Africa reported that Aristida adscension & Deuosperma eremophilum are preffered by camel. Indian worker (Ranjan, 1997) reported that Acacia prosopis, salvadora, wild
olive, zizyphus, indigofera, salt bush, green fodders and dry forages (straws) are like by
camel in his country. In Kuwait, Rhanterium eppapousum, Penicum turgidum, Haloxylon
salicornicum & Sovignia perviflora are the ice cream species for camel (Ibnoaf, 1987).
Preferred plants reported from the different parts of the world are presented in the
Appendix Table 2.4.

2.13.2 Supplementation

December through February is the period in which, household’s supplement all ages of
camels, whereas only weak and disease camels are supplemented under nomadic and
transhumant systems during winter in Balochistan (Aujla et al, 1998). El-Zubeir and Nour
Ehsan, 2006 investigated in Egypt, that the camel herders support their camels with
minerals (common salt); moreover camel herders at Omdurman give their herds licking
stone. The importance of salt for camels is common knowledge among camel herders
(Farah et al, 2004). The water standing on the salty soils Shoramagh, and forages
growing on such soils were the key sources of mineral supplements for Killa Saifullah
based camels. On the other hand the salt feeding was considered as integral part of the
lactating camel nutrition in Musakhel, where salty soil and forage was scarcely available
(Raziq and Younas, 2007b). Dereje and Uden (2005b) reported that producing more milk
by use of supplements is important, not only for sustenance, but also for the growing
dependence of the sedentary herders on milk sales. A higher milk yield could reduce
competition between the calves and the family for milk and thereby increase calf
survival, which also can have a positive effect on overall herd productivity. Farah et al
(2004) reported from Africa that camels depend on salt plants (halophytes), salty soils
(kuro) and sometimes commercial salt supplements for their mineral needs. Most herd
ers (70%) claim to follow a regular deficiency preventive routine. Camels kept in the home-
based herd were more frequently supplemented with purchased salt. This was attributed
to the fact that they had limited access to distant grazing areas with salt plants. “Salt
deficiency symptoms” revealed by the herders included chewing bones, eating soils from
anthills, reduced milk yield, reduced water intake, and increased straying in search of
salty plants. Kuria (2004) conducted a study to document the traditional mineral
supplementation strategies on camel milking herds in Kenya. The results indicated that a
combination of rain water standing on salty soils referred to as marmar, and forages
growing on such soils were the key sources of mineral supplements to Manyatta based camels, with commercial mineral supplements playing only a minor role. Chaudhary et al (2003) reported that draught camels working 6–8 hr a day are fed an additional allowance of concentrate which is generally limited to the work season only, and also for a few days before the breeding season. The concentrate ingredients generally consist of gour korma (Cyamposis tetragonoloba), moth bran (Phaseolus aconitifolius), crushed Bajra (Pennisetum typpoides) grain, barley (Hordeum vulgaris), groundnut cake, wheat bran and 500–700 g Gur (Molasses). Hammadi et al (2001) concluded that under range conditions, dietary supplementation of dromedary during late pregnancy stage and post-partum period improves productive and reproductive parameters.

2.13.3 Watering

Water requirements of camel in relation to body size and normal functions do not differ greatly from other animals. After severe dehydration amounting to 30 percent of the initial body weight, as much as 90 liter of water can be drunk in a very short time. The dromedary is the subject of myth and legend regarding its supposed water storing abilities. Dromedaries are extremely efficient in water consumption, because of their physiological, anatomical and behavioral adaptations (Wilson, 1989b). The watering interval for the camels was generally between 14-21 days among in Somalia, decreasing to 6–7 days during severe dry seasons. This may be explained by differences in forage availability, the water content in the forage, and distance to water sources. The nomadic herds are less frequently watered because they feed in areas with good and relatively plentiful forage, usually far from watering points (Farah et al, 2004). In another study Chaudhary et al (2003) revealed that camels receive 5-7 liters water per day from a great number of evergreen top trees and bushes in summer from their daily browsing in the dry areas. Aujla et al (1998) reported that although water is an essential part of an animal’s diet, the camel can survive long periods without drinking and would replenish the loss in a very short time. Nevertheless, the water requirement varied from season to season from 5 to 15 liters a day.
2.14 Indigenous Knowledge and Ethnoveterinary Practices

2.14.1 Why Ethnoveterinary treatment?

Ethnoveterinary research has been defined as the "systematic investigation and application of veterinary folk knowledge, theory and practice (McCorkle, 1986), and has recently been the focus of renewed interest in scientific debate and the formulation of animal healthcare policies in Europe and elsewhere, especially after recent dramatic emergencies such as bovine spongiform encephalopathy (BSE) in the UK, and the discovery of dioxin contamination in chicken meat in Belgium (Pieroni et al, 2006). In the UNESCO convention 2005 in Paris, it was stated for the first time that, knowledge and practices concerning nature and the universe are part of our cultural heritage (UNESCO, 2005). This means that ethnobotany, ethnobiology, ethnoecology (including ethnopedology and ethnoclimatology), traditional environmental knowledge, ethnoveterinary, folk medical, and pharmaceutical knowledge are now recognized as being inextricable components of culture, and, therefore, worthy of being protected and sustained (Pieroni et al, 2005).

In recent years, there has been a resurgence of interest in traditional health-care practices in the western as well as in the developing world. In animal health, this has led to further interest in ethnoveterinary research and development, a relatively new field of study that covers traditional practices, ethnobotany and application of animal care practices embedded in local tradition (Schilihorn van Veen, 1997). Ethno veterinary practices are practiced in almost the entire world (Pieroni et al, 2006). Ethnoveterinary practices have been developed through trial-and-error and deliberate experimentation, but developed by farmers in fields and barns, rather than by scientists in laboratories and clinics (Mathias, 2001). For generations, nomadic herders have been learning to manage herd health, particularly in dromedaries because of their great value. Owing to the unavailability of veterinary services, camel herders in remote areas have been developing their own pharmacopoeia and veterinary techniques (Antoine-Moussiaux et al, 2007). Ethnoveterinary medicine covers people’s knowledge, skills, methods, practices and beliefs about the care of their animals (Mathias, 2004; McCorkle, 1986).
Pastorals have many arguments to follow ethnoveterinary rather than allopathic treatment. The very common are, veterinarians are not from pastoral groups, communication problems and lack of motivation reported from India (Geerlings, 2001). The remoteness of the areas occupied by the pastoralists from urban centers as well as the continuous mobility inherent in the system has operated to endow pastoralists with a high degree of self reliance (Allen, 1965). Constraint faced by the pastoralists in their health management is the low availability of modern veterinary medicine in the remote area, therefore, pastoralists use their own way of treatment. The treatment ranges from their own way of vaccine preparation to minor surgeries as reported by Swaleh (1999). He further reported that availability of veterinary services is a major constraint in the arid areas of Kenya. The government resources to run veterinary practices do not meet the rising costs of within the veterinary sector. An increasing number of pastoralists are turning to ethnoveterinary medicine. The camel breeding area was far-flung from the modern animal health service. Its remoteness and poor infrastructure nature made it isolated from other parts of the province. In such circumstances, it is very difficult to provide veterinary services according to the Western model. The same situation exists in the other parts of the world where the camel is reared in pastoral system (Köhler-Rollefson et al, 2001).

Integrating ethnoveterinary medicine can reduce the costs of animal health care. The modern sector increasingly recognizes the value of ethnoveterinary medicine and uses it as an input into community-based animal health care and epidemiological intelligence (Mathias, 2004; McCorkle, 1986). Abbas (1997) reported from Sudan that high prices of western medicines and unavailability of these medicines in the desert are the reasons for the demand of ethnoveterinary besides the cheapness of the traditional inputs.

High incidence of parasitic and infectious diseases in Balochistan was reported as serious concern and 45 to 100% were using traditional for the treatment of that diseases (Jasra and Mirza, (2004). In Loralai and Zhob districts of Balochistan, home remedies were used as 72 and 83%, respectively. The reason for mortality was hard to define, farmers could not give positive indications in most of the cases, and although diseases were a major contributor; broken legs and eating poisonous plants were the minor contributor (Sabir et al, 1991). Lack of veterinary services was the most common constraints for the
revival of livestock sector in Balochistan (Ali et al, 2004). Dudi and Gahlot, (2003) from Indian state of Rajasthan reported that the ethnoveterinary treatment is widely used for common surgical conditions. The types of practices used for this purpose may be classified as, cauterization, ashing the wound, removal of maggots, application of certain oils and liquids and wooden splints etc.

2.14.2 Diseases and ethnoveterinary practices

In several field surveys conducted in Sudan (Agab, 1993, 1998), the presence of camel diseases among camel population are considered as one of the major limiting constraints. The 5 most fearful and common diseases in Eastern Sudan are trypnosomiasis, mange, wry neck, internal parasitism and streptothricosis. Different disease conditions and mineral deficiencies are said to pose important constraints in the overall management of camels in pastoral husbandry system of Kenya (Maritz, 2007). Muhammad et al (2006) reported a total of 34 different clinical diseases/disorders, in Faisalabad city of Pakistan about the carting camel, i.e. sarcoptic mange, followed by anhidrosis and trypanosomosis were the three most frequently encountered disorders. While Raziq and Younas (2007a), reported six major diseases from the Suleiman mountainous region of Balochistan, i.e. mange, pox, lymph node swelling, orf and oshmak disease. The disease profile reported from Oman revealed the occurrence of the disease as trypnosomiasis 12%, gastrointestinal parasites 37%, ectoparasites 68%, ring worm 3.4% and infertility 1.2% (Falah and Gamal, 2007). A survey study reported by Abbas et al (2002) from Saudi Arabia, revealed that, (according to the Saudian camel herders) the disease was a fate decreed by God, and identified wind, bad water, certain plants and insects, worms and toxic poisons as direct causes of the diseases.

A variety of ethno treatment have been reported from the various part of the world inhibited by camels, i.e. treatment ranges from, rectal manipulation for removal of persistent corpus luteum, oiling of the skin for the treatment of mange and fly repletion, wooden splints application for broken limbs, meat and grains noillen, browsing on certain plants, bone and other ashes, ashes suspension, cauterization, trees tar, wood oil, certain minerals springs, sea water, sulfur, motor oil bone marrow oil, sour milk, crush leaves of different plants, fuzzing, and minor surgeries, etc (Köhler-Rollefson (1994)
2.14.3 Types of treatment

Inputs generally utilized by the traditional healers were quite diverse including plant products or whole plants, certain oil ingredients, honey, urine, hair, salts, animal fat, soil and mud of certain areas, perfumes and surgical and firing tools (Agab, 1998). Modern pharmaceuticals are replacing many plant remedies that have long been used to cure animals of various ailments; on the other hand, there is a new tendency among urban dwellers to use plant-based and homoeopathic remedies (Pieroni et al, 2006). The most common traditional treatment among camel pastoralists of Sudan is the use of firing or cauterization, which is commonly used for the treatment of joints and muscles affections such as lameness and musculoskeletal abnormalities (Agab, 1998). In another study Antoine-Moussiaux et al (2007) reported that the bleeding of sick animals is a common treatment, as Tuareg herders believe that ‘tainted blood’ (izni) is the cause of many conditions. The remedies mentioned in this survey are derived from Maerua crassifolia, Boscia senegalensis, Acacia raddiana, Cucumis prophetarum, Calotropis procera, Ricinus communis, Citrullus colocynthis, green tea, millet, tobacco and onions. While in the region of Artificial elements are also used for treatment of animals: Powders collected from batteries, various hair care or skincare creams, crushed glass, insecticides or motor oil belong to their pharmacopoeia.

Hammiche and Maiza (2006) conducted a study in Central Sahara Algeria, and reported that more than 100 drugs were investigated falling in 80 species belonging to 33 botanical species. The healers use the aerial part usually, but sometimes the cortex and latex (roots) were also used. The plants were used fresh or dried, essential in the form of decoction, maceration as an infusion in water, but sometimes oils are used and exceptionally milk. The dosage varies from 20-50 g, depending upon the drug. The volume corresponds to the household objects that belong to the nomad: tea pot or kettle and tea glass.

Plant species selected, and prepared for animal dosing with the help of traditional healers were: Aframomum sanguineum, Albizia anthelmintica, Ananas comosus, Annona squamosa, Azadirachta indica, Dodonaea angustifolia, Hagenia abyssinica, Hildebrandtia sepalosa, Myrsine africana, Olea europaea var. africana, and Rapanea melanophloeos (Githiori, 2004). Pieroni et al, (2006) reported one hundred and thirty-six
veterinary preparations and 110 plant taxa were recorded in the survey, with Asteraceae and Lamiaceae being the most quoted botanical families. These include *Anabasis articulata* (Chenopodiaceae), *Cardopatium corymbosum* (Asteraceae), *Lilium martagon* (Liliaceae), *Dorycnium rectum* (Fabaceae), *Oenanthe pimpinelloides* (Apiaceae), *Origanum floribundum* (Lamiaceae), *Tuberaria lignosa* (Cistaceae), and *Dittrichia graveolens* (Asteraceae).

Sori et al (2004) conducted a survey in southern Ethiopia and reported that oral administration of infusions, decoctions, and other preparations comprised 56.42% of the applications, followed by topical application of poultice, sap, and other forms (37.2%). Infusion was the most frequently used preparation (35.6%), followed by poultice (30.13%) and decoction (17.8%). Knowledge of medicinal plants can empower pastoralists to solve animal health problems cost-effectively. Some pastoralist treats their animals with bleeding and hot branding.

Matekaire and Bwakura (2004) worked in Zimbabwe and reported that different herbal treatments were often cited for the same disease, with varying dosages and methods of administration. Standardization and validation of traditional knowledge is necessary to fully integrate ethnoveterinary medicine into orthodox veterinary medicine. But Agarwal (1995) noted that indigenous knowledge differs from western scientific knowledge on substantive, methodological/epistemological as well as contextual grounds, arguing that indigenous knowledge is more deeply rooted in its environment, and based on different values, and is assessed by different methods. Sori et al (2004) conducted a survey in Ethiopia and reported that oral administration of infusions, decoctions, and other preparations comprised 56.42% of the applications, followed by topical application of poultice, sap, and other forms (37.2%). Infusion was the most frequently used preparation (35.6%), followed by poultice (30.13%) and decoction (17.8%).

Fresh plants chopped and pulverized dough is made using water or oil, to make an ointment. This technique is used to apply local analgesic, healing lotions and creams, antiparasitics and most of the remedies indicated for rheumatic pains (Hammichie and Maiza, 2006). Pieroni et al (2006), while conducting a field survey of Circum-Mediterranean cultural heritage and reported that medicinal plant uses in traditional
animal healthcare in areas. The plants mostly used are, *Mormodica spinosa* (Middanqajibu), *Premna resinosa* (Kate), *Cadaba farinosa* (Kalkacha hare), *Maerua subcordata* (Kukube tari), *Cordia sinensis* (Mader), traditional butter (hadano), tobacco pastes and fish wastes. Geerlings (2001) reported that Raikas have build up a large network of traditional healers (bhopa, ghuni and daam) and make use of a large variety of plants, minerals and animal products to cure their sheep. Some plants have active ingredients which work against those diseases and problems for which these plants are used, or these plants are used in other parts of the world for the same diseases.

Abbas and Omar (2005) conducted a detail survey of three months to document the ethnoveterinary practices of traditional healers in Saudi Arabia. They reported that numerous ethnoveterinary procedures were practiced for the treatment of camel diseases and used variety of plants for treatment. Surgical procedures were practiced to correct fractures or treat wounds or abscesses or to help in cases of distocia, uterine, vaginal prolapses.

Diseases affecting individual parts of the body are named according to the parts that the disease affects. These include mouth disease, foot rot, cold (jalabu), cough (daggu); sneezing (tummudu), etc. On the basis of durability, Reddis (ethno Healer) classify diseases into two types: those with lesser duration (mamulu jabbulu) and diseases of longer duration (pedda jabbulu). For example, diseases of lesser duration for them are commonly occurring diseases like contagious ecthyma or mouth disease, foot rot, cold, cough, sneezing, while the diseases of longer duration include enterotoxaemia, blue tongue, smallpox, ephemeral fever, tuberculosis, trypanosomiasis, pneumonia, hemorrhagic septicemia, black quarter, rinderpest, etc, however some diseases are very specific to different species (Misra and Kumar, 2004).

### 2.14.4 Gender and Ethnoveterinary

In some communities, male but in others female, are more expert in the treatment of the local animals. It is not possible to differentiate between the ethnoveterinary knowledge of men and women because the sample size of women was too small to draw conclusions in Indian state of Rajasthan (Geerlings, 2001). The difference in observational skills was studied among Koochi women (Afghanistan) by Davis (1996) who found that these
women, who are the main animal caretakers, appeared better able to recognize and differentiate between four parasitic diseases (liver fluke, two intestinal worms and lungworms) than men.

2.15 Breeds Characterization of Camel

Animal genetic resources are essential for food security from at least two angles i.e. as a means of utilizing marginal environments not suitable for crop cultivation and as building blocks for future livestock development (Köhler-Rollefson, 2005a). The genetic variation comprised of components between and within breeds, is under threat. The threat of genetic erosion and the cause are different in different species (Oldenbroek, 2007). The breed improvement schemes (introduction of exotic blood from North, especially in cattle) have negative affect on the local breeds (Mathias and Munday, 2005).

Local livestock resources play an important role in marginal areas because of their adaptation to the production conditions. The main bias in developing breeding strategies for marginal regions is an improper definition of breeding goals for these livestock resources. A characterization of the local livestock and husbandry conditions is a prerequisite to define those goals (Valle Zárate, 1995). The harsh and unpredictable weather (sometimes erratic rains and then long period of drought) makes the environment hostile which demand for highly adapted livestock breeds like camel. Such an adapted and hard animal must be conserved (Köhler-Rollefson, 2005b). Characterization of local livestock resources has an increased interest in recent years (Mendelson, 2003). Genetic diversity should be conserved to maintain the flexibility of livestock systems and to sustain the further development of rural areas (Oldenbroek, 2007). There is an urgent need for the characterization of camel breeds, types and population with respect to morphology, actual production levels and genetic differentiation (Wilson, 1997). Simianer (2002) revealed that breeds need to be documented and their special traits identified. During the past decade a large number of genetic diversity studies in domestic livestock heads on microsatellite loci was carried out all over the world, but such studies were very few in the case of camel (Baumung et al, 2004).
The breeds of the pastoral people are multipurpose. The pastoral people know well the salient traits of a specific breed. So the breed must be characterized in their own perspectives. Before going to characterize a breed the socioeconomic circumstances in which the breed exists must be documented (Köhler-Rolfeson, 2005b). Socioeconomic and ecological information of the habitat of that breed were reported and the physical characteristics, management and production systems and productivity were used for the documentation of the camel breed in India (Köhler-Rolfeson and Rathore, 1996).

A thorough assessment is necessary before the breed characterization. The breeders of those specific breeds are in better position to tell the important traits. The socioeconomic data is also helpful for the appropriation of a breed for characterization (Simianer, 2002). The bases for characterization of a breed are judging, performance traits, adaptation traits, and special traits like drought and disease tolerance and biomolecular studies (Grund, 2004). Another attempt to categorize local breeds of camels suggest a grouping similar to cattle into beef, dairy, dual-purpose and racing (Wardeh, 2004a). The classification for the Sudanese camel is based on conformational and tribal ownership and is classified as pack, riding and hybrid camels (Wathing et al, 2007). This can, however be discussed because camels are very rarely reared for their meat alone except under experimental conditions and racing or camels are not bred separately from different breeds of camels (Payne and Wilson, 1999).

2.15.1 Breed

A breed is a sub specific group of domesticated livestock with definable and identifiable external characteristics that enable it to be separated by visual appraisal from other similar defined groups within the same species, or a group for which geographical and/or cultural separation from phenotypically similar groups has lead to acceptance of its separate identity (FAO and UNDP, 2000). The definition of breed by the Oklahoma State University (2003) is fairly general. "Animals, which through selection and breeding, have come to resemble one another in certain traits and pass those traits uniformly to their offspring."

FAO has listed 52 documented dromedary camel species worldwide (FAO and UNDP, 2000). The Malvi camel has been reported from India (Köhler-Rolfeson and Rathore,
1996) is a new addition to the camel breeds. However, the number of different local camel breeds is much higher, since it is to be expected that there are more breeds yet not described in Africa as well as in Asia (Payne and Wilson, 1999). In Pakistan, Qureshi (1986) has narrated that the types of camels belong to 4 breeds in the country, Isani and Baloch (2000) have listed about 20 breeds of camel in the country based on morphological characteristics, habitat and geographical distribution. However, Khan et al (2003) concluded that in depth research work was needed to verify the breed documentation of breed in Pakistani camel due to gap in knowledge and overlapping of characteristics of some local breeds.

2.15.2 Phenotypic traits

The phenotype is often evaluated in the process of breeding towards a defined breeding goal or goals. In camels there are fewer established external parameters than in cattle according to Wilson (1997); however, sparsely methods from large ruminants or horses are adapted for camels (Yagil and Etzion, 1980a; Wilson, 1997). Guerouali and Acharbane (2004), used body measurement i.e. shoulder height, body length, and body girth and head length for the phenotypic characterization of Moroccan camel.

Apart from characterizing a breed, body parameters have their own importance. The body lengths, height at withers and heart girth have been shown to be positively correlated with the draught potential of the camel whereas the size of the hump is more related to the nutritional status of the camels. Long and thin legs indicate better racing potential (Khanna and Rai, 1989). The heart girth, height at withers and body weight and length of a camel are positively correlated with power output and draught force (Raghyendar et al, 2003). The height at wither in adult camel was found to be a reliable measure for growth from its association with important body measurements (Patel et al, 2007). Long tails have been designated as a tool for protection from wild honey bees (Rathore, 1986).

Some work on breed identification and their explanation has been reported by Pakistani scientists based on the habitat, ecology and biometric measurements of each breed (Isani and Baloch, 2000). The morphological data included the measurement of various body parts, like face, head, ears, neck, hump, and somatometric measurements included girth, height, length and measurement of fore and hind legs (Baloch, 2001). Coat color, and
body dimension and measurements along with the morphological data and body weight at birth and adult age were used for the characterization of Kachchhi camel breed in the Gujrat State of India (Patel et al, 2007). The effects of the breed and sex were found significant. Camels have a very slow weight gain resulting from their slow increase in height and length compared to cattle or horses (Wilson, 1984). Abdominal girth, chest girth in front of breast pad and chest girth behind breast pad were not significant but there was significant difference in height between sexes. The means plots indicated that the mean height of males were greater than females (Mehari et al, 2007). In a study while working on the meat production and consumption of meat in Jijiga and Harar town of Ethiopia, it was revealed that all the measurements were significantly greater in male than female.

2.15.3 Performance trait

Performance traits are traits which are closely linked to the purpose the animal is kept for. Yield of fiber for example is more important for fiber animals such as Alpacas and milk yield and composition for dairy animals such as camels. Performance traits are often regarded as important factors for characterizing livestock. This holds especially true for camels as the physical differences in camel breeds are less pronounced than in other species (Bissa et al, 2000).

The body size and weight development of an animal collectively reflect the growth pattern of that animal. Body size development typically displays a sigmoid curve when plotted time against height when effects of the environment are small, and the curve is calculated from a number of animals. Height at the withers, rump length and other linear measurements are commonly used in camels to determine body size development (Simpkin, 1995; Peters, 1999). Body weight and its development can either be measured directly using a weigh scale or be estimated by using biometric measurements and established formula. In the field typically tape measures or fiber glass or metal are used for the ease of handling (Tibary and Anouassi, 1997b, Bekele and Zeleke 2001; Tahir, 2003).

The real shape of that curve is determined by many factors. The body size development depends both on the fodder availability as well as the ability to valorize poor quality
feeds (Kamoun, 1988). Strong relation between body size development and weight gain of grazing animals is reported if no additional feeding is available (Horn et al, 2002). The availability of fodder underlies big variations in savannas and dry lands due to erratic rainfall (Fynn and O'Connor, 2000; Bekele and Zeleke, 2001). The mean daily weight gain of camels up to three years is higher than for camels of 3-4 years, as the span from 1-3 years is the time of active growth in terms of weight and height. Camels kept under pastoral conditions furthermore realize much higher daily weight gains during the rainy than during the dry season (Bekele and Zeleke, 2001).

The potential weight gain of camels is influenced by the birth weight which itself is strongly affected by the nutritional status of the dam and the type of camel. A higher birth weight typically leads to a higher weight at weaning. The nutritional requirements of camel calves are easy to fulfill in their first months after birth. A small quantity of milk seems to be enough for a moderate weight gain (Hammadi, 2001). Adult weight is typically reached between 7 and 10 years of age (Rahim, 1996; Wilson, 1997; Gebrehiwet, 1998). Under ranch conditions in Kenya adult weight defined as the weight of reaching sexual maturity was typically reached at the age of 43.4 months (SD 7.45 months) in females. For males the information was lacking but generally assumed to be at 4 years of age (Musavaya, 2003).

The relatively large size of camel and the absence of weighing balance in most camel rearing areas require an alternative measurement techniques and general estimates of weights in different age groups. Estimation of weight in live state is essential to determine stocking rate, calculate feed requirement, and to properly determine the dose of many veterinary drugs required for administration (Wilson, 1984). It is very difficult in the field to determine weight with balance. In the case of camel it is almost impossible. Measurable side-effects of field conditions like uneven ground on the data have been analyzed by Peters (1999) concerning in how far they influence biometric measurements. He concluded that even 15 cm unevenness in the ground do not cause more than 2.27% difference in the precision of the measurements for height at the withers. Linear measurements are the basis for weight estimation in camel in the field conditions (Yagil, 1994; Simpkin, 1995). Schwartz and Dioli, 1992 suggested formula for the mountain camel, different from that of desert camel. The formula is same like that of (Yagil, 1994;
Simpkin, 1995) but is multiply with the factor of 53 rather than 50, because, the hilly camel is small, compact, muscular and heavy boned type, bred in rough highland regions, very different from that of rangy and riverine camel (Payne, 1990).

Formula by Yagil 1994, Simpkin, 1995 is as follow

\[ Y = SH (m) \times TG (m) \times HG (m) \times 50 \]

The formula used for the estimated weight reported by Boue (1949) is as follow, which probably well fit for the weight estimation of mountainous camel like in Balochistan.

\[ Y = SH (m) \times TG (m) \times HG (m) \times 53 \]

Where as \( Y \) (estimated live weight in kg), \( SH \) (Height at the withers or shoulder height in m), \( TG \) (Thoracic girth in m) and \( HG \) (Hump or Abdominal girth in m)

### 2.15.4 Body condition score

Body condition scoring is used in a range of species. Condition scoring provides a measure of the level of body reserves, which is independent of live weight, and a more reliable description of condition of the animal than live weight alone in beef cows (Corah, 1989). Another study on beef cattle indicated that the size does not change anymore in adult animals the condition undergoes a parallel development. Condition might be more relevant information about an animal than weight because the information is of higher biological importance (Morris et al, 2002). However, there has been very little research done on body condition in camels. While there are few studies on growth of camels under field conditions (Hammadi, 2001) and on a ranch (Musavaya, 2003), condition has not been researched yet only recommended as a tool for herd monitoring in camels. The subcutaneous rump fat and muscle layer thickness has been reported an excellent measure for assessing condition both for live animal and the carcass. To measure the level of body reserves, body condition score, is the best method in camels (Grund, 2004).

There are principally two different techniques to body score livestock. One is a visual assessment using illustrations or photos as a reference. To focus on the crucial points
further clarifications for separation of states are given verbally in mare (Henneke et al, 1983) and camel (Rahim, 1996). In the camel, the hump is the most important fat storage place accessible to external observation. Condition might be more relevant information about an animal than weight because the information is of higher biological importance, reported 6 conditions scoring for camel, ranging from 0-5 (Faye et al, 2001). Simpkin (1995) suggested a scale from 1 to 3 for evaluation of condition. Then, a scale from 1-8 has been suggested alternatively (Tibary and Anouassi, 1997b). In another study Grund (2004) reported a body condition score of 1-8 while working on Rindalle camel in Kenya.

2.15.5 Drought tolerance

Drought tolerance is determined by different factors; five important ones are rate of increase of body size, and weight gain, feed conversion ratio, turnover rate and tolerance against long watering intervals. The first four can be combined in the ability to withstand feed shortages (Anderson, 2003). The outstanding performance of the dromedary in this respect is well proven (Gebrehiwet, 1998).

The sign of drought tolerance is that the animals are not loosing weight at a high rate and therefore can also survive severe hardship periods until feed becomes availably after the drought. Body size development as one of the visible characteristic of adaptation is an important trait for characterization as well as for production in animals (Adams and Kaufmann, 2003).

Working on the Kenyan camel Grund (2004) used the body condition score and other body characteristics for the assessment of the drought tolerance ability of different types. Body condition is often of more biological importance than sheer weight and could be used further. The drought tolerances assessment was done at the end of the dry period. A systematic appraisal of the trait 'drought tolerance' in livestock is at its very beginning and recommended further studies in this direction. Adams et al (2002) worked out body condition score in dry season for the assessment of the drought tolerance in different camel types in Kenya.
CHAPTER III

MATERIALS AND METHODS

3.1 Location and History of Study Area

The Suleiman Mountains and the Suleiman range collectively form the Suleiman Mountainous region in Blaochistan, Pakistan. This region comprises of six northeastern District of the province viz Barkhn, Killa Saifullah, Kohlu, Loralai, Musakhel and Zhob (GOB, 1999). The location of the area has been presented in Fig. 3.1. The region had very rich history. Avesta, the holy book of Zoroaster, written in 2570 and 2523, BP determines the Suleiman mountainous region and the Paktia in Afghanistan as Orawah. The region was called as Arya Warsha (mean the place for grazing). The word is still in use as Pashto (Warsh) word for the grazing land. Suleiman region is the historical home tract of the Pashtoon ethnic group. The famous Kase Mountain is situated near the Zhob district, which is believed to be the birth place of Kais, the father of Pashtoon. Kharspoon, the grand son of Kais, believed to be ruled on this area with his family on the present northern Balochistan and southern Afghanistan (Habibi, 1999). The famous Kharspoon Mountain located in Musakhel district. The Baloch pastoral people live in the Southern part of the Suleiman region and famously called as Marri and Bugti hills.

3.2 Topography and Climate

The study area falls in semi-arid region, receiving 200-500 mm precipitation bimodal. The region receives major portion of precipitation from the summer monsoon. The region is situated from 29°-37' to 31°-70' at North latitudes and
from 68°-06' to 70°-20' at East longitudes. The climate of Suleiman region, generally located 600-1350 m above sea level, can be placed in the "arid to semi arid with warm summer and cool winter" category. The summers are warm with mean temperatures ranging from 21-32°C. In winter the temperature drops below 0 °C.

In most of the areas of the region total annual precipitation remains around 250 mm. However, annual rainfall exceeds some parts of the region, most of which takes place in summer due to monsoon (GOB, 1999).

### 3.3 Agricultural Operations and Land Use

The area is mainly flood irrigated. But in some areas like Killa Saifullah and Loralai districts, Karez system is also a source of irrigation, especially for orchard farming. The major crops are wheat, tomato, tobacco, chilies, cotton and other vegetables. Due to the drought prevailed in the last decade (1994-2004) and heavy water drainage, the ground water table dropped rendering the majority of the Karezes dry. Due to the lower water table the submersible technology was introduced and the water table went more down as reported by some workers (Shafiq and Kakar. 2007, Ahmad et al, 2004). This abrupt shortage of water once again realized the importance of local livestock breeds, especially the Kohi camel.
Fig. 3.1. Map of the study area in the Balochistan province and the brush painted line indicates the Suleiman mountainous series.

3.4 Natural Resources and Infrastructure

The total estimated reserve of all the coal fields in Balochistan is 195 million tones. In Duki of Loralai district, the total reserve has been estimated as 51
million tones, which is 26.15% of the total reserves of the Province. Presently chromites and magnetite are being mined in Killa Saifullah District while prospecting licenses have been issued for mining of asbestos, gabbros and granite. The Mining Directorate of Balochistan has also indicated deposits of soapstone, limestone and occurrence of calcite, manganese and coal (GOB, 1999).

There is no Railway service in the whole region. The historic Bostan Zhob railway section had been closed 20 years back. There is only one Airport in Zhob with very limited flights. The roads are badly broken, but some improvement has been noticed since last 2 years. The work is in progress on roads, but the vast area is still lacking such facilities (Raziq, 2007).

3.5 Camel Population

Balochistan province consists of 46% of national land mass and less than 5% of the human population of the country. The province shares 41% camel population, out of which, 30% found in Suleiman mountainous region of Balochistan (ACO, 2006) as reported in Table 3.1 as under.

3.6 Socioeconomic Studies

Data was collected in six northeastern districts viz Barkhn, Killa Saifullah, Kohlu, Loralai, Musakhel and Zhob. In Barkhan, Killa Saifullah, Loralai and Zhob districts 20 herders and in other 2 District (Kohlu and Musakhel) 30 herders from each location were interviewed, totally 140 herders, during the period of 2005-2007. The herders’ selection was based on the principal that the herder might have at least 3 breeding female camels in their herd. The difference in the number of the districts is argued as the difference in camel population, production system, availability and the accessibility of the herds.
Table. 3.1 District wise Camel Population of the study Area

<table>
<thead>
<tr>
<th>District</th>
<th>Male</th>
<th>Female</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Barkhan</td>
<td>2098</td>
<td>4078</td>
<td>6,176</td>
</tr>
<tr>
<td>Killa Saifullah</td>
<td>6369</td>
<td>4558</td>
<td>10,927</td>
</tr>
<tr>
<td>Kohlu</td>
<td>24796</td>
<td>23647</td>
<td>48,443</td>
</tr>
<tr>
<td>Loralai</td>
<td>1396</td>
<td>494</td>
<td>1,890</td>
</tr>
<tr>
<td>Musakhel</td>
<td>6708</td>
<td>13898</td>
<td>20,606</td>
</tr>
<tr>
<td>Zhob</td>
<td>2343</td>
<td>844</td>
<td>3,187</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td></td>
<td></td>
<td>91,229</td>
</tr>
</tbody>
</table>

The respondents were interviewed on a specially prepared pre-tested questionnaire to obtain data, which included herd size, herd structure, herd movement, type of husbandry, nutrition, annual income, women role, management problems, diseases, ethnic knowledge, available services such as veterinary, health and education. Adapted methods of data collection were based on the principle of a single visit formal survey. The data were analyzed using Statistical Package for Social Sciences (SPSS, 1999). The sampling procedure in extensive camel studies was purposive, because strictly random sampling procedure was not possible due to mobile, scattered and less accessible nature of pastoral communities.

Draught ability was accessed by interviewing herders 150 camel taker (50 from each District) from Barkhan, Kohlu and Musakhel. In each district out of 50 respondents, 25 were wood cutter and 25 were semi-nomadic camel herder who uses camel for family transportation. The data were collected on a prescribed Performa for the parameters like, the baggage ability, distance covered, preference to other draught animals and their special feeding for draught camels if any. Statistical software SPSS (1999) was used for the analysis of this study.
3.7 Marketing of Camel

Data were collected from study area at herd level, on a pre-tested proforma covering 140 respondents. The respondents were interviewed to obtain data including major camel market, sale of kind, and number of animals and income generated from the camel activities etc.

Because of the frequent visits of the study area, Mangrota camel fair was the largest camel marketing event therefore, this portion of study was centered on the Mangrota camel fair. The Mangrota is a town of Tehsil Taunsa, Dera Ghazi Khan (DG Khan) District of the Punjab province, Pakistan, situated at the end of the piedmont of Suleiman Mountain eastward.

This work is based on two years data (2006, 2007). The animal present in the Mela were counted by simple counting practice from 5 blocks and each block was counted and recounted by co-workers for confirmation. The counting was performed at third day of Mela when the camel figure was at crest. The daily sale data of animals were achieved from the contractor at the end of each day. The importance, history and the mechanism of the Mela was assessed by group discussions, interviews and personal observations. All type of the beneficiaries of the Mela i.e. farmers, herders, breeders, traders, brokers and the contractor were interviewed separately and in group discussions. The data was analyzed simple for averages while using Microsoft excel program.

3.8 Reproductive Aspects and Hormonal Profile

Data on the reproductive aspects of the camel were collected through a pre-tested questionnaire especially prepared for this purpose. The farmers and progressive breeders from all 6 districts were interviewed (total of 140 farmers). The data gathered were, upon the period of mating, age at first mating, gestation period, post calving first estrus, estrous interval, estrous time, calving interval, average reproductive life of female, average stud life, approximate birth weight, approximate weaning weight (36 weeks), lactation length, dry period, service period and fecundity etc.
Apparantly 10 healthy bull camels of 2 breeds i.e. Gaddai and Kohi (ranging from 9-13 year of age) were selected for this study. The camels were allowed for free browsing at the available mountainous vegetation predominantly composed of *Acacia modesta, Olea cuspidata* and *Caragana ambigu* bush. No special feeding was offered to the camel.

The samples for non-rutting season were collected in the second week of June when the temperature was highest and the second week of Jan for the rutting season. The blood sampling was done twice for a season within a month. Blood samples were collected in the morning, before feeding and watering, from a jugular vein under aseptic conditions directly into test tubes without any anticoagulant. The blood was allowed to clot at room temperature and then serum was separated following centrifugation for 15 min at 3000 r.p.m., and any haemolysed samples were discarded. Serum samples were stored at -20 C° until analyzed.

The serum was analyzed for LH, FSH, Prolactin, testosterone and cortisol hormones by RIA technique using the standard kit methods (AccuLite CLIA, Microwells, Monobind inc. USA). Data were analyzed by one way ANOVA and regression analysis using SAS (2003) program.

### 3.9 Milk Production Potential and Composition

In Musakhel District, forty (40) Kohi camels were used for this part of research. The animals were selected through a purposive sampling method, willingness to provide their camels and information for the study, accessibility of the site and sufficient number of camel on a site. The milk recording for each cow started at the end of first week. The milk was calculated at alternate week interval. The cow was regularized 36 hours before the data collection as; udder cover was applied to the animal and the milking was practiced on equal intervals (12 hours). After 36 hour the milk was recorded for two times on equal interval of 12 hours. The data was recorded on milk production, parity number, age, time of milking, stage of lactation, season, color/type of animal, tribe of the herder and location.
Prior to milking, calves were allowed to suckle for a few seconds to stimulate milk letdown. Then the calf was restricted to two teats of right side by one handler and the other handler was milking the two teats of the left side. The animal was milked in a container used by the herder; the milk was then let to settle down for some time, and was measured through a graduated cylinder.

3.9.1 Milk composition

The milk samples were analyzed for fat, protein, lactose and ash. Ultrasonic milk analyzer (Model Ekomilk Total Ultrasonic Milk Analyzer, Bulltek 2000, Stara Zaqora, Bulgharia) was used for the analysis of fat, protein and lactose in Department of Livestock Management, NWFP Agricultural University Peshawar and ash was determined by using the standard method (AOAC, 1999). The protocol of cow was used for this purpose, as the camel milk is believed to be close to that of cow milk compare to sheep, goat and buffalo milk. The amount of protein, fats and lactose are in the range of Friesian cow while higher in buffalo and sheep and goat (Knoess, 1984). Data collected were thoroughly checked, coded and entered into data files and analyzed by using Microsoft excel program.

3.10 Feeding Behavior and Composition of Selected Vegetation

Five camels (lactating 13 y age, bull 10 y age, pregnant animal 4 y age, male 2 y and female 2 y age) were selected for this study from the herd of Haji Khanan of Musakhel. The study was conducted in the 1st week of May to eliminate the effect of feeding behavior on foraging activity.

That period is the season most of the vegetation was in flowering stage. The camels were accustomed to humans and did not exhibit avoidance behavior. The activities recorded were on the bite count on a specific plant, the total time spent on grazing, walking, resting (standing or lying), and ruminating. Grazing was defined as the time spent searching and eating (browse or herbage) within a feeding station, Walking occurred when moving to a new feeding station or in social interactions among the animals. Rumination occurred when the animals were resting, and was detected by regurgitation.
Rumination was recorded as the time spent ruminating. The camels were not given supplemental feed. Simulative sample were taken from each plant for analysis in the lab for moisture, dry matter, crude protein, NDF, ADF, and ash contents.

3.11 Indigenous Knowledge (IK) and Ethnoveterinary Practices

Data were collected from the study area on a pre-tested Performa, 90 herders from research area (30 Baloch, 30 Pashtoon transhumant and 30 Nomad) were interviewed, based on the prevalence of the diseases, causes, symptoms and common practices they used for the treatment. Then 10 healers from each community were selected for detailed study of each disease and their treatment. A total of 90 camel owners and 30 healers were directly interviewed about their perceptions of the status of animal health delivery in their area. The detail of each disease was documented with the healer. Data obtained, included type of healer, general information, local name of the disease, symptoms, etiology, type of treatment, medicinal materials, their preparation, application and period of curing.

Package for Social Sciences (SPSS, 1999) Statistical methods were used to identify the most frequently used of ethnoveterinary medicine, associated with or used to treat a particular disease (consistency of veterinary usage).

3.12 Camel Utilities

The camel utilities (hide, hair/wool) other than milk were determined through the socioeconomic Performa, already discussed. Two breeds of camel were chosen for this study, Raigi breed of the Qamardin Karez of Zhob District and Kohi camel in Musakhel. Total sample of 120 from 40 camels were taken from 3 body sites i.e. hump, shoulders and neck. Four age groups were selected, i.e. 1-3, 3-6, 6-9 and 9 to above.

Gross study of the hair was conducted in the lab for hair diameter, coefficient of variation (CV) of the diameter, and modulation (OFDA at wool lab at NARC, Islamabad, Pakistan). The data were analyzed using mixed mode least square and maximum likely
hood programmed to study the factors like sex, breed and age influencing hair quality attributes.

### 3.13 Breeds Characterization and Documentation

This study was conducted in 2007. The breed of the area i.e. Pahwal, Kohi and Raigi were included in this study. The information available on the camels ranges from age 4 and above. Information on the male animals was very hard to collect because of the scarcity of male animals in the herd and the nature of the male bull. The herds selected for this study was based on the principle of the availability and accessibility of the herd and the willingness of the herders. The group of camels comprising at least of 3 fertile female was considered as the herd of the camel. A color illustrated table of the paint preparing company was used as a standard for the name of the color of the breed and was further verified the color while in the group discussions with the herders.

The body measurements were done in the paddock early in the morning while the camels were empty. No pregnant animal was included in this study. Each animal was measured with in a limit of 10 minutes and the other person was writing the measurements. The animals were measured from the left side to keep the data homogenized. The animals were placed on a smooth place and were measured with a type measure. The parameters for this study used were that of modified protocol of Grund, 2004 and Isani and Baloch, 2000. Description of the individual animals is given in Appendix Table 3.1.

Breed differentiation was made on the basis of criteria laid down by Isani and Baloch, 2000 and Grund, 2004, and the breed differentiations also made while using their modified protocol. The parameters used for this purpose were i.e. Biometrical, dimensional, conditional and productive traits of the camels.

#### 3.13.1 Body condition score (BCS)

Body condition score (BCS) from 1-5 was measured while using the modified protocol of Grund, 2004. The illustrations and photographs and the visual assessment of the author
and the herders were used for this purpose. At the end of the measurements the illustrations were showed to the herders and were asked to place the animal in the proper condition score.

The body condition scoring was based on the following principles, presented in Table 3.2

**Table. 3.2 Descriptions of the body condition scoring**

<table>
<thead>
<tr>
<th>BCS</th>
<th>Name by the herder</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Weak</td>
<td>Absence of the hump and the prominent hip bones. Mostly the animal in the last stage of lactation and the chronic trypnosomiasis fall in this category.</td>
</tr>
<tr>
<td>2</td>
<td>Skinny</td>
<td>Very small hump, prominent ribs. The bull in the mid of the breeding season and the lactating animal fall in this category.</td>
</tr>
<tr>
<td>3</td>
<td>Fair</td>
<td>Medium sized hump proportional to the body and lower body line.</td>
</tr>
<tr>
<td>4</td>
<td>Good</td>
<td>Large size hump, with a good height and the shiny skin.</td>
</tr>
<tr>
<td>5</td>
<td>Excellent</td>
<td>The hump grows more and move downwards and overlap the ribs.</td>
</tr>
</tbody>
</table>

**3.13.2 Body size development and growth pattern**

The Body size development and growth pattern of the all three breeds since puberty to the maturity of camel were determined by the modified protocol of Grund (2004). To know the body size development, growth pattern and to verify the end of the growing period in terms of height the following parameters were used i.e. growth of height at the wither upon time, rump length and estimated weigh. The detail parts of the body measured are given in the description of the individual animals presented in Appendix Table 3.1.
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CHAPTER IV

Paper 1

SOCIOECONOMIC PROFILE, ETHNOVETERINARY PRACTICES AND DRAUGHTABILITY AMONG CAMEL HERDERS OF MARRI TRIBE IN BALOCHISTAN, PAKISTAN

Abstracts

Out of the camel herders in the northeastern districts of Balochistan, Marri tribe is traditionally and historically professional in camel breeding. The Marri tribe having the largest number of the camel in the study area is the custodian of camel genetic resource. Camel is well fitted in their culture. The belt is the habitat of many important livestock species mainly raised on the vast ranges. The camel of the area (Kohi breed) is well adapted to the climatic extremes and is well praised for their significance in the pastoral economy. Marri belt is situated in the Suleiman mountainous region of the northeastern part in Balochistan province of Pakistan. The concurrent drought, socioeconomic changes and the environmental instability once again has realized the importance of camel. Therefore, a study was conducted in the Marri belt of Suleiman region to investigate its socioeconomic profile, followed by its documentation. It was revealed that camel still play important role, provide cash earning, transportation, food and wool, etc. The camel herders follow a regular pattern of seasonal migration according to the season, foliage availability and agricultural operations. Women perform all management practices at home, and take care of young and sick animals. Keeping in view the important roles camel play and its future importance as a valuable animal genetic resource, authorities are stressed upon to reconsider this animal specie in the research and development plans of the country.

Key Words: Camel, Socioeconomic, Ethnoveterinary, Pastoral people, Production systems, Balochistan, Pakistan
4.1 Introduction

Marri belt (Kohlu district) makes the extreme south of the Suleiman mountainous region of Balochistan. Livestock farming has been a century's old occupation of a vast majority of the population in this district, and was the only source of food winning for most of the households. Area is very famous for its livestock agriculture especially large herds of camels and full-size small ruminants' flocks. The livestock farmers follow a regular pattern of seasonal migration; mainly depend upon the season and agricultural operation.

Camel is an important animal genetic resource, plays a very pivotal role in herders’ socioeconomic life and providing valuable food items in the most stressful conditions (Jasra and Aujla, 1998). The camel of the area (Kohi breed) is well adapted to the climatic extremes and is well appreciated for its’ significance in the pastoral economy (Raziq and Younas, 2006). The camel is praised in many parts of the worlds’ arid and semi-arid zones for their unique characteristics especially under the harsh conditions (Schwartz and Dioli, 1992). The region is comprised of vast ranges and are used judiciously by the well adapted various livestock breeds of the pastoral people especially camel, which otherwise go waste.

The climate of Kohlu, generally located 600-1200 meters above sea level (ASL), can be placed in the “arid with warm summer and cool winter” category. The summer is warm with mean temperatures ranging from 21°C to 32°C. In winter the temperature drops below 10°C and in the coolest month (January) the mercury may touch the freezing point. In most of the areas of the District total annual precipitation remains below 250 mm, however annual rainfall exceeds this range in the areas surrounding Kohlu town, most of which takes place in summer due to monsoon. Generally the potential evaporation exceeds precipitation by more than two times. Therefore the area is arid. Total area of the District is 7,610 square kilometers. The land of Kohlu is rock outcrops and loamy, very shallow steep high mountain soils of mainly arid and semi-arid zones. Kohlu is located approximately from 29°-20° to 30°-06° north latitudes and from 68°-06° to 69°-65° east longitudes. Kohlu is situated at the southern end of the Suleiman mountainous region and consists chiefly of narrow parallel ridges of closely packed hills which form the gradual descent from the Suleiman plateau into the plains (GOB, 1999).
At present national herd comprises about one million heads of camels (Economic Survey, 2007-08) and 13% growth rate has been observed since 1996 to 2006. Out of the total national camel population 41% found in Balochistan province alone, while 27% of the camels of Balochistan are found in the Suleiman region. The Marri belt possessed about 60% camel of the Suleiman region (ACO, 2006).

While living in the remote and poor infrastructures, the pastoral people having good expertise while using ethnic knowledge they had gained from their fore fathers. The camel breeders of the region are well familiar with the significance of camel for their hardiness, adaptation and valuable turn out. The concurrent drought, social and economic changes and the environmental vacillation once again realized the importance of camel, and therefore this study was conducted in the Marri belt of Suleiman region to evaluate its socioeconomic profile.

4.2 Materials and Methods

This study was conducted during the period of 2006-2006. During the study period this area received a lot of rains and the weather was quite pleasant. It was observed that lush green vegetation available, and the trees and bushes contained a plenty of forage in the form of leaves and twigs.

All the general aspects of camel were studied through a pre-tested questionnaire, specially designed for this purpose. The camel herders in general, progressive owners, Jaths and ethno veterinarians from the different camel sanctuaries (Kohlu tehsil itself, Thamboo, Kahan and Maiwand) of the District were interviewed. Both group discussion and the personal interview methods were adopted. The vegetation samples collected were brought to Botany Department, University of Agriculture Faisalabad for confirmation of botanical nomenclature.

Draught ability was accessed by interviewing herders 50 camel takers (25 wood cutters and 25 semi-nomadic camel herd) on a prescribed Performa for the parameters like, the baggage ability, distance covered, preference to other draught animals and their special
feeding for draught camels if any. The statistical software program, SPSS (1999) was used for the analysis of this study.

Livestock farming is the major activity of the people living in the Kohlu district. Gigantic flocks of small ruminants are often seen everywhere in the district. Large herds of camel and cattle are also visible in the area. Donkeys are used for draught purpose mainly for water transportation for family use. Horses are kept for prestige and riding in the area. The major portion of the people in the District is pastoral and depends upon the livestock. Earning of the inhabitants is mainly from the livestock agriculture. In the vicinity of Kohlu town, tube well agriculture is being introduced with the supply of electric power. The major crops are wheat, cotton, tomato and other vegetables.

4.3 Results and Discussion

4.3.1 Migration patterns

The camel herders follow a regular migration depending on the season and agricultural operation. Migratory period starts with the onset of autumn. The animals meant for sale are sorted from their herds in August-September and move towards the Mangrota camel fair (October) in D.G.Khan District of Punjab province, which is the largest camel marketing event in the country (Raziq, 2006, 2007).

The migration may originate from Kohlu District and its locality like Chamalang, Thambo & Paza and may end up in the Southern part of Kohlu or the Sibbi District of Balochistan. Some herds may reach to the Kachi area (adjoining area of Balochistan and Sindh province).

They stay there with their animals until March or April. With the onset of the spring season, they move back to the mountainous areas. They try to reach Kohlu area in the wheat harvesting season and take part in the crop harvesting and threshening. The movement is along traditionally fixed routes. The migration involves only the pastoral activities, but some people work in the agricultural fields in the canal irrigated areas of
Balochistan and Sindh in winter. The Baloch pastorals do not participate in business activities like Afghan nomads.

4.3.2 Type of Camel

The study area is dominantly inhibited by Kohi, which is kept mainly in transhumant production systems. Average milk production per day was about 10.70 liters and live body weight was 550 kg and 485 kg for male and female respectively presented in Table 4.1. The feet of the camels were round & hard and the wool was shorter in length, curly and fine. The detailed characteristics of Kohi camel are also reported previously (Raziq and Younas, 2006). The picture of a browsing Kohi camel is presented in Fig. 4.1 as follow.

![Fig. 4.1 Showing Kohi Camel](image-url)
4.3.3 Ethnic Terminology

The Marri tribes have their own terminology for camel management and production systems. In this paper the ethnic terminology and the IK related to management are intensively used to explain the management practices used by the herders of the area. The detailed out ethnic terminology is presented in the Appendix Table 4.1.

4.3.4 Socioeconomic importance of camel

The survey finding revealed that camel is still performing important role, providing cash profit by selling mature male camels for draught purpose, transportation for daily life, and food as milk and wool for household needs. Camels provide important sources of subsistence and income to the people residing in the mountainous areas of Balochistan, which has also been reported by Jasra and Aujla (1998). They earned a reasonable amount of cash while selling their mature bulls, sick and culled animals in vicinity and annual camel fairs. The camel is the sign of prestige for Marri camel herders and source of recreation and hobby. The Marri people really love their camels and camel is precious animal specie since their forefathers. After the severe drought (1994-2004) in the region and introduction of camel export both legally and illegally, the importance of camel augmented. The economic value of camel boosted and camel is no more kept only for prestige but considered as important source of cash earning. Now camel production is regulated on the only criterion of the more calf production to earn more money. They earn a handsome amount about worth of Rs 60,000 to 75, 000 (US $ 1000-1200) per mature male camel, which is almost ten times more than the prices ten years back.

Herders believe that camel is guarantee for family income when the other earnings ceased as the crop failure and diseases out breaks. The camel is highly appreciated and well praised for their tiny list of diseases, disease and drought tolerance, hardiness and adaptation.

In the Marri belt mostly camels are being raised by the Jaths. The Jaths are the lower community of the Marri tribe who look after the camel herds of the Marri herders. In very few cases the herders themselves care the camel. The Jaths are very often illiterate, only
graze the animals. In most of the cases, they use simply prepared bread (Kak) with the camel’s milk. Major portion of the Jath's earning comes from the camel rearing.

The Jath is paid Rs. 100 and 3 Kasa of wheat grain per year on each animal rearing. In addition to that, one Bharri of wheat per Jorra land of the herder is also provided. A complete terminology of the local terms used in management and ethnoveterinary treatment are listed in Appendix 4.1. A pair of shoes, a bed, a pair of cloths, a Loomer, and a turbine on weeding is also given each year by each herder. The herd size is counted in the month of October when the animals are sorted for sale. The herders have to pay next year on the number of camels left after sorting. The rearing cost of all the age classes of camels is same.

Women play a pivotal role in the production and management of camels in the region. They perform all the management practices at home which include; taking care of young and sick animals and perform all other household activities i.e. she brings water, take care her own children, do all the family cooking & cleaning and watch & care the home. Despite all they have got very low social status. Our study is in line with the finding of Iqbal (2002), who reported that women of the pastoralist’s community are playing a significant role to run the camel production systems. Our results are also inline with the former study of the author, which revealed that woman play a pivotal role in camel production and husbandry care of young and sick animal at home (Raziq and Younas, 2007). The finding of our study revealed that women were very rarely involved in the marketing activities of camel. This finding is inline with the findings of the study reported from the province of Balochistan (Jasra and Mirza, 2004), and reported that women were rarely involved in the marketing of the camel and their products and were mostly not consulted in decision making.

4.3.5 Production potential

The Kohi camel is well reported for its production potential in that area (Raziq and Younas, 2006). The body weight, puberty age, productive life, milk and wool production parameters recorded during the study area presented in Table 4.1.
1. Milk production and Consumption: Our study revealed that the productive life of the camel in the study area is 21-25 years, lactation length ranged from 8-11 months and daily milk production was recorded as 10.7 kg per day. The detailed potential of Kohi camel as a milch animal is being discussed in chapter 6 and paper 3.

The camel milk was one of the important food items of the Marri pastoral people and was considered as the potential source of human medicine too. This study is in agreement with the conclusion of (Faye and Esenov, 2005), who reported that by virtue of its attributes and potentials, the role of camel as food animal is being accepted globally and the camel scientists stated that camel has unfathomed potential for satisfying human’s future dietary and medical needs. The herders believed that the camel browse on certain medicinal plants which fortified its milk with the medicinal ingredients. This finding is inline with the finding of Rao et al (1970), who reported that therapeutic property of camel milk is attributed to the fact that camels browse on various plant species and active agents with therapeutic properties from these plant species are secreted into the milk of camels.

The Marri tribe camel herders believed that camel milk is well for water belly, jaundice, aphrodisiac, general body fatigue, source of energy, liver disease, joint problems and febrile disease (anti-infectious). This study is in agreement with many studies which revealed that camel milk is considered well for the treatment of jaundice (Knoess, 1984’ Mehari et al, 2007; Seifu, 2007) in Ethiopia, aphrodisiac and jaundice (Tezera, 1998), anti-infectious and energy-giving product (Konuspayeva and Faye, 2005) from Kazakhstan and liver diseases, general fatigue, (Bengoumi et al, 2005).

The herders of the study area believed that in the sever summer when the water sources become limited and the calves unable to go long for water, milk is the sole source of water for the calves. These findings are in agreement with the finding of Wernery (2006) who reported that in the summer season, when there was scarcity of water and the vegetation was no more accessible for the young calf, camel milk is the only source of food and water. The dromedary has an accepted and well known peculiarity, as its milk water contents increases with the shortage of water and may reach up to 90%.
Table. 4.1 Productive Traits of the Kohi Camel

<table>
<thead>
<tr>
<th>No</th>
<th>Traits</th>
<th>Male</th>
<th>Female</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Average birth Weight</td>
<td>32 – 40 kg</td>
<td>31 - 40 kg</td>
</tr>
<tr>
<td>2</td>
<td>Average weaning Weight*</td>
<td>160 - 185 kg</td>
<td>155 - 180 kg</td>
</tr>
<tr>
<td>3</td>
<td>Average live weight</td>
<td>550 kg</td>
<td>485 kg</td>
</tr>
<tr>
<td>4</td>
<td>Height at wither</td>
<td>2 m</td>
<td>1.7 m</td>
</tr>
<tr>
<td>5</td>
<td>Ready for workload</td>
<td>3 yr</td>
<td>3 yr</td>
</tr>
<tr>
<td>7</td>
<td>Use for heavy duty</td>
<td>7-8 yr</td>
<td>-</td>
</tr>
<tr>
<td>8</td>
<td>Age of puberty</td>
<td>4 yr</td>
<td>3 yr</td>
</tr>
<tr>
<td>9</td>
<td>Average work life</td>
<td>25 yr</td>
<td>-</td>
</tr>
<tr>
<td>10</td>
<td>Average reproductive life</td>
<td>25 ye</td>
<td>21 yr</td>
</tr>
<tr>
<td>11</td>
<td>Conception rate out of herd</td>
<td>-</td>
<td>50-53%</td>
</tr>
<tr>
<td>12</td>
<td>Gestation period</td>
<td>-</td>
<td>375-386 day</td>
</tr>
<tr>
<td>13</td>
<td>Calving rate out of herd</td>
<td>-</td>
<td>45-50%</td>
</tr>
<tr>
<td>14</td>
<td>Calving interval</td>
<td>-</td>
<td>2 yr</td>
</tr>
<tr>
<td>15</td>
<td>Average milk production</td>
<td>-</td>
<td>10.7 kg/day</td>
</tr>
<tr>
<td>16</td>
<td>Lactation length</td>
<td>-</td>
<td>8-11 month</td>
</tr>
<tr>
<td>17</td>
<td>Wool Production</td>
<td>-</td>
<td>2.5 kg</td>
</tr>
</tbody>
</table>

*Weaning age is 8 month.*

As the Jaths remain in remote areas along with their camels, mostly far from their families, so they don’t need more milk. The animal is milked only when needed or in the case when the udders firmly full, which otherwise causes mastitis. This finding is inline with the other study from Balochistan, which revealed that camel is milked according to the need of the pastoral family in most of the nomadic types of production systems (Jasra and Aujla, 1998). In another study reported from the province of Punjab, Pakistan, (Qureshi, 1986) the milking frequency was same as reported from Balochistan, but some camel herders do 4 times of milking per day.
Our finding revealed that the lactation period is shorter because of the desire of the herders to have more calves, however, lactation length depends upon the age of animal, body conditioning, parity, stage of lactation, need of the family for milk and health status of the cow. Our findings are in agreement with the findings of Farah et al (2004), who reported from Somalia that Somali camel herders are geared towards the improvement of milk production and the continuous supply of milk for the family need throughout the season resulted in the long lactation length.

The lactation yield of this study was controlled artificially and the herders manage the camel production for the purpose of more calves, but not milk production. They dry their camel before the onset of the breeding season, not like the herders of the other part of the country where camels are dry in the advanced pregnancy (Knoess et al, 1986).

The finding of our study revealed that provision of a reasonable dry period was very important for the camel herders of Marri tribe. As the camel is a seasonal breeder therefore they dry the camel in October to November to provide a dry period of 3-4 months. A jal (udder covering) is provided to keep the calf away from suckling. In the mean time the lush green vegetation also get less in the autumn and winter, which affect the cow's health and vigor for breeding. If the cow is not being dried at proper stage the two factors i.e. decreasing vegetation and the continuous calf suckling, will adversely affect the body conditioning of the camel and will cause fertility failure in the coming breeding season.

Colostrums are also used by the Jaths locally called as Boli. The Boli is prepared while boiling the colostrums and some sugar & ghee is added for taste and quality. The Boli is believed to be the rich source of energy and power and is used as such or taken with bread.

2. Meat production: The Marri tribe does no slaughter the camel for meat production. The animal not fit for work and sale are usually slaughtered. The bone fracture especially, the long bone fracture is very hard to treat because of poor health facility, remoteness and mobile nature of the camel, therefore, the animal is slaughtered and the meat is distributed in the families of the community but free of cost. The other occasion for camel slaughtering is Sadqa (Khairath), in which camel is sacrifice in the name of Allah.
and the meat is distributed free of cost in the community. The camel is rarely used for Muslim religious ritual of Eid ul Azha in the Marri belt. Our study is in agreement with the findings of the other scientists who reported that that camel meat is rarely eaten in Africa and the pastoral prefer to have a live animal rather to meant of the camel (Matekaire and Gebreah, 2001; Negatu, 2002).

The majority of the respondents believed that camel meat also had medicinal value; it decreases the backache, and the long bones pain. The hump fats are used for the treatment of infertility in women and mastitis in cows and small ruminants. The hump fat is crushed and tied at the lower abdomen of the infertile women. The hump fats are boiled and applied on the udder for the treatment of the mastitis. Meat of old camel is also used as anthelmentics in small ruminants. The meat is boiled in water, thrived well, and a viscous solution is prepared which is fed to the parasites infested animals. Some other scientists also reported from Ethiopia that the camel herders over there believe that camel meat and urine are among the materials used as traditional medicines (Mehari et al, 2007).

Since last few years camel's meat demand has been increased among the coal mine workers in the adjoining Duki area of Loralai district. The mine workers believed that camel meat is better to remove the deleterious gases accumulated in their bodies during mine digging. The old, sick and spent animals are now moving to that market for better returns.

3. **Draughtability:** Generally camel is used for all sort of work like transportation of fuel wood, home utilities, agricultural operations, bringing fodder for the animals kept at home and riding. Mainly used for the transportation of the family by the semi-nomadic pastoral of the Marri tribe and by the wood cutter.

Our study is in agreement with the finding of other fellow scientists who reported that camel perform an active role in many agricultural and other operations and save fossil oil energy worth of several thousand barrels annually (Heston et al, 1985). Our study is also inline with another study reported from Balochistan, revealed that camel is used for agricultural operations and riding (Jasra and Aujla, 1998). In a recent study Baloch, (2001) reported that camel performing various on and off farm operations (load carrying
on back, pulling cart load, drawing water from the wells, drawing Persian well and oil extraction mills etc. have also been assessed.

The male animal is introduced to work at the age of 3 years and gradually increased burden on it. Full load is applied at the age of 7-8 years and the animal is used up to the age of 18 years. A wood cutter put a weight of $317\pm10.64$ kg, covering a distance of $16.17\pm0.84$ km, consuming a time of $3.67\pm0.20$ hr (4.4 km/hr) and earning a sum of money PKR. $666.67\pm0.20$ per load. While a semi-nomadic pastoral put a weight of $59.93\pm22.20$ kg, covering a distance of $16.48\pm0.52$ km, consuming a time of $3.76\pm0.25$ hr (4.38 km/hr), but the earning of the pastoral people is not valued in money generating (Table 4.2). Female is using rarely for work, sometimes the kids of the pastorals and light weight home luggage are loaded on her back. Also in the other parts of pastoral world like Africa, camels were first used for transport, 5.4 years on average (range 4-7), depended on the number of camels available and on the load and females were rarely used for transport (Baars, 2000).

Our findings are very much inline with the findings of Payne (1990), who reported that the baggage camel travel at a walking pace at just over 4 km/hr. This study is also in line with the results of Raghvendar et al (2003), who revealed that camel travel with baggage about 4-5 hours continuously. Another study conducted in the province of Balochistan, also in line with the finding of this study, which revealed that camels carried average of 280 kg with a range of 220 to 370 kg, depending upon type of commodity and distance to cover (Jasra and Aujla, 1998).

The findings of our study are also in line with the finding of an Indian study which revealed that a pack dromedary camel can cover 20-25 km/day at an average speed of about 5 km/hr and can carry burden of 200 kg on its back (Khanna et al, 1996).
Table. 4.2 Droughtability of Kohi camel in the study area

<table>
<thead>
<tr>
<th>Descriptions</th>
<th>N</th>
<th>Mean</th>
<th>S.E</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Wood cutter</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Load (kg)</td>
<td>24</td>
<td>317</td>
<td>10.64</td>
</tr>
<tr>
<td>Distance (km)</td>
<td>24</td>
<td>16.17</td>
<td>0.84</td>
</tr>
<tr>
<td>Earning (PKR)</td>
<td>24</td>
<td>666.67</td>
<td>28.17</td>
</tr>
<tr>
<td>Time consumed (hr)</td>
<td>24</td>
<td>3.67</td>
<td>0.20</td>
</tr>
<tr>
<td>Supplementation to camel</td>
<td>24</td>
<td>4.35</td>
<td>0.15</td>
</tr>
<tr>
<td><strong>Semi-nomadic migration</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Load (kg)</td>
<td>27</td>
<td>59.93</td>
<td>22.20</td>
</tr>
<tr>
<td>Distance (km)</td>
<td>27</td>
<td>16.48</td>
<td>0.52</td>
</tr>
<tr>
<td>Earning (PKR)</td>
<td>27</td>
<td>N/A</td>
<td>N/A</td>
</tr>
<tr>
<td>Time consumed (hr)</td>
<td>27</td>
<td>3.76</td>
<td>0.25</td>
</tr>
<tr>
<td>Supplementation to camel</td>
<td>27</td>
<td>2.52</td>
<td>0.14</td>
</tr>
</tbody>
</table>

Our study revealed that the animals are trained for riding and the trained animal is called locally as Mahari. The Mahari camel can carry two person depend upon the type of saddle. Some saddles are especially designed for two persons. In most cases one person sit and ride the camel. A Mahari camel run on an average speed of 10 km and may cover up to 40 km in a day. The Mahari camels are well decorated and are well cared especially on occasions like wedding etc.

Our study revealed that the sum of $4.35 \pm 0.15$ kg and $2.52 \pm 0.14$ kg of grains (barley, maize, wheat or grams) when the animal return from work is offered by the wood cutter and the semi-nomadic herder respectively. This study is in agreement with the finding of Rees et al (1988), who worked in Balochistani camel and reported that 1-2 kg of crushed wheat and barley mixture is offered by the nomadic pastoral to their work animal, especially in winter. The finding of Chaudhary et al (2003) are also in agreement with our findings, who reported that draught camels working 6–8 hr a day are fed an additional allowance of concentrate which is generally limited to the work season only.
4. Wool: The study revealed that average annual wool production is 2.5 kg/animal. This finding is in agreement with the finding of a Tunisian study which revealed that the average hair production per head is estimated as 3 kilograms per year (Sghaier, 2004). The wool is widely used for bedding material but some people also used it for ropes, horse and camel saddles and rugs. The herders believed that the camel's wool bedding is very comfortable; rectify the day long tiredness and treat the body aches. The camel wool is also use for some medicinal purposes both in animals and human being. A thread is made by the camel wool and tied around the neck of the sheep for the treatment of the chronic respiratory problem. The camel's wool smoke is smell by the new born baby with the view that it keep the baby safe from the Tetanus.

4.3.6 Production management systems

The transhumant production system makes the major portion of the production system in the region, the sedentary and nomadic system are very rare. Some draught purpose camels are being kept in the vicinity of the Kohlu town by some agriculturists and wood cutters. There is no special arrangement of housing for the camels in this area. As the camels are always on move, they hardly spend more than one month at one place. The camel in the transhumant system is rarely brought to the home. The Jaths stay with their camel herds in mountains. The Jaths in the vicinity gather on one place at night, called as Jhok.

1. Feeding: Camel production predominantly depends on the community owned rangelands. The rangelands of the region have copious woody vegetation and bushes, liked by the camel. The camels proceed early in the morning to grazing areas, where they drink water first especially in summer and then they move towards the grazing area. The water is offered twice in summer and once in winter. The sources of water are river, ponds and sometimes tube wells. The herders of the area are well familiar with the importance of salt bushes in camel nutrition and therefore they prefer to graze the camels on salt bushes in the start of the day, but some time depend upon the availability, camels are specially move towards the salt bush area at least once in a week. The herders believe that the camel browse well on other vegetation after allowing to graze on salt bushes. Keeping away from the salt bushes and off salt may cause serious problem of pica. The
salt bushes are abundantly available in the area, and therefore, salt deficiency symptoms were not well known to the herders.

No stall-feeding is provided in any part of the year. In the crop harvesting season in the study area, animals are allowed for grazing aftermath in the fields. The stubbles of maize and sorghum are also offered if available. The weak and diseased animals, which are unable to graze, are provided wheat straw, if available but such cases were seen very rarely.

2. Major vegetation of Marri belt: It was observed that the camel relish on twigs and pods of *Acacia modesta* especially when there is good year and the twigs are hanging. Only the pods of *Acacia arboica* are liked by camel, but not the twigs and leaves. Other woody vegetation like Zizyphus, Olive, Pistachio and Jand are also available. The Tamarix trees are the source of salts and minerals and the lactating animal especially like it. The trees form of Tamarix is available on the stream's banks and the bushy Tamarix is found inside the streams. The bushes (*Caragana ambigua* and *camel thorn*) are also much liked by the camel, especially when they are in blooming stage. The salt bushes like *Haloxyllon griffithi* and *Haloxyllon recurvum* are also found in the plain terrains, which are one of the main feed sources for camels in the region. The camel rarely likes the grasses but the juicy grasses like *Cynodon dactylon*, and *Stipa capillata* like very much when fresh. Some of the important vegetation for camel found in the area is given in the Appendix Table 4.2.

3. Calving and calf care: The Jaths described the behavior of female camel before parturition. Signs of approaching parturition are restlessness and leaving the herd. She changes from calmness and quietness to unstable and reduces the grazing time, looks into distance and emitting a specific sound. She may go very far if allowed and the Jaths give due care at that time. The vulva swells up, the udder and teats increases in size. Teats are filled with milk and sometimes even leakage is there. She lies down, get up quickly and urinates frequently with small amount of urine. In the first stage of parturition the cervix gradually relaxes, the forefeet of the calf, with the layer (amnion), are forced into the vagina. In the second stage the animal increases straining. The feet become visible, still enclosed in the amnion. The head then appears and the rest of the body quickly follows.
The first two stages average 30-40 minutes. In the third stage the placenta is expelled. This takes about 50 minutes, but can take much longer. The Jaths assist the animal by pulling the calf, because sometimes calves while standing which can harm the calf. The herders noticed the cases of distocia and retained placenta. They believe that only the weak and emaciated animals may face such problems (Tibary and Anouassi, 2001). The calves stand within 20 minutes of birth and in a short while start suckling. The Jaths offer colostrums with in one hour, but avoid excessive colostrums, which might cause diarrhea. Many herders believed that post calving full colostrums feeding is far better than depriving the calf of colostrums. The herders know the importance of the colostrums feeding and believed that it is important in keeping the calf healthy, strong and vigorous.

Calf mortality was very rare and it might be the result of bull selection & replacement, colostrums feeding and good husbandry care. According to the respondents, intensive care was needed to save the calves from cold and predators. The dams accept the calf in majority of the cases but very rare dams especially the young ones, quite often refuse to nurse their calves, so they must be forced to accept otherwise milk production would ceased within days. Pastoralists have developed several elaborate techniques to reach this objective all based on the same principle (Schwartz and Dioli, 1992). All these techniques based rely on causing increasing degrees of discomfort or even pain to the mother which will absorb her attention to such an extent that she will accept "forget" to reject the calf. After the calf has suckled a few times the device is removed and in most cases the relief is so strong that the mother will accept the calf permanently. The vagina and anus are brought between the two stick and tightly closed by the rope to prevent excretion and apply pain. This technique is called as Dozz.

The newborn calves stay at Jhok almost ten days and then move with the herd, while providing cover to the udder of the mother. The new crop is well cared (Fig. 4.2) and tall grasses, leaves and twigs were of the trees are offered, and ad lib water is provided.
4. Shearing: Shearing is done once a year in the month of April depending upon the health of individual animal and the season. Shearing is sometimes delayed up to May, if animals are weak, sick, freshly calved or the weather is rainy and cold. Almost, 4 Gorrie of wool is produced per shearing, which makes about 2.5 kg.

4.3.7 Identification

The identification of the animal is necessary for many reasons. The identification sign tells the owner and his tribe. It also helps in the prevention of pilferage. Jath is bound to show the piece of the hide with its identification to the owner, if the animal dies. The identification sign is applied below the ear, cheek and sometimes on the thigh. Each herder has his own sign of identification. Hot red iron is used for this purpose; mostly the first capital English word of the herder's name is used. Branding of the new comers in the herd is done in the month of October, before the animals move to the low lands.
4.3.8 Reproduction profile

Calf is selected for bull replacement at the age of 9 month, when the calf is generally weaned. The selection criteria is based on the fine and curly wool, pure white or creamy color, body confirmation, vigor, pedigree record and milk production, hardiness, viability and body development. The breeders like qualities such as Roman nose, strong and wide canon bones & arms, broad chest, prominent eyes and strong neck. They dislike hanging lips, rough body coat, weak legs and short neck. The bull kept for breeding is usually farm produced, because they know the pedigree background well. The breeders memorize the pedigree record and there is no formal register for this purpose. The breeders much emphasized on the selection of bull in their breeding program. The breeders are well aware about the importance of the bull.

A bull is not allowed in the herd longer than 5 years, to stop to mate with his own offspring. Very few herders use the bull for more than 10 years. Sometimes, the herders introduce bull from other herds to harvest the high worth blood. At the age of 4 years, male become ready to mate. The bull used for breeding is never used for draught purpose, because of the fear that burden would affect the vigor and libido for breeding. However, the bull is trained for work and the nose ring is applied at the age of 3 years, for its future value as draught animal. The healthy fully grown bull when retired from breeding purpose is then sold in the camel Fair, which is used for heavy draught duty in mountainous areas. More emphasis is given to the bull selection; however, all heifers produced are kept in the herd except the deformed and abnormal which cannot move with the herd. Moreover, if choice is given to the herders, they will select heifer with the same characteristics as in the bull selection. Culling level among the female calves is very low. Only the very old, sick and non fertile animals are culled.

Male reach to the age of puberty at 4 year and introduce in the herd for breeding at the same age, while female at the age of 3 years and the M: F ratio is 1:50. The breeding season in Kohlu District starts in the last week of December and ends in mid April. The fertility is generally low in start of the breeding period because of the low rutting intensity of the bull. With advancement of the breeding season rutting intensity and fertility rate increases simultaneously. The herders believe that the fertility is governed by
two factors, intensity of the rutting and the level of humidity, therefore, fertility is high in the rainy and humid season. Calving interval was 2 years but in green years she may produce two calves in three years.

Our findings of the survey resulted that the newly introduced bull need assistance in mating, but no more help was needed in the following seasons. Male camel plays important role in camel breeding due to its rutting behavior. The rutting is directly correlated to temperature, and remains at peak in the coolest period of the year. The bull remained inactive in the summer season (non-rutting), when the temperature is high. The female usually show lesser breeding behavior compared to male. The camel is considered to be seasonal polyestrous, in mature female the ovarian activity is in association with the breeding cycle (Wilson, 1984 and Skidmore, 2000). It is interesting fact that the pastoral people of the Marri tribe practice forced mating, whenever a rutting bull is available, the same exercise is common in some camel tribes of East Africa (Schwartz and Dioli, 1992). The herders believe that by this practice either the female will conceive or will come in heat naturally after one week. The author observed mating of a camel cow again just after 2 days of parturition (Fig. 4.3). This practice depends upon the richness of the year, health status and age of the camel. The similar finding have been reported from the other parts of the world especially Middle East (Yagil, 2006).

The average conception rate on the overall herd basis was 50-53%, and the calving rate on the overall herd basis was 45-50%. Dry period was 3 month and service period was almost 4 months. Abortion and reproductive disorders were rarely reported. Gestation period ranged from 375-386 days. Approximate birth weight was 32-35 kg and there was no noticeable difference between the weight of male and female. Weaning weight (36 week) was almost 160-185 kg & 155-180 kg and adult live body weight was 550 & 485 for male and female respectively. The height at wither at adult age for male and female was 2 m and 1.7 m respectively. The calving interval reported was 2 years. One cow camel produce up to 12 calves in her whole life span. The stud life reaches up to 30 years. Detailed reproductive traits of the camel are given in Table 4.1. The cow could produce more calves but she looses her eyesight in the advanced age and many times falls from the mountains and dies. The blind cow cannot care her calf and cannot fulfill her body requirements by browsing.
The respondents replied that sometimes the case of abnormal calf (mostly alopecia) has been observed, which might be because of some poisonous vegetation or the continuous use of same bull for breeding more than 4 years, which result in inbreeding. There were rare cases of infertility, but sometimes infertility or repeated services were observed. The causes for infertility were believed due to some hidden diseases, poor vegetation and lengthy lactation. The ethnoveterinary practice for the treatment of infertility is Ponni.

**Fig 4.3** Force mating at the third day of parturition while blood is visible on her vulva

### 4.3.9 Marketing

The camel’s herders sell their male animal of any age depending upon their management policy. The main reason for selling camels was family cash need to meet their basic needs. There is a custom of selling larger sized, old and unproductive camels. They sell ready to sale camels in the Mangrota camel fair but some animals are also sold in the
community. At community level, they either exchange or buy and sell camel according to their needs. In many countries especially in Africa and India the main market for camel sale is festivals and fairs (Mehari et al, 2007).

Now a day a new market for the spent animal has been emerged. Since last few years camel's meat demand has been increased among the coal mines workers. The animals are kept for grazing in uplands of Kohlu District i.e. Kohlu tehsil, Chamalang, Thamboo and Paza area since March to the end of the September. At the end of October, the animals selected for sale are sorted and moved to the (Mela) fair of Mangrota. The rest herd is moved towards the lowlands of Suleiman region and the adjoining areas of Sibbi region, where they spend autumn and winter season.

4.3.10 Health aspects and Ethnoveterinary practices

The camel breeding area was far-flung from the modern animal health service. Its remoteness and poor infrastructure nature made it isolated from other parts of the province. In such circumstances it is very difficult to provide veterinary services according to the Western model. The same situation exists in the other parts of the world where the camel is reared in pastoral system (Köhler-Rollefson et al, 2001). Only small number of animals gets benefit from the health service provided by the Government Livestock & Dairy Development Department and other private practitioners. The draught animals while coming to the Kohlu city, if sometimes injured or sick are brought to civil veterinary hospital. Most often the Jaths practice ethnoveterinary care, therefore only the ethnic treatment will be discussed in the following paragraphs. The respondents consider ethnoveterinary care as painless, readily available & easy applicable, cheap and reliable.

The main camel diseases in the area along with their ethnoveterinary treatment are given below.

1. Mange (Gerr): The mange (Gerr) is well known and common camel disease in the area. The weak animals are more prone to this disease. The disease is prevalent in the cold and rainy season, which also affects the fertility of the camel. The area has cool winter and rainy spring which makes the situation friendlier for this disease. The disease is contagious, widespread, causes poor growth & production, affect the draught ability,
and even death of the animal. They believe that the disease is highly contagious and even transfers from other animal even from the rats. During the last drought period (1994-2004) many animals died due to this disease. Common signs of the disease are irritation, itchiness, baldness and ultimately wrinkles and cracks appear, skin becomes thick, grey and muddy. The mange affected animals are usually rejected in the camel markets because of the low credibility for work. The traders knew the mange affected animal very quickly by rubbing the skin of the lower neck and judge the thickness of the skin. Mange most of the time, renders thick skin thus indicating that animal has been pre-disposed to the mange.

_Treatment:_ First step of the treatment of the mange starts with the washing, rubbing and cleaning of the skin with sand and laundry soap. The scabs and dirt is removed and the skin becomes clean and red followed by its treatment. (i) Natural raw mud oil (Kattan) springs from the famous mountain of Chakar Mangi, Kohlu (famous for raw mud oil), thick in nature & blackish in color is used by the Marri tribe camel herders for the treatment of mange. The _Kattan_ is mixed (1:1 ratio) with the _taramira_ oil (Eruca sativa seed oil) and applied at the effected areas. (ii) The wood of Kirar (Capparis aphulla) is burned; the ash is mixed with _taramira_ oil followed by its application the affected area. The mixture is applied again and again till the affected area becomes dry. When the skin becomes soft and smooth then the treatment is discontinued usually when the animal is recovered almost within 1 month.

2. _Trynosomiases_ (Sokerr): It is a common and important disease in the area, locally called as _Sokker_ (emaciation). Loss of appetite, progressive emaciation, hump disappearance, distinct urine smell, watery & pale eyes, intermittent fever, dullness, depression, rough body coat and sitting facing the sun shine to warm are the main symptoms. The disease is economically important and affects the animal health and production adversely. The disease out brook is after the rainy season, when there are plenty of flies. The pastorals are well familiar about this disease and believe that the fly is the carrier of this ailment.

_Treatment:_ (i) Bitter flavored plant _Tharkha_ (Artimisia maritima) is recommended for the treatment of the disease. The plant is crushed, boiled, kept in basin overnight and
administrated orally early in the morning. Three to four times treatment is believed to be affective. (ii) The meat of the sheep is boiled and well thrived and the solution is orally administrated. As the animal goes off feed and emaciated, supportive therapy is necessary to keep the animal vigorous to fight with disease. In severe cases, sheep blood is also administrated orally. (iii) The animal is branded at the base of the ear by hot red iron during this disease. The herders believe that animal recover from this disease but they couldn’t tell the philosophy behind that.

3. Pox (Groopak): It is a contagious disease mostly affects the calves. Its outbreak is mostly in late winter when there is wet season. The disease exposed the animal to other diseases like Trypnosomiasis and Orf. The mortality is very rare, only continuous off feeding and secondary infection could cause the death. The animal becomes dull and depress in the beginning of the disease, get fever and lesions appear on the hairless parts of the skin. The animal goes off feed, unable to eat due to lesion in mouth and lips. The disease could be differentiated from the Orf, because the Orf’s lesions only appear on the mouth, nose and eyes. The disease occurs once in life and will never repeat again and the phenomenon is indigenously called as pokh.

**Treatment:** No specific treatment is there but some supportive therapy is practiced. (i) Hen/cockerel is boiled, thrived well and fed to animal. (ii) Head of sheep, goat or cattle is boiled, thrived and offered to camel. (iii) Flour of Sorghum is boiled, spices and chilies are added (sorghum soup) and offered. (iv) The rumen and reticulum of small ruminant is boiled and thrives well and offered to animal. The above treatments continue until the animal recover from the ailment.

4 Lymph node swelling (Barri): The disease is also called as sehsal (three year age disease) and the pastoral people believe that the disease compulsory once occurs in the life and most commonly at the age of three year. They consider that the disease is well for the future health of animals, because the discharge drains the hidden disease factors with the fluid. The herders, therefore, offer the (hot food), to keep the wound pustules. When the pus is discharged then animal becomes recover.

Common symptoms are the swelling of nodes especially in the bottom of the neck region, around the jaw and above the hock. Fever, dry & hard feces, off feeding and emaciation
are also reported as important signs. Gradually the abscess increases in size and ultimately reaches to the size of an apple. The large sized abscess burst itself, but some times it is punctured by injecting a large sized needle. Small sized abscesses evaporate itself, but take more time than postulated abscess. If the abscess could not grow well it would affect inside the body and the disease will go in hidden form which will adversely affect the animals’ health. A yellowish viscous fluid discharges when bursts and become postulated for some days, in this period fly repulsion is the important part of the disease management. The disease is pokh in nature and occurs once in life.

**Treatment:** (i) Provision of the *hot food* is considered as the integral part of the treatment. The pulses or cockerel soup is offered to support animal health by additional energy and protein. Such nutrients are believed to increase the size of the small abscess and ease in the rupturing of the mature one. (ii) Inject the spine of the *Acacia modesta* or needle to rupture the abscess if it delays in rupturing. (iii) Fly and maggots’ repellant powder like DDT, trichlorofon etc are applied on the postulated wound.

**5 Orf (Duph Pagh):** This disease is also pokh in nature and occurs once in the life. Orf occurs before the permanent teeth appear. The disease is contagious coupled with fever and depression. Nodules develop on the lips and changes in blisters. In advanced stages blisters are formed inside the mouth and nose. Swelling of face and head is the third and the advanced stage of this disease. If not treated properly, the animal becomes blind & unable to eat.

**Treatment:** (i) Water is boiled and the warm water is poured on the head of the affected animal to minimize the swelling. (ii) Prevent the diseased animal to drink more water. (iii) Hot branding on the whole head. This treatment is not accepted as affective remedy of the disease. (iv) DDT powder or Trichlorofon is added in kerosene oil and applied on external wounds as fly repellent and maggots’ cidal.

**6 Pneumonia (Kalokh):** The disease is not common in Marri tribe area. It is characterized by nasal discharge, coughing and difficult breathing. Sometimes the nose is obstructed due to the thick nasal fluid and the animal breath through mouth.
Treatment: (i) Keeping the animal in warm place or cover with cloths. (ii) Provision of hot food to empower the body to cope with the disease condition. The disease is considered as cool in nature; therefore, hot food was the best remedy. (iii) Black tea and spices are mixed, boiled well, and offered to the animal. Black tea and spices mixture is also considered as hot food for keeping the animal warm. (iv) A stick is inserted in the nose to open it when there is difficulty of breathing. (v) Tobacco powder or spices are inhaled by the animal to activate nasal reflex for sneezing. (vi) Hot branding on the both sides of the rib cage by hot stone.

7 Heamorrhagic disease or heamoturia (Rindek): The disease is not common in the area and only occurs in mature females. Urine becomes blood stained, resulted in weakness and emaciation of the animal. The herders could not explain the disease well.

Treatment: (i) The bones are burnt and the ash is collected and offered to the affected animal. (ii) Hot branding by red hot iron or hot stone at both flanks.

8 Urine obstructions (Misband): The disease is mainly noticed in male draught animal. The causes of the disease are heavy work load, long traveling, dirty water and poisonous leaves of wild olive (Olea officinalus).

Treatment: (i) Black tea is boiled well and offered to the animal. (ii) Wheat straw is boiled and the extracted solution is offered to the affected animal. (iii) Keeps the camel in sitting posture in deep water for almost one hour, leaving head out.

Conclusion

The camel breeders are under pressure in many parts of the world, Marri tribe at Kohlu District of Balochistan, Pakistan is not except to this. Alarming growing human population need more food, therefore, more land is being brought under cultivation. In areas having electricity, the agricultural activities creep very progressively. The extra burden of over population of livestock resulted in over grazing also accelerated the process of deforestation. The energy sources are limited, and the firewood is the only source for the cooking, heating home in the winter and the Government has no control on
the ranges because their administrative control is under the tribes. The drought since last
decade has also seriously effected the rangelands and livestock productivity. The
immunity of the animals against different diseases decreased due to the poor feeding,
more than 15% of the camel of the area was affected badly due to poor vegetation and the
severe mange. No proper facilities have been provided to the camel owners for
marketing. Illegal export of camel is common, in which the income goes in the pockets of
the smugglers and the real farmers are ignored. The herders are always on move;
therefore, they couldn’t avail the basic life facilities. They don’t have access to health
facilities including their livestock. Their kids are always deprived of modern educational
facilities, what to speak about the animals. Ethnoveterinary practices are very common
due to the lack of modern veterinary facilities.

In Kohlu District of Suleiman mountainous region, Mari tribe is facing a lot of riddles in
camel production and protection. Their problems of deforestation, expanding agriculture,
decreasing rangelands, lack of infrastructure and marketing facilities, illegal export of
camels and lack of modern veterinary facilities need to be addressed by the Livestock and
Dairy Development Department and other policy makers. To save this financial loss to
the public, as well as to the economy of Suleiman region, some drastic measures are
warranted, so that this area can play a leading role in the camel preservation, enhanced
milk production and even value addition to access the market of the area in particular and
the country at large. This area can further act as a hub of camel production activities
involving the Marri tribe who are the custodian of this unique animal genetic resource.
Appendixes

Appendix Table 4.1. Ethnic terminology use for production system

- **Bharri** is a bundle of wheat shoot along with kernel and weighing about 5 kg.

- **Boli (Bohli)** is the term used for the cooked colostrums used for human consumption.

- **Dozz** is an indigenous practice in which the vagina and anus are brought between the two stick and tightly closed by the rope to prevent excretion and apply pain. The technique is used for the acceptance of the rejected calf.

- **Gorri** is term used for the amount of wool. It is a bundle of wool of camel weighing almost 600 g.

- **Hot food** is a composite of those nutrients which keeps the body active, energetic and enhance the activities inside the body. The herder’s indigenous veterinary knowledge is mainly based on the hot and cold philosophy of food. The hot food (hot soup) comprises of cockerel meat, egg, pulses, cereals, chilies and black pepper. The above ingredients are boiled well in water and a viscous solution is produced. This soup is used for orf, pox and nodes swelling diseases.

- Black tea and spices are mixed and boil well and offer to the animal. Black tea and spices mixture is also a hot food which keeps the animal warm. This solution is mainly used in respiratory problems.

- **Jaths** are the lower community people of the Marri tribe who are involved especially to care the camel herds of the Marri herders.

- **Jhok** is a place where the Jaths in the transhumant system gather at a place in group. All the breeders live like family away from their families. They take their food and exchange social chat and take rest there at night and the camel herds stay around.

- **Jorra** is a local unit for land measurement. One jora is equal to 4 hectare.
- **Kak** is the Jaths' bread. Round and strong stone is heated and floor dough is overlapped on it and kept around the burning coal and after some time the kak is ready for use.

- **Kasa** is equal to 6 Patth and a path is weighed as 2 kg.

- **Loomer** is the term used for the male kid of small ruminant given to the Jath each year on each herd. The Loomer is optional but the herdsmen give it regularly to the Jath.

- **Pokh** is used for the disease which occurs once in whole life.

- **Ponni** is an ethnic practice used for the treatment of infertility by injuring and hemorrhaging the clitoris by sharp blade and then salt is applied on the hemorrhagic place.

- **Sadqa (Khairath)** is a term, used for the sacrifice of camel in the name of Allah. The meat is then freely offered to the community.

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**Appendix Table 4.2** The preferred plants reported from the different camel habitat

<table>
<thead>
<tr>
<th>Local name</th>
<th>Botanical name</th>
<th>Local name</th>
<th>Botanical name</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Trees</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Uzhgai</td>
<td><em>Oleao officinalus</em></td>
<td>Karkana</td>
<td><em>Ziz. nummolaria</em></td>
</tr>
<tr>
<td>Showan, Shanani</td>
<td><em>Oleao ferrugina</em></td>
<td>Ber</td>
<td><em>Ziz. mauritiana</em></td>
</tr>
<tr>
<td>Wanna</td>
<td><em>Pistacia cabulica</em></td>
<td>Helani</td>
<td><em>Ziz. sativa</em></td>
</tr>
<tr>
<td>Sherwan</td>
<td><em>Pistacia khinjuk</em></td>
<td>Zarga</td>
<td><em>Prunus eburnean</em></td>
</tr>
<tr>
<td>Ghaz, Tamand</td>
<td><em>Tamarix indica</em></td>
<td>Sur Ghaz</td>
<td><em>Tamarax aphylla</em></td>
</tr>
<tr>
<td>Khler, karar</td>
<td><em>Capparis aphylla</em></td>
<td>Pah, Palosa</td>
<td><em>Acacia modesta</em></td>
</tr>
<tr>
<td>Local Name</td>
<td>Botanical name</td>
<td>Local Name</td>
<td>Botanical name</td>
</tr>
<tr>
<td>------------------</td>
<td>----------------------</td>
<td>------------------</td>
<td>----------------------</td>
</tr>
<tr>
<td>Bushes/shrubs</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Barar</td>
<td><em>Periploca aphylla</em></td>
<td>Pesh</td>
<td><em>Nannorhops ritchieana</em></td>
</tr>
<tr>
<td>Mākhæ</td>
<td><em>Caragana ambiguа</em></td>
<td>Ghelmi, Thrath</td>
<td><em>Haloxylon recurvum</em></td>
</tr>
<tr>
<td>Tindan</td>
<td><em>Alhagi camelorum</em></td>
<td>Khar, Zumai, Lani</td>
<td><em>Suæda fruticosa</em></td>
</tr>
<tr>
<td>Shinbutæ, shoræ,</td>
<td><em>Haloxylon grifithii</em></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Grasses</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Barau</td>
<td><em>Sorghum halepense</em></td>
<td>Sargarae, shang</td>
<td><em>Fraxinus xanthoxyloides</em></td>
</tr>
<tr>
<td>Raghbolæ, sāba</td>
<td><em>Stipa capillata</em></td>
<td>Murgha, khabbal</td>
<td><em>Cynodon dactylon</em></td>
</tr>
<tr>
<td>Local Name</td>
<td>Botanical name</td>
<td>Local Name</td>
<td>Botanical name</td>
</tr>
<tr>
<td>Rejected plants</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Urgalama</td>
<td><em>Rhazya stricta</em></td>
<td>Leghunae</td>
<td><em>Daphne oleoides</em></td>
</tr>
<tr>
<td>Spalmai</td>
<td><em>Calotropis gigantea</em></td>
<td>Ghozera</td>
<td><em>Sophora grifithii</em></td>
</tr>
<tr>
<td>Khamazurga</td>
<td><em>Withania coagulans</em></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Poisonous plant</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Orgalama</td>
<td><em>Rhazya stricta</em></td>
<td>Genderi, kaneer</td>
<td><em>Nierum odorum</em></td>
</tr>
<tr>
<td>Uzhgai</td>
<td><em>Oleo officinalus</em></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

*only the dry leaves of the *O. officinalus* are considered as poisonous.*

References


CHAPTER V

Paper II

MANGROTA CAMEL FAIR:-
THE LARGEST MARKETING ACTIVITY OF
NORTHEASTERN BALOCHISTAN

Abstract

Camel is the major player and the food and livelihood earning source in the existence of pastoral people of Suleiman mountainous region. Mangrota camel fair (Mela) is one of the largest socioeconomic activities of camel herders of the said region, which is held every year in the month of October, in Mangrota town. Mangrota is a town of tehsil Thonsa, District Dera Ghazi Khan in the Punjab province of Pakistan. The pastoral people graze, mange and care well of their camels round the year and in the season of fall, they bring their camel down the mountains, get together in Mangrota where they sell their camel and earn year’s round utilities. The objective of this study was to know the mechanism of camel trade and business and social importance in the lives of herders. A simple methodology was adopted for the assessment of the Mela configuration. The animals present were counted at third day of Mela by simple counting procedure. The daily sale data of animals were achieved from the contractor record and tabulated. The importance, history and the mechanism of camel trade in Mela was assessed by group conversation and personal interviews. It was found that the camels are brought mainly by the people of Suleiman mountainous region, bought mostly by the people of NWFP (North West Frontier Province) and Western and Central Balochistan. The herders avail a good opportunity for the sale of their animals on one hand and exchange their expertise, vision and social chit chat on the other hand. Some ethnoveterinarian also participated, where they treat the sick and diseased animals and educate the camel herders about the important camel health tribulations.

Key words: Camel, Balochistan, pastoral people, Mela, socioeconomic and marketing
5.1 Introduction

In many parts of the world, camel marketing is mainly done in the annual camel fairs. The camel fair of Pushkar in Indian Western state of Rajasthan is very famous for this purpose. The Pushkar fair held in the month of November every year and the pastoral people sell their annual male young stock (Rollefson, 1995). Such traditional camel fairs are also held in many parts of Africa. The traditional markets are used for the sale of beef and pack camels. The traditional local markets supply camels to those pastoral and mixed farming communities who need burden camels, but do not themselves breed camels (Mehari et al, 2007).

In Pakistan annual camel fairs are held every year in different parts of the country, which are the major camel marketing events, but some other markets like biannual, monthly and weekly markets (Mandi) are also held. These fairs are the major sources of providing camel for draught, slaughter, milk and breeding. The famous annual camel fairs in Pakistan are Mangrota, Anayath shah, Karorr, Jalsa, Sakhi Sarwar, Sibbi, Shahjamal, Thandla, Rosthum and Lakki. Out of which, Mangrota fair is very famous for the marketing of draught animals and breeding bulls. The Mela held before the onset of the camel breeding season in the Suleiman region. The breeders either exchange their used breeding bull to avoid in breeding or buy new energetic bull with the known and acceptable traits. The majority of the camel of the Suleiman mountainous region is sold in the Mangrota camel fair and very rare animals goes in the other fairs like Jalsa and Sakhi Sarwar.

The Mangrota camel Mela held every year in the month of October when the weather is pleasant and friendly. The Mela is the largest socioeconomic event of the year for the pastorals and traders of the Region. They get together here and along with the business they exchange their views about camel related issues. Some ethnoveterinarian also participate in the Mela where they treat the sick animals and educate the camel herdsmen about the important camel health tribulations. Mela is also a source of recreation for the herdsmen. They get pleasure from the theater show, horse racing and circus, which otherwise impossible in the Mountains. Some herdsmen and Jaths (camel Herders) meet even their relatives here in the Mela. The camels brought are predominantly white in
color and are known as Kohi camel. These camels are mostly brought from the Suleiman Mountains and the adjoining areas. Mostly mature well developed males of age 4 and above are brought, but some lactating camels, juvenile, old and spent animals also brought. The draught animals are acquired mainly by the people of the high mountains of North West frontier province.

Camel plays a pivotal role in the socioeconomic life of the pastoral people in Balochistan especially the northeastern part (Jasra and Aujla, 1998). In spite of their invaluable importance, little is known about the marketing of the camels and their products, which is considered as corner stone in understanding the pastoral subsistence economy in the northeastern Balochistan. This study was, therefore, initiated to bridge the information gap on camel sub sector in reference to Suleiman mountainous region.

5.2 Materials and Methods

5.2.1 Location

Mangrota is a town of Tehsil Taunsa, Dera Ghazi Khan (DG Khan) District of the Punjab province, Pakistan. It is situated at the end of the piedmont of Suleiman Mountain eastward.

5.2.2 History

According to some elders (Lashari, 2006), this fair was previously called as Dosehra, which was being held regularly at 16-23 October of each year. The Mela was purely a religious event of Hindu community before partition. Those times the camel was being used for bringing the Hindu families to the Mela place mainly on camel back, donkeys and horses. A lot of camel, donkeys and horses were being gathered at one place and the Mela gradually got importance as camel and other draught animal’s bazaar. After partition the religious importance was diminished but the marketing importance still exists. With the passage of time, the fair got more importance and the Mela had been declared as Camel Mela officially.
This paper is based on two years data (2006, 2007). The animal present in the Mela were counted by simple counting practice. The animals were kept in 5 plots and it was easy to count them. Each plot was counted and recounted by my co-workers for confirmation. The difference of 30-40 animals was observed between different counting. The counting was performed at third day of Mela when the camel figure was at crest. The daily sale data of animals were achieved from the contractor at the end of each day. The importance, history and the mechanism of the Mela was assessed by group discussion, interviews and personal observations. All type of the beneficiaries of the Mela i.e. breeders, traders, brokers and the contractor were interviewed personally and in group discussions.

5.3 Results and Discussion

5.3.1 Number and type of animals

Mela is for camel but horses and donkeys are also brought. An increasing trend in the number of donkeys and horses has been observed. Camel comes here range from 8,000 to 10,000 every year. In year 2006 the Mela was small compared to previous years, because of the trouble in Marri and Bugti hills of Suleiman Range (Buzdar, 2006). In the year 2007, the camel number was higher than 2006 but the traders were lesser, because of the uncertainty in Northern tribal area, where majority of the camel goes.

5.3.2 Camel in the Mela

According to (Lashari, 2006), 90% of the camel comes here from the Suleiman mountainous region of Balochistan and the adjoining part of Punjab province. Kohlu, Barkhan and Musakhel districts are the major suppliers of camel from Balochistan, while the D.G. Khan District (Fazla Kach, Baharathi, Hingloon Kach, Mubarki and Dalan villages) of Punjab is the minor suppliers.

According to our study findings the following number and type of animals were participating in the Mela, presented in the (Table 5.1) and presented in graphic form in the Fig. 5.1.
Table 5.1 Number of Animals Participated

<table>
<thead>
<tr>
<th>Animal</th>
<th>2006</th>
<th>2007</th>
<th>Total</th>
<th>% Participation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Camel</td>
<td>6700</td>
<td>10330</td>
<td>17030</td>
<td>91.35</td>
</tr>
<tr>
<td>Donkeys</td>
<td>480</td>
<td>724</td>
<td>1204</td>
<td>6.46</td>
</tr>
<tr>
<td>Horses</td>
<td>130</td>
<td>272</td>
<td>402</td>
<td>2.16</td>
</tr>
<tr>
<td>Mule</td>
<td>2</td>
<td>4</td>
<td>6</td>
<td>0.03</td>
</tr>
</tbody>
</table>

According to Lashari, 2006, and Master (2007), 6 types of camel mainly brought and marketed in the local Mela, like

1 Damani: This type of camel is found in the Daman (Foot hills) of southwestern Punjab and is mainly used for the draught purpose in their home tract. This animal is use for ploughing and other agricultural purposes.

2 Kohi: According to our assessment almost 90% of the camels come in the mela were Kohi. Kohi camel is mainly brought from the Suleiman mountainous region. The Kohi camel is also called as Suleimani, Kachi, Ghulamani and Khandar in different areas by different people. But the most appropriate and suited name is Kohi (mountainous). The people of the area and the pastorals know this camel as Kohi (Raziq and Younas, 2006). Most of these camels are white in color and are known as Kohi (mountainous).

3. Lal Gadd: Found in Rajanpur, Kashmore and adjoining areas of southeastern piedmonts of Suleiman region in Punjab. The animal is heavier than Kohi. Lal Gadd is red in color with a big head and strong legs.

4. Pahwal, Pawinda, Girdie or Gaddie: Such camel is also called as Kochi camel. The animal has very compact body, much resistant to drought and can thrive well on poor roughages. They hardly refuse any thing to feed. They can travel long but having light draught ability compare to heavy breeds. Very few animals of this type were available in the Mela.
5. **Riasati (Bahawalpuri, Cholistan):** The camels are also called as Mahri, Mareech, and Utti. These camels are very famous for their rabbit like ears, long neck, smart bodies and thinner bones. These camels are better performing in desert and are used for racing and riding. Marecha camel is also famous for high milk production.

6. **Sindhi:** Camel of the canal irrigated area of Sindh and Punjab (Indus Delta), mostly use for draught purpose in the urban areas for pulling carts in Sind and Punjab. Sindhi camel is well praised for their body growth rate and beef production. The spent animals of this breed are purchased by the butchers, especially from Balochistan.

7. **Non-descript camels:** There were many non-descript animals. Some small camel breeders have no long term policy. They just breed the camel according to short term policy. Such policies mainly depend upon the availability of the bull, color, and draught ability.

The detailed out composition of camel breeds and their population is given in the Table 5.2 and presented in the graphical form in Fig. 5.2.
Table. 5.2. Composition of camel types (2006, 2007)

<table>
<thead>
<tr>
<th>No</th>
<th>Breed</th>
<th>Number</th>
<th>% in Population</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Damani</td>
<td>510</td>
<td>2.73</td>
</tr>
<tr>
<td>2</td>
<td>Kohi</td>
<td>16964</td>
<td>91.00</td>
</tr>
<tr>
<td>3</td>
<td>Lal Gadd</td>
<td>395</td>
<td>2.11</td>
</tr>
<tr>
<td>4</td>
<td>Pahwali</td>
<td>11</td>
<td>0.05</td>
</tr>
<tr>
<td>5</td>
<td>Riasathi</td>
<td>24</td>
<td>0.12</td>
</tr>
<tr>
<td>6</td>
<td>Sindhi</td>
<td>138</td>
<td>0.74</td>
</tr>
<tr>
<td>7</td>
<td>Non-descript</td>
<td>606</td>
<td>3.25</td>
</tr>
</tbody>
</table>

5.3.3 Donkeys in the Mela

Heavy draught breed of donkey (Shinghari) were brought in majority. Shinghari are found and bred in the high mountainous area of Suleiman especially in the Kibzai area of Zhob and Kohaie area of Musakhel District.

Non-descript animals were also brought. The light breed of donkeys (*Pundi*) were mostly bringing from the Daman area. *Pundi* animals were also not uncommon in the Mela.

5.3.4 Horses in the Mela

Small number of horses participates in the Mela compare to the camel, because, the Mela is predominantly for camel. Horse plays recreational role and some hobbyist buy and sell the animals. The horses are mainly from the Balochi breed which is the best in the region.

5.3.5 Business and Marketing System

1. Contract of the Mela: The contract is auctioned by D.G. Khan Municipal Corporation each year for all district’s animal markets. There is no separate contract for the Mangrota camel Mela. A sum of rupees of Rs 250,000, 00/year in 2006 was paid by the contractor to the Municipal authorities of the D.G Khan District, but this year (2007) it was 200,000, 00. Both the year the contractor was same. Only Rs. 30,000/year was paid to the owner of the land where the Mela held. There is no entrance fee or purchee fee for the
animal owners. The stalls inside the compound of the Mela are allowed free to ease the camel Pastoral people (Abbas, 2006).

![Graph showing the breed of camels with percent share]

**Fig. 5.2** Presence of Kohi camel in the fair

Contractor of the Mela charges 5% of the cost of camel, which is paid by both the supplier and buyer or only one party pay the whole tax depending on the bargain. If someone found selling or buying animal without paying the tax, will be punished eleven time of the actual tax.

2. **Broker Charges:** Broker charges of Rs. 400/ on each bargain (200 from each party) on camel while Rs. 200 on donkey, mule and horse with the same manner. One broker can make up to 25 bargains in a day. The Mela continues for 6 to 8 days and there are almost 35 to 40 active brokers in the Mela. The brokers do not pay any tax to the contractor (Bux, 2006, 2007)
Table 5.3 Average Prices of animal from the contractor record

<table>
<thead>
<tr>
<th></th>
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<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>4&lt;yr♂</td>
<td>50,000</td>
<td>48,500</td>
<td>13,000</td>
<td>13,850</td>
<td>44,000</td>
<td>49,000</td>
</tr>
<tr>
<td>2</td>
<td>4&lt;yr♀</td>
<td>40,000</td>
<td>39,000</td>
<td>9,000</td>
<td>8,000</td>
<td>47,000</td>
<td>55,000</td>
</tr>
<tr>
<td>3</td>
<td>2yr♂</td>
<td>25,000</td>
<td>25,700</td>
<td>N/A</td>
<td>6,550</td>
<td>N/A</td>
<td>16,700</td>
</tr>
<tr>
<td>4</td>
<td>2yr♀</td>
<td>22,000</td>
<td>23,000</td>
<td>N/A</td>
<td>5,600</td>
<td>N/A</td>
<td>19,000</td>
</tr>
<tr>
<td>5</td>
<td>1yr♂</td>
<td>20,000</td>
<td>21,000</td>
<td>N/A</td>
<td>4,000</td>
<td>N/A</td>
<td>13,000</td>
</tr>
<tr>
<td>6</td>
<td>1yr♀</td>
<td>18,000</td>
<td>19,000</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
<td>9,000</td>
</tr>
</tbody>
</table>

3. Camel Prices: Camel prices are fixed according to the type/ breed, size, age, health status, and the demand of camel buyer. The highest price was caught by heavy Sindhi (riverine) camels, purchased by the traders of Punjab for pulling camel cart in the Faisalabad, Lahore, Multan and other Metropolitan and industrialized cities. According to the contractor’s record, average rate for fully mature draught camel (2006, 07) was Rs 49,000/ rupees, while Rs 53,000/ in 2005. The average prices was lesser in 2006, 07 than the previous year (2005). There are many reasons for the lower prices, which have been discussed already. According to (Buzdar, 2006, 2007) the rate per camel was decreased Rs 4,000-6,000/mature animal in the years 2006, 2007. The detailed age wise prices are presented in Table 5.3 and presented in the graphical form in the Fig. 5.3.

4. Donkey prices: The demand for donkeys especially Shingharri increased with the passage of time because of donkeys demand in metropolis of Punjab where the donkey cart can easily travel in the narrow streets to provide cheap and easy transportation to looming industry. The light breed (Pundi) is mainly used for light draught work and water transportation. The donkeys are also bought by the people of Darya Khan, Jandola, Laki, Pizo and D.I. Khan of NWFP, and Layya, Bhakkar,and Karor area of Punjab province for different draught purposes.
The average prices for the mature Shinghari donkeys were Rs.13,425, ranging from 8,000 to 32,000. One Shinghari hinny was sold at Rs 32,000, which was the highest rate in Mela.

Increasing trend in donkeys’ rates @ Rs 25,00-4,000/ per animal was observed. The reason for the increasing donkeys’ rate was the growing demand (Bux, 2006, 07).

Fig. 5.3 Prices of the camel in 2007, 2008

5. **Horse prices**: The average rates for the horses were 46,500, depending upon the health status and the racing ability of the horse. Horse prices are very variable and untrustworthy. The horse’s rate depends on the willingness and desire of the purchaser. Horse has no constant market because of the introduction of the motorcycle which is mainly used by the mountainous people. Horse is now only the source of recreation and hobby. Only the hobbyist purchases the horses. The famous horse breed (Balochi) is found in the Suleiman mountainous area.

6. **Daily sale of the animals**: The daily sale is governed by many factors, like the presence of the traders in the Mela, demand of the consumers, availability of animals and weather etc. The Mela persists for 7-8 days and the sale reached to peak at the third day of the Mela. Three types of draught animals i.e. camels, donkeys and horses were there but
mainly camels were sold because of the largest number of the specie in the Fair as presented in the (Table 5.4). Density of the animal participated in the fair is presented in the Fig. 5.4.

**Table. 5.4** Daily sale of animals 2006, 07

<table>
<thead>
<tr>
<th>Days</th>
<th>Donkeys</th>
<th>Camels</th>
<th>Horses</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>23</td>
<td>51</td>
<td>70</td>
</tr>
<tr>
<td>2</td>
<td>63</td>
<td>72</td>
<td>500</td>
</tr>
<tr>
<td>3</td>
<td>105</td>
<td>115</td>
<td>1200</td>
</tr>
<tr>
<td>4</td>
<td>92</td>
<td>106</td>
<td>1050</td>
</tr>
<tr>
<td>5</td>
<td>77</td>
<td>101</td>
<td>1090</td>
</tr>
<tr>
<td>6</td>
<td>47</td>
<td>68</td>
<td>980</td>
</tr>
<tr>
<td>7</td>
<td>33</td>
<td>55</td>
<td>77</td>
</tr>
<tr>
<td>Total</td>
<td>440</td>
<td>568</td>
<td>4967</td>
</tr>
</tbody>
</table>

**Fig. 5.4** Density of animals in the different days of fair
7. **Buyers of the Camel**: The traders arrive from various parts of the country, mainly from the Northern tribal areas. Majority of the traders in Mela were interesting in the draught animals especially camel. The draught camels are bought for the loading purpose in the mountainous area; therefore the camels adapted to the mountainous habitat (Kohi) are well praised. Some of the main areas of traders are given below.

**Former State of Sawat**: The Former state of Sawat comprises the highlands (Sawat, Dir and Malakand) of NWFP province. The area has dense forests and poor infrastructure especially in the high mountains. The woody vegetation is abundantly available here for camel feeding. Mainly the Kohi breed of camel is brought here, but sometimes Gaddai animal is also bought. Kohi camel is well suited and performs well here in the uplands. (Bux, 2006, 2007). These people pay reasonable amount of money to buy healthy, vigorous and hardy animal up to 5-8 years old for heavy duty. They use these camels not more than 4 years. They bring it again after harvesting their teen age and sell it to the hand of traders of Southern Balochistan. But some people sell it to the hand of the local butchers in their own area. They use the camel in the high mountains for downloading potatoes, onions, fruits, and timber woods, sick and old people from the tops of the mountains. They download crop produced, from the terrace croplands to the roadsides and nearby towns. They cross their goods at the river of Sawat by these camels in Batkhela area. They load two bags of potato or onion while downloading and two bags of flour while upcoming to their homes. They almost put 100 to 160 kg depending on many factors like age and stage of animal, bulkiness of the commodity and height of the mountain. The people here would not earn money in cash but the camel play role in the value addition to their crop produced and timer woods.

**Waziristan and other tribal areas**: The topography of the tribal area is mountainous. These mountains make the boundary line between Pakistan and Afghanistan. The people live in the high and Rug Mountains with poor infrastructure. Here reasonable woody vegetation is available for camel feeding. The Beopari or traders come from the area of Jandola, Wana, Mir Ali, Angoor Adda, Darra Adem Khel, Momend Agency and other parts of the tribal areas. They mostly purchase the mature up to 4-8 years old healthy and heavy male
camels for heavy duty in the Rug Mountains. They do care their camels well; bring these camels again in the Mela for sale when they become older and no more able for heavy and hard duty.

They transport fuel wood and the Mazari (Nannorhops Ritchieana) leaves on camel back from the mountains to the nearby towns of Wana, Mir Ali and Angoor Adda in Waziristan. The leaves Mazari are used for making mats, ropes and other household items. The camel is also used for daily household transportation and for on farm duties. The nearby towns are the main markets for fuel wood, therefore, they earn reasonable amount by selling wood. The wood cutter praised the loading ability and the adaptability of the Kohi camel for that area. They load 120 to 160 kg on a camel’s back in the mountainous region and 240 to 280 kg in the plain area. Average daily cash earning from a camel is Rs. 400 to 600. But this earning depends upon the weight of the load, type of the commodity and the ownership of the fuel wood producing area.

The trade on Durand line (Pak-Afghan border) is largely done on the camel’s back. The goods are transport on the border both legally and illegally. Some people buy camel for milk production. They knew well the camel's milk as high worth, health friendly and precious commodity; therefore there is an increasing trend for camel milk in the area. They carry their camel on walk from Mangrota to Waziristan. (Gul et al, 2006).

**Southern and central settled areas of NWFP:** The Southern part of NWFP comprises high mountains, foot hills and plain lands. The area include Sherani mountains (Takht-e - Suleiman), D.I.Khan, Tank, Laki Marwat and Karak. The central area comprises Rosthum, Mardan and the adjoining area. The area has timber forest of Pinus Geranandiana (Chilghozna Pine) in the high mountains and fuel wood like Acacia, Zizyphus etc in the foot hills. Acacia modesta, Zizyphus and Tamarix is available in the foothills which is the best feed for camels. Camels eat from the ranges and there is no need for special feeding, as for cow etc.

These people here also like the Kohi camel, due to their well adapted nature to mountains. In that area Gaddai camel is also like. The area is one of the main winter destinations of the nomads coming from Afghanistan; therefore, some people buy Gaddai camel from there, locally. The traders from Tank buy cow camel from the Mela and sell it
in their home town again to earn money. According to (Khan, 2006) and his group from Tank, they use camel for downloading fuel wood from the mountains and supply to the near by cities. The prices for the fuel wood in Tank are high; therefore, camel is a good source of earning. They earn almost 300-500 rupees by one camel per day.

Some people of that area also buy camels for milk production for their family use, as the camels are well suited and thrive well in their area comparing to cow. The people of Laki Marwath and adjoining areas like camel milk especially for their medicinal value. They believe that camel milk is the cure and treatment for the long bone pain and backache. According to them they buy cow camel use for milking round the year and slaughter when dry, this phenomenon resulting in the killing of high worth gene. The people of the area much like the camel meat. (Marwath et al, 2006).

A group discussion with the people of Drazantha (Sherani area of D.I.Khan) revealed that, they buy camels for work, like bringing water and food items, and taking farm yard manure from their homes to their small orchard in the mountains. They keep 160 weight on their camels in mountains while 240 kg in the plain areas. Kohi camel is well to walk easily in the Rug Mountains and foot hills of the area. (Usman et al, 2006). Some traders move these camels to their destination on walk while some use trucks for that purpose.

Traders from Quetta, Balochistan: Quetta is a densely populated city and is the capital of Balochistan province. Here the people like the camel meat and the butchers slaughter camel. Some people here use camel for Lanthie purpose. Lanthie is the dry meat made from the small ruminants and large ruminants’ meat. Some traders further push this camel to Iran, where camel meat is much like. The spent but healthy and fattened animals are pushed to Iran and the weak and sick animals are slaughtered in Quetta (Sattar, 2006).

Some traders from Karachi also practice the same exercise. Such animals are very cheap and unable for other use. The animal’s fit for works are very costly and per kg meat produced is very expensive, if used for meat purpose.

Calves Buyers: There are two types of camel calves buyers. The camel herders in the Mela buy the female calves for future cow camel. Some Jaths, herders and camel loaders also buy the male calves. The Jaths rear these male calves in the herd, when it matures; they
bring it in the Mela and sell at reasonable price. The camel loaders and pastorals especially in Suleiman mountainous region buy the young calves use for light draught purposes and bring again in the Mela when fully grown and sell at higher prices. They get two types of benefits from such calves i.e. light work and the value addition to the price of the animal. By selling only one heavy, mature and healthy animal they can buy two animals of medium quality and they move these animals again to their area and repeat this exercise again. This practice is also done by the small farmers of Balochistan province (Bux, 2006, 2007)

Some traders from central Punjab and Karachi, purchase the young calve slaughter them in modern Abattoirs and export the meat to the Gulf States. They earn reasonable money, but pay very less to the producers. The calves and cows are mostly sold by the poor breeders to earn their food.

**Camel Carters:** The heavy breeds of camels like Sindhi, Marrecha and Lal Gadd are purchased by the traders of the central Punjab. Such animals are use for heavy duty in camel carts, use in the metropolis of that area. In pneumatic camel carts the old tires of airplane are used and they can divert the camel cart in the zigzag narrow streets. One can see the larger camel carts while moving in the streets of Faisalabad loaded with the cotton cloth. The camel carters feed well their camel and take heavy duty. They earn reasonable earning up to 700-10, 00 daily.

**Breeding Bull:** Some of the herders only come to the Mela to exchange their used breeding bull. Sometimes they sell their well grown, used breeding bulls at a very high price and buy other one from well know breeders according to their criteria. Some breeders exchange the bulls which already have been used for 4 years. Mela is not only the marketing place but a good source of breed improvement. In Suleiman mountainous area the herders strictly avoid inbreeding. They consider it a sin to mate cow camel with closely mate bulls.

**5.3.6 Feeding pattern in the Mela**

Feed for animals available comprises mainly pulses straw, wheat straw, green sorghum fodder but at higher prices. The wheat straw was priced at Rs. 4/kg and that of pulses
straw and sorghum fodder at Rs.5/kg. The mountainous camel hesitates to eat straws. They prefer rather tress twigs or green fodder.

The rain water is gathered in Thalab (ponds), available for animals. The water is muddy and scarce also. Water availability is not according to the need of the camels. The tap water is available only for the people, but not well fulfilling the requirements.

5.3.7 Camels and herders utilities in Mela Bazaar

The camel saddles, nose rings and ropes were available every where in the Mela. The prices of the saddle were ranging from Rs. 200-300, depending upon the size and quality of the saddle. The price for a nose ring was Rs. 10/piece. The neck bells were also available and the herders were taking interest. The price of the neck bells was different according to the size and the quality and ranging from Rs. 30-200. Halting ropes and saddles were being made by some skilled man at the spot, and selling their in Mela. The price of the rope was ranging from 20-100 rupees depending upon the length, beauty and quality of the rope. The ropes and saddle cushion was made by the hair of goat and saddles were filled by sheep wool. An overview of the prices of herders utilities are presented in the (Table 5.5).

5.3.8 Social activities of the Mela

Many recreational and social activities were available for the camel herders, where they enjoy and relax the round year tiredness behind the camel. The following even were available there

Table. 5.5 Utilities prices in the Mela

<table>
<thead>
<tr>
<th>No</th>
<th>Item</th>
<th>Price(Rs.)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Saddle</td>
<td>200-300</td>
</tr>
<tr>
<td>2</td>
<td>Nose Ring</td>
<td>10</td>
</tr>
<tr>
<td>3</td>
<td>Neck Bell</td>
<td>30-200</td>
</tr>
<tr>
<td>4</td>
<td>Halting Rope</td>
<td>20-200</td>
</tr>
<tr>
<td>5</td>
<td>Pipe for music</td>
<td>60-300</td>
</tr>
</tbody>
</table>
1. Theater: There is theater show every morning with a very cheap ticket. Dramas and dance is offered to the pastorals. Pastorals enjoy the event and crowd of people were observed in the theater.

2. Horse racing: Horse racing is the other source of recreation in the Mela. The horses are being categorized on the basis of health, vigor and race ability. The good horses then gain a reasonable cost.

3. Circus: Circus is also available. Where the motorcycle in well and globe is being run. The famous Hijrra dance of the sub continent is also offered here. Some very special shows are also offered like, calf with 5 feet etc.

4. Folk songs and pipes: The camel grazer (jath) sings songs with the pipe. They gather after the dinner where a group sing song with the pipe (Nar) and the other enjoy.

**Conclusion**

The Mangroata camel fair is the important socioeconomic activity of the camel herders of northeastern Balochistan. Thousands of camels and camel herders and businessmen participate in this fair each year. The herders of the Suleiman mountainous region catch reasonable prices of their camel in this event. The fair is a good place for the gathering of the camel herders annually. Moreover the herders especially, from Balochistan face some hurdles in the fair which must be rectified. The management of the fair was poor and there was no proper control of any authority. The contractor is the only person who halts the pastorals in the way what ever he wants. Fresh and clean water is scarcely available for the people here in fair. The muddy water of the rains was collected in pounds, was available for animals.

Some people said that the fair area is far away from their home tract, therefore it take many days to reach here. No facility of protection from rain or other weather severities has been provided. Sometimes the animals get sick and become unfit for sale but there is no animal health facility. Health cover and quarantine measure are the utmost need to keep the animal fit for sale for comparatively longer time like one week. Some people
bring the animals with contagious diseases but there is no control on it. Dense population of camel and other animals comes together, if there is an outbreak, it will spread in the whole Mela in a short time, but no facility has been provided in this regards.

Selling and buying facilities might be provided well. Provision of shelter from weather extremities, health cover and security to the pastorals will boom the fair. The event is the best place where the herdsmen gather. It is a better place to know the problems of camel herdsmen and other beneficiaries. Welfare associations, societies and NGOs working for pastoral people and animal sciences, could better know the problems here. These societies can sort out their concepts for the well being of camel herdsmen here which might be helpful in the field.

The western parts of Suleiman hills of Balochistan are very far from the Mangrota; therefore camel fair under government supervision will be the best option if held in the Kingri area of Musakhel District of Balochistan. Kingri would be the best consign for this purpose because of its dimension. Falling in the centre of camel production vicinity, abundantly available water of Kingri River, good infra structure and easy accessibility make it an attractive place for this purpose.

Camel competitions will positively affect the activities in the Mela. Products competition especially for milk will help for further improvement in the milk production. As Kohi camel is one of the best milk producers in the country. Pastorals in the world unanimously were in favor of looking for new avenues to commercially market camel and camel’s products. Display of the product of camel in the fair will positively affect the camel marketing and business. Pastoralist must be provoked and educate for camel products and their value addition in the pastoral economy. It will earn valuable money in the form of tax form of camel export to the Government. Publicity of the fair both nationally and internationally will boost the Camel racing can attract more people both nationally and internationally, which will help in tourism development on one hand and economic benefit to the herdsmen on the other hand.
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CHAPTER VI

Paper III

MILK PRODUCTION POTENTIAL OF KOHI CAMEL IN BALOCHISTAN, PAKISTAN

Abstract

Camels are a potential milch animal and produce more and quality milk than any indigenous cattle breed in Pakistan, but their potential have never been realized and couldn’t be harvested as a prospective milk producing animal. No proper place is given in respect of research and development on this specie. The over expanding agricultural activities, environmental changes and the concurrent droughts in the region demand to harvest camel potential for the over expanding food demand of the people of the country. This study was conducted on 40 lactating camels in northeastern Balochistan and sampling was done at the end of each second week (level) for one whole lactation in 2006. The camel was brought under close observation and regular milking 24 h before the sampling. The daily milk yield ranged from 6.045-11.732 kg/day with a mean daily yield as 10.22±0.43 kg/day (mean±SE). The lactation length ranged from 231-275 days with a mean of 259±7.02 days. The lactation yield ranged from 1566-3168 kg with an average of 2590.5 kg. Many factors found affecting daily and lactation yield i.e. affect of age and parity, stage of lactation, season of production, type/breed of camel and calving season on milk production. Among parities, 5th parity (13.50 year) of age had the highest lactation yield (3168 kg) of milk followed by 3rd parity (8.75 year) of age with (3051 kg) of milk and 4th parity (11.45 year) of age with (3010 kg) of milk and lowest milk was produced in the 1st parity (4.5 year of age ) with (1566 kg) (p>0.05). The mean daily yield was lower in first month of lactation (9.592±0.87 SE kg/day) increased to (10.833±0.42 kg/day) in 2nd month and (11.066±0.30 kg/day) in 3rd month and reached to its peak in the 4th month of lactation (11.217±0.31 kg/day) (p>0.05). The milk was lower in dry season
(10.02±0.15) than the wet season (10.53±0.14) (p>0.05). The white camel of Kohi breed produced significantly higher milk (11.45±0.14) than that of Spole Kohi (8.91±0.12) kg/day (p>0.05). Camels that calved in the month of April yielded highest milk (11.235±0.13) kg/day followed by the camels calved in March (10.092±0.21) kg/day and (8.853±0.21) kg/day in May (p>0.05). The potential of camels as a dairy animal was demonstrated under traditional management, to further elucidate factors affecting the milk yield capacity, studies under different management and controlled environment were recommended.

**Key words: Camel milk, production, products, pastorals, Kohi, parity, season, age, season of calving and Pakistan**

### 6.1 Introduction

The country produced 38.69 billion liters milk in year 2006-2007 and made its place as one of the higher milk producing country in international ranking but per capita milk availability (170. liter) is still very low. The share of different species has been reported as buffalo 25.04 billion liters, cow 13.33 billion liters and goats 0.32 billion liters (Economic Survey, 2007-2008). In spite of 0.92 million camel population (Economic Survey, 2007-2008), camel milk has not been documented in the grey record and has never been appreciated, valued and estimated properly.

Balochistan comprises mainly on the rangelands which are already over grazed and the palatable grasses have already been vanished. The scanty, woody and bushy vegetation remains left behind. The camel is the best converter of that vegetation in to valuable food items like milk. This quality of camel is considered to be the reason of camel domestication (Epstein, 1971).

Balochistan places 41% of the total camel population with only 5% of the human population of the country. The northeastern Balochistan is the home of nomadic and semi-nomadic herders, who use camel for transportation of goods, family luggage and hauling of different daily needs. Its milk is very important food item for them, used for drinking fresh, making tea and converting into yogurt, Shalombey, Kurth and other
valuable food items. The herders use camel milk with the Kak, which is a type of bread prepared on hot stone (Fig. 6.1). It was reported that in Balochistan the mainstay of a nomad’s food is camel milk and is consumed fresh or soured (Aujla et al, 1998).

Fig.6.1. Kak and camel milk

In part of the camel rearing world, camel milk is used as raw state and drink as such without any processing (Seifu, 2007; Yagil, 1982; Alhadrani, 2003). The camel milk is liked by its keepers for its magic characteristics in almost all the camel rearing areas and many sayings are bound with it. The Somalian Camel men say, "Water is soul, but camel milk is life" (Elmi, 1989).

The camel milk is very much liked in Balochistan and appreciated for its therapeutic peculiarities and nutrient richness. Its milk is used for the treatment of many diseases i.e. chronic liver diseases, arthritis, long bone pain (general body fatigue) and sexual weaknesses. According to the pastoralists the therapeutic property of camel milk is attributed to the fact that camels browse on various plant species and active agents with
therapeutic properties from these plant species are secreted into the milk of camels (Rao et al, 1970). The camel milk has antibacterial and anti-viral properties (El-Agmy et al, 1992) and the milk does not form a coagulum with the acid (Abu-Lehia, 1989) and is difficult to coagulate with rennet (Wangoh, 1993), which allows the camel milk to pass rapidly through the stomach, together with insulin. In a review study Yagil et al (1994) recommend camel milk as future of the malnourished children where breast feeding is very limited and the mothers are malnourished. It is estimated that worldwide there are 145 million malnourished children and form 4-5 million deaths due to diarrhea each year (UNICEF, 1992)

Camel’s milk yield differs in quantity from area to area and ranged from few liters to 35 liters a day. The length of production also reported variably from 8 to 18 months. There are many factors reported, which are responsible for this variation. Moreover, camel lactates in adverse conditions (Yagil and Etzion, 1983) and significantly superior to other livestock in terms of food production (Stile, 1987). Camel has the ability to produce more milk than cow in similar conditions (Faye, 2005), but the camel milk productivity is not well known in Balochistan and especially from pastoral areas, where performance monitoring is uncommon. Elsewhere, the data are not homogeneous from one author to another with regards to mean daily yield, total yield per lactation and herd average. In spite of the all above characteristics of camel, especially its milk producing ability in adverse conditions, very rare work has been done on its milk production ability. This work was therefore designed and conducted on the pastoral camel in Suleiman mountainous region of Balochistan.

6.2 Materials and Methods

The study area of this research endeavor lies in the northeastern Balochistan famously known as Suleiman mountainous region. The region is categorized as semi-arid, receiving 200-500 mm precipitation bimodal. The region is situated from to 31º-70’ at North latitudes and from 68º-06’ to 70º-20’ at East29º-37’ longitudes; the climate can be placed in the "arid to semi arid with warm summer and cool winter" category. The
average temperature of summers (21-32°C) and winter (below 0 °C) have been reported (GOB, 1999).

6.2.1 Grazing management

The camels used for this study were belonging to the pastoral herders grazing on the natural vegetation. The animals were let to move in the grazing area with the onset of the sunrise. They were allowed to drink water before going to the grazing area. The herd was watered daily in winter and 3 times of the day i.e. in the morning before the grazing in the noon and in evening while returning home from the grazing area in the summer.

The area is rich in vegetation especially the mountainous region. The milk was especially collected from the mountainous camels. The vegetation of the area is composed of Palosa (Aacia modesta), Showan (Olea ferrugina), Gorgula (Reptonia buxifolia), Makhie (Caragina ambigu), Bararr (Periploca aphylla), Shorie (Haloxilon griffithii) and Barwazi (Heteropogon contrutus). The camel of the study was freely grazing without any supplementation except salt (250 g in a week).

6.2.2 Basis for data collection

Kohi camels (40) in from pastoral herds in Musakhel District of Balochistan were selected for this study. The camels were selected through a purposive sampling method, willingness to provide their camels and information for the study, accessibility of the site and sufficient number of camel on a site. The milk of the first week was considered as colostrums and the initial milk recording was started at the end of first week of parturition. The milk was calculated at the end of each second week (13 days interval). It was difficult to measure the daily milk yield of the dromedary under pastoral conditions because remoteness of the area, continuous moving herds, need based milking practice (cows may be milked once, twice, or even 6 or 7 times per day). The presence of nursing calves also confounds accurate measurement of daily yields.

The cow was regularized 36 hours before the data collection as; udder cover was applied to the animal and the milking was practiced on equal intervals (12 hours). After 36 hour the milk was recorded for two times on equal interval of 12 hours (morning and evening). The data was recorded on the daily and lactation yield and the factors affecting the milk
yield and the lactation length. The factors like age and parity, stage of lactation, season of production, type/breed of camel and calving season on milk production were brought under consideration.

**6.2.3 Milking practice, recording and data analysis**

Prior to milking, calves were allowed to suckle for a few seconds to stimulate milk letdown. Then the calf was restricted to the two teats of right side by one handler and the other handler was milking the two teats of the left side. The animal was milked in a container used by the herder and the milk was then let to settle down for 30 minutes, and later on milk was measured in a graduated cylinder.

Data collected thoroughly checked, coded and entered into different data files using Microsoft excel program. The data was then transported to Minitab 12.21, 1998 software and General linear model was used to run analysis of variance (ANOVA) for variable affecting daily milk production.

The mean daily and lactation yield were calculated on the basis of pooled parity data.

**6.3 Results and Discussion**

**6.3.1 Camel distribution on the bases of parity and age**

The age of camels varied from 4-20 years of age from parity 1 to 6 and above. The highest proportion of the lactating animal (25%) was in parity four followed by parity 2 with 22% share. The lowest number of lactating camel (7%) was in the 1st parity (Table 6.1).

**6.3.2 Mean daily yield**

The mean daily milk yield of this study ranged from 6.045-11.732 kg/day with a mean daily yield as 10.22±0.43 kg/day (p>0.05) presented in Table 6.1. Our study is well in the range of other studies reported by various authors from the different parts of the world i.e. 3.5-13.5 kg/day by Yasin and Wahid (1957) from Pakistan, 6.9-18.2 kg/day by Rao
(1974) from India, 5-13 kg/day by Knoess (1977) while working on the Ethiopian camels and 4-12 kg/day reported by Aujla et al (1998) from Balochistan province of Pakistan.

**Table. 6.1** Parity, milk yield, lactation length and lactation yield

<table>
<thead>
<tr>
<th>Parity</th>
<th>No of camels</th>
<th>Mean age (Year±SE)</th>
<th>D.M.Y (kg±SE)</th>
<th>L.L (days±SE)</th>
<th>L.Y (kg)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>3 (7.50%)</td>
<td>4.50±0.32</td>
<td>6.045±0.38</td>
<td>259±8.08</td>
<td>1566</td>
</tr>
<tr>
<td>2</td>
<td>9 (22.50%)</td>
<td>7.33±0.88</td>
<td>8.784±0.68</td>
<td>231±24.64</td>
<td>2029</td>
</tr>
<tr>
<td>3</td>
<td>6 (15.00%)</td>
<td>8.75±0.17</td>
<td>11.094±1.21</td>
<td>275±2.34</td>
<td>3051</td>
</tr>
<tr>
<td>4</td>
<td>10 (25.00%)</td>
<td>11.45±0.76</td>
<td>11.025±0.69</td>
<td>273±4.58</td>
<td>3010</td>
</tr>
<tr>
<td>5</td>
<td>4 (10.00%)</td>
<td>13.50±0.29</td>
<td>11.732±1.79</td>
<td>270±4.06</td>
<td>3168</td>
</tr>
<tr>
<td>6-8</td>
<td>8 (20.00%)</td>
<td>17.37±0.50</td>
<td>10.964±0.79</td>
<td>248±18.62</td>
<td>2719</td>
</tr>
<tr>
<td>Total/Mean</td>
<td>40 (100%)</td>
<td>10.48±0.34</td>
<td>10.22±0.43</td>
<td>259±7.02</td>
<td>2590.5</td>
</tr>
</tbody>
</table>

*Means sharing similar superscripts in a column are statistically non-significant (p>0.05)*

Our study findings are lower than the finding of some studies interestingly reported from Pakistan. A yield of 15-35 kg/day reported by Knoess et al (1986) while working on the heavy riverine camel in Punjab province of Pakistan. The riverine camel is heavy in its size and produced more milk than the compact, medium sized Kohi camel. Our study proved that the mountainous camels are low yielder than the heavy sized low land camels. A study conducted on farm rearing mountainous Cambelpuri camel in Attock, Pakistan by Iqbal (2002), reported a milk yield of 11.66 kg/day, which is higher than our finding. The reason for this more milk might be the better farm conditioning. While our camels were in continuous move and belong to the pastoral herds.

If we consider separately the white camel of Kohi breed then the milk produced by white kohi is very closed to the finding that of reported by Iqbal (2002). White camel could be a potential dairy animal if raised properly and their minimum requirements are fulfilled.
The finding of our study proved that Kohi camel produced more milk than the finding of various studies. Amount of milk in kg/day was reported as 3.5-4.5 by El-Bahay (1962) from Egypt, 8-10 by (Sial, 1950) from Pakistan, 4.5-9.1, 4 by Burgemeister (1974) from Tunisia, 8.3-10 by GEFL (1977) from Libya, 6.7-10 by (Leopold, 1978) from Pakistan, 5.00 by Yagil (1982) from Somalia, 3.24-5.39 by Reta and Mekonnen (2002) from Ethiopia, 8-9 by Wernery et al (2004) from UAE, 3-10 by Farah et al (2004) from Somalia, 6.00 by Raghvendar et al (2005) from India, 4-7 by Mehari et al (2007) from Kenya, 3-10 and by Farah et al (2007 from Somalia.

The Somali pastoral people are the one of the better camel milk users in the world and they usually milk the camel twice a day (Farah et al, 2004). As stated in the methodology of this manuscript the milking was done on 2 equal intervals and the frequency of milking also influence the milk yield as reported by Knoess (1976), Wernery et al (2004) and Al-Shaikh & Salah (1994). Yagil (1982) proved that the daily milk yield was lower (1.26 kg) for one time milking to (6.77 kg/day) for four times milking. The size and storage rates, there are no larger storage cisterns in the camel udder as seen in the cattle (Simpkin, 1998), which results build-up intra-mammary pressure and ultimately results in reduction of secretion rate. Moreover the milk yield is also influenced by the fodder quality and availability of water (Knoess, 1976).

6.3.3 Lactation length

The lactation length ranged from 231-275 days with a mean of 259±7.02 presented in the Table 6.1. Our study is in agreement with the only finding of Leopold (1978) who reported a lactation length of 9-18 month from Pakistan. We find our study one of the lowest in the other studies reported by various authors i.e. 12 month by Sial (1950), 12 month by Knoess et al (1986), 9-16 month by GEFL (1977), 12-18 month by Knoess (1977), 9-18 month by Schwartz (1992) from Pakistan while reviewing the milk production potential of world dromedary camel. The only study reported from Balochistan reported by Aujla et al (1998) with 9-11 months is also in agreement of this study.

A lactation length of 300 days by Wardeh (1994) from Syria, 12 month by Iqbal (2002), 15 month by Baloch (2001) from Pakistan, 12 month by Reta and Mekonnen (2002), 13-

The long lactation length is mainly reported from the horn of Africa, where mainly the Somali camel herders reside and they mainly depend on camel milk for their family use. Most of the husbandry and the management practices of the Somali camel herders are geared towards the improvement of milk production and the continuous supply of milk for the family need throughout the season (Farah et al, 2004).

The lactation length of she camel depend on various factors (Wilson, 1989c), comprises of the artificial lactation length control, dam and calf status, availability of the vegetation and the decision of the herders. The lactation yield of this study was controlled artificially and the herders manage the camel production for the purpose of more calves, but not milk production. They dry their camel before the onset of the breeding season, not like the herders of the other part of the country where camels are dry in the advanced pregnancy (Knoess et al, 1986). Some pastoral communities are solely rely on the camel milk (Qureshi, 1986; Schwart and Dioli, 1992; Farah, 2004) and therefore, they do not dry the animal, which results in the lengthy lactation period, even higher than 18 months.

The calves catch high prices which are a source of earning while there is no market for camel milk in the study area and are only use for household. When the herders are away from their families which is a common practice in the area then the milk value decreased more. Artificial control of lactation is practiced more in Kebrbeyah and in Babilie tribes of camel pasturals in Ethiopia (Mehari et al, 2007) and the reasons for the shortening of the lactation length are when the feed for the calf is plenty or safeguard the she camel. Lactation length varies depending on the management decision of the owners (Ahmed, 2002).

Due to the above artificial control the actual lactation length is difficult to determine in the present study. At the same time it is difficult to know the minimum milk yield at the low stage of lactation.
6.3.4 Lactation yield

The lactation yield ranges from 1566-3168 kg with an average of 2590.5 kg (Table 6.1). Our findings are well in range of 2700-3600 kg of mean lactation yield reported by Leopold (1978), 2430-4914 kg by Rao (1973), 2700-4000 kg by GEFL (1977), 1872-2592 kg by Knoess (1977), 2550-2900 kg by Wardeh (1994) from Syria, 1250-3650 kg by Aujla et al (1998) and 1244-2009 kg by Belay and Getahun (2002) from Eastern Ethiopia.

Our study findings were lower than the findings of 12000 kg reported by Schwartz (1992), 4,179 kg by Sial (1950), 5475-12775 kg by Knoess et al (1986) and 4260 kg by Iqbal (2002). Our study finding was higher than the only finding of 1894.93 kg reported by Baloch (2001) from Pakistan. Our study might not tell the true picture of the actual lactation yield because of the management decisions of the pastoral people who control lactation length artificially as discussed earlier.

6.3.5 Factors affecting the milk yield

There are many factors affecting the camel milk production i.e. calving season, age, parity, type and season of the year.

1. Effect of age and Parity on milk production: Among parities, 5th parity (13.50 year) of age had the highest lactation yield (3168 kg) of milk followed by 3rd parity (8.75 year) of age with (3051 kg) of milk and 4th parity (11.45 year) of age with (3010 kg) of milk and lowest milk was produced in the 1st parity (4.5 year of age) with (1566 kg) (p>0.05) presented in Table 6.1, Fig. 6.2 and Fig. 6.3.
In this study the effect of parity was significant on milk production. Our study is in line with the finding of Yagil, (1982), Bekele et al (2002) Mal et al (2006) and Zeleke (2007), whom reported that the stage of lactation effect the mean daily and lactation yields. The study reported from Israel, camels in the fourth parity showed the highest mean daily yield, whereas camels in the last parity had the lowest daily and lactation yield Yagil (1982). Another study reported by Simpkin (1998) revealed that the camel in first lactation yielded much less the subsequent lactation and Kebebew and Baars (1998) indicated that the later parities yielded a significantly lower milk yield than the mid parities. In an Eastern Ethiopian study the peak daily milk yield was recorded at the 3rd parity to the parity 5th gave the highest lactation yield and the parity 1st and 7th with the lowest lactation offtake than the others (Bekele et al, 2002)

**Fig. 6.2** Effect of parities (lactation number) on the milk yield based on the fortnights of lactation
An Indian study revealed that daily milk yield was highest in 3\textsuperscript{rd} parity followed by parity 1\textsuperscript{st} and 2\textsuperscript{nd} (Mal et al, 2007). Whereas in a Kenyan study parity of camels significantly influenced daily milk yield (Zeleke, 2007), and camel in the third parity yielding the highest volume of milk per day whereas camels at the first and sixth parities producing significantly lower milk volumes compared to the rest of the parity groups.

Production of the least volume of milk during the first parity is logical in that camels in the first parity are still growing and the nutrients are partitioned for body building purpose and milk production. Similarly, reduction in the daily milk yields from the older camels (parity 6\textsuperscript{th} and above) as compared to the intermediate age groups may be due to wear of teeth, reduction in the number and potency of milk secreting cells, and general weakness due to old age.

The probable difference in the parities milk production might be the early maturity of the camel in the study area, and the quantity of milk production might be correlated with the body maturity of the camel. Our camel’s falls in the age of 12 years when it is in the 4\textsuperscript{th} parity and that is the age of complete maturity. So the camel will produce up to its peak

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**Fig. 6.3** Effect of parity on the average milk yield
in the 5th parity after the completion of the body size. As our camel reaches to the mature body size in the later parities as compare to the African camel which reach in earlier parities to mature body size. As the body size completes the nutrient shift to the milk results in higher fat contents.

2. Effect of month (stage) of lactation: The milk yield was lower in the first month of lactation ((9.592±0.87 SE kg/day) and increased in the following month (10.833±0.42 kg/day) presented in Table 6.2 and Fig. 6.4. The milk increased significantly in the third month of lactation (11.066±0.30 kg/day) and reached to its peak in the 4th month of lactation (11.217±0.31 kg/day). This finding is in agreement with the finding of El-Hatmi et al (2004), who reported that the milk production was lower in the start of lactation, highest at the third month, showing an irregular pattern in the following months and lowers in the end of lactation in Tunisia.

Table. 6.2 Effect of month of lactation on milk yield

<table>
<thead>
<tr>
<th>Month</th>
<th>Number of sample</th>
<th>Mean production (kg±SE)</th>
</tr>
</thead>
<tbody>
<tr>
<td>3</td>
<td>13</td>
<td>9.592±0.87</td>
</tr>
<tr>
<td>4</td>
<td>47</td>
<td>10.833±0.42</td>
</tr>
<tr>
<td>5</td>
<td>90</td>
<td>11.066±0.30</td>
</tr>
<tr>
<td>6</td>
<td>85</td>
<td>11.217±0.31</td>
</tr>
<tr>
<td>7</td>
<td>84</td>
<td>10.385±0.30</td>
</tr>
<tr>
<td>8</td>
<td>87</td>
<td>9.712±0.30</td>
</tr>
<tr>
<td>9</td>
<td>77</td>
<td>10.100±0.33</td>
</tr>
<tr>
<td>10</td>
<td>86</td>
<td>10.458±0.31</td>
</tr>
<tr>
<td>11</td>
<td>83</td>
<td>10.320±0.29</td>
</tr>
<tr>
<td>12</td>
<td>73</td>
<td>9.414±0.31</td>
</tr>
<tr>
<td>1</td>
<td>29</td>
<td>8.031±0.50</td>
</tr>
</tbody>
</table>

Means sharing similar superscripts in a column are statistically non-significant (p>0.05)
The mean daily yield slightly decreased in the 5\textsuperscript{th} month of lactation (10.385±0.30 kg/day) and reached to (9.712±0.30 kg/day) in the 6\textsuperscript{th} month of lactation. This decrease was due to the two factors i.e. the high ambient temperature, discomfort due to flies and the shifting of camel from the plain lands to the high mountains area to keep the camel in comparatively low temperature and away from the flies. The shifting of the camel from one type of vegetation to another type of vegetation might be another cause of this decrease.

![Graph showing milk yield over months of lactation](image)

\textbf{Fig. 6.4.} Effect of month (stage) of lactation on the average milk yield

The milk yield again increase in the 7\textsuperscript{th} month of lactation ((10.100±0.33 kg/day) and remain constants in the coming two months (8\textsuperscript{th} and 9\textsuperscript{th}) when the temperature become mild and the season becomes wet in the area. This increase is due to the availability of the succulent vegetation due to the rains of monsoon.

The milk yield decline in 10\textsuperscript{th} month of lactation (9.414±0.31 kg/day) and reach to the lowest level of the lactation 11\textsuperscript{th} (8.031 ±0.50 kg/day). This decline is because of the
factors like the advancement in the lactation period, dry season, drop in temperature and scarcity in the succulent vegetation.

Our study is in line with the findings of Wernery et al (2004) who reported that milk production is significantly decreased over time. The stage of lactation reported by Zeleke (2007) also revealed that significantly affected their daily milk yield and there was no significant reduction in the milk yield until the 9th month of lactation. Our study depicts the change in production according to the stage of lactation. Our study is in agreement with the findings of (Shalash, 1984; Knoess, 1984), whom reported the daily average milk yield is different at different stages of lactation.

The peak yield is reported at different stages of the lactation and varies from ten weeks to 6 month. So the peak period (6th month of lactation) of our study is well in the range of the Indian study with peak yield recorded in the 5th and 6th months of lactation (Raghvendar et al, 2005), 6th month by (Sahani et al, 1998) from India and Kenyan study with the peak yield recorded in the 10th week of lactation (Hartley, 1984).

### Table. 6.3 Effect of season on the milk production

<table>
<thead>
<tr>
<th>Season</th>
<th>Number of observation</th>
<th>Mean milk yield (kg±SE)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Wet season</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Dry season</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total/mean</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

3. **Effect of season on milk production**: The mean milk yield was 10.53±0.14 kg/day in wet season and 10.02±0.15 kg/day in dry season (p>0.05) presented in Table 6.3. Our study is in conformity with the previous finding of (Shalash, 1984; Zeleke and Bekele, 2001; Bekele et al, 2002; Farah et al, 2004; Mehari et al, 2007 and Zeleke, 2007), whom reported that the daily milk yield was significantly higher during wet months as
compared to dry months of lactation. Comparatively higher milk yields recorded in the wet season than the dry season might be due to better availability of the feed.

In Somalia the daily milk produced was higher (6.5 kg) in wet season and lower (3.6 kg) in dry season (Hussein, 1993). The daily milk yield was significantly higher during the wet season than during the dry season in Ethiopia Zeleke and Bekele (2001). During the rainy season when the pasturing is good the camel will give an average of about 10 liter of milk a day and in dry season the camel will continue throughout to give 2-5 liter a day (Stile, 1987). In Kenya Rendille camel produced as much milk as four Samburu cows in the wet season and in the dry season the cow’s milk fall to minimal volumes and the camel continue its milk production (Spencer, 1973).

4. Effect of type of camel on milk production: The white camel of Kohi breed produced significantly higher milk (11.45±2.90) than that of Spole Kohi (8.91±2.17) kg/day (p>0.05) presented in Table 6.4.

<table>
<thead>
<tr>
<th>Color</th>
<th>Number of sample</th>
<th>Mean Milk prod kg±SE</th>
<th>St Dev</th>
</tr>
</thead>
<tbody>
<tr>
<td>Spole</td>
<td>346</td>
<td>8.91±0.12c</td>
<td>2.17</td>
</tr>
<tr>
<td>White</td>
<td>408</td>
<td>11.45±0.14a</td>
<td>2.90</td>
</tr>
<tr>
<td>Total/mean</td>
<td>754</td>
<td>10.28±1.27b</td>
<td>2.88</td>
</tr>
</tbody>
</table>

Means sharing similar superscripts in a column are statistically non-significant (p>0.05)

Our study is in line with the findings of other studies reported by many authors (Shalash, 1984; Wilson, 1984; Schwartz and Dioli, 1992 and Farah et al, 2004). Our study is in agreement with the finding of Sahani et al, 1998, reported that affect of breed was significant on milk yield, while working on the Bekaneri, Jaisalmeri and Kachchi camel in the Indian state of Rajasthan.

5. Effect of calving season on milk production: Camels that calved in the month of April yielded highest milk (11.235 kg/day) followed by the camels calved in March (10.092 kg/day) and (8.853 kg/day) in May (p>0.05) presented in Table 6.5. Our study is in
agreement with the findings of Zeleke (2007), Zeleke and bekele (2001) and Bekele et al (2002), who reported the calving season imparted significant effect on the milk yield and that highest peak yield was observed in the dams that calved in the wet season as compare to the dry season. In our study March is the start of the spring’s wet season and the dams calved in the season produces a medium quantity of milk (10.092 kg/day). The milk production was highest in the dams calved in the mid of the wet season (April) and lowest in the dams calved in the end of the wet season (May), because the dams interned in the dry season in a very short period and could not attain its peak which results in the low yield.

Table. 6.5 Effect of calving season on the milk production

<table>
<thead>
<tr>
<th>Month of lactation</th>
<th>Number of calving</th>
<th>Mean milk yield kg ±SE</th>
</tr>
</thead>
<tbody>
<tr>
<td>March</td>
<td>202</td>
<td>10.092±0.21</td>
</tr>
<tr>
<td>April</td>
<td>348</td>
<td>11.235±0.13</td>
</tr>
<tr>
<td>May</td>
<td>204</td>
<td>8.853±0.21</td>
</tr>
<tr>
<td>Total/mean</td>
<td>754</td>
<td>10.06±0.57</td>
</tr>
</tbody>
</table>

Means sharing similar superscripts in a column are statistically non-significant (p>0.05)

Management systems affect the milk production potential of the dromedary camels. Farah et al (2004) reported that production depends on the breed, age, lactation period, season, availability of browse and water. Under different management systems camel milk produced, varied from 5 to 18 kg (Salhab and Merestani, 2002). The relatively high produce of 9.0 kg/day under nomadic production system was observed in Somalia (Hussein, 1993). Generally daily milk yield is 8-10 liters but under intensive management conditions milk yield is from 15 to 20 liters daily (Sial, 1950). Supplementation of 4 kg concentrates per day significantly increased milk production in Tunisia (El-Hatmi et al, 2004). Under desert conditions of Balochistan, a lactation length ranges from 9-18 months) with an average yield of 1,800 liters (Aujla et al, 1998). The average daily milk yield for camel browsing on irrigated and non irrigated lands were 5.39 and 3.24 liters respectively (Reta and Mekonnen, 2002).
Conclusion

Camels are found to be the most persistent milk producer in arid and semi-arid areas of Eastern Balochistan with a little decline in milk yield as stage of lactation advances. Irrespective to the national livestock census reports, it is fact that the numbers of camel worldwide are disappearing from their natural habitats and Balochistan is not exception to that. There are many reasons for this sad of state of affairs, all man-made. Strategies for halting the decline and increasing in members can be implemented, based on introduction of marketable products from the lands where the milch camel exists.

Camel should accept a worthwhile milch animal and might be properly placed in the research and development projects of the country. The quality of camel milk must be publicities at national and international level. The value addition to camel milk can help in this regards. The camel ice-cream and came milk soap already introduced in India and Israel and the bakery products are available in Dubai supper markets. Tvisky dairy service in Mauritania is pasteurizing camel milk and makes it available to the main cities.

In the context of the advancing urbanization, camel milk is increasingly commercialized and consumed in urban areas worldwide but why not in Pakistan. Camel milk is well suited for the kids devoid of breast milk.

Reference


CHAPTER VII

Paper IV

MILK COMPOSITION AS AFFECTED BY PARITY
AND STAGE OF LACTATION IN KOHI CAMEL
OF BALOCHISTAN, PAKISTAN

Abstract

The camel milk is famous for its peculiarities especially for its health responsive aspects. Camel’s milk having low and high contents of fats and protein respectively, which proves its superiority. The Balochistan province of Pakistan places about (379,528 heads) 41% of the country’s camel but rare work has been done especially on their various aspects of milk production and milk composition. This study was, therefore, conducted to know the chemical composition of the camel milk in northeastern Balochistan. Six multiparous camels regularly milking were selected for this study, and the milk was analyzed for two stages of lactation (2nd and 7th month of lactation). The study revealed that the Kohi camel milk contains average of fat, protein, lactose and ash contents as 2.63, 5.05, 4.01 and 0.70%, respectively. The parity affected the milk fat, protein, lactose and ash contents. The fat and protein contents increased with the advancement of the parity but to a certain level (parity 5). Stage of lactation also affected the milk composition and fat percentage was higher (2.70%) in the second stage of lactation than (2.57%) those of first stage. protein was higher in the first stage of lactation (5.56% and 4.15% respectively) than second stage of lactation (4.54% and 3.87% respectively). Lactose was higher in the first stage of lactation (3.67%) than second stage of lactation (2.55%), while the ash was higher in the second stage of lactation (0.73%) than first stage of lactation (0.68%). Average mineral profile of the milk samples was observed as Na (49.42 mg/100g), Mg (15.04 mg/100g), Fe (0.55 mg/100g), Mn (0.066 mg/100g), Cu (0.22 mg/100g) and Zn (1.42 mg/100g). All minerals except Na had showed a very minute variation among
parities. An irregularity was found in the chemical composition of the camel milk based on the parity and stage of lactation. Not only the parity and stage of lactation but also the age of the animal, continuous herd’s movement, nutritional management and the seasonal difference might have contributed in the cause of all irregularities.

Key Words: Kohi camel, milk composition, parity, stage of lactation and Balochistan

7.1 Introduction

Pakistan produced 38.69 billion liters milk in year 2006-2007 and made its place as one of the higher milk producing country in international ranking but per capita milk availability (170. liter) is still very low. The share of different milch viz, buffalo (25.04 billion liters), cow (13.33 billion liters) and goats (0.32 billion liters) have been reported (Economic Survey, 2007-2008). In spite of 0.92 million camel population, camel milk has not been documented in the grey record and has never been appreciated, valued and estimated properly.

The northeastern Balochistan is the home of nomadic and semi-nomadic herders, who use camel for transportation of goods, family luggage and hauling of different daily needs. Its milk is very important food item for them, used for drinking, making tea and converting into yogurt, Shalombey, Kurth and other valuable food items (Fig. 7.1). The camel milk is very much liked in Balochistan and appreciated for its therapeutic peculiarities and nutrient richness. The herder accepts its role as remedy of liver disfunctioning, arthritis, long bone pain and aphrodisiac contents. Moreover the herders rely on camel as potential milch animal in the drought years. In some parts of the area the camel is purely raised and use as milch animal, because camel is the best converter of the vegetation of that area into valuable milk and meat products.

The camel milk composition reported from the different parts of the world, revealed a wide variability in its contents due to many reasons like available vegetation, feeding pattern, topography, breed and the methodology used for the analyses. According to some scientists, not only environment but the need of the young calves themselves dictates the
Fig. 7.1. Kurth made of the camel milk

quality of the milk (Yagil and Etzion, 1983). They further stated that the milk in the arid areas could contain more water than the milk in cold or temperate climates, the water availability and intake also affect the composition of the camel milk.

Very rare work has been done on Pakistani camel, especially, on their milk composition and the factors affecting their chemical composition. This study was, therefore, planned to access the compositional aspects of camel milk as affected by the parity and stage of lactation in the Kohi breed of Balochistan.

7.2 Materials and Methods

7.2.1 Animals

This study was carried out on a total of 12 camels of Kohi breed: 6 in the first stage (2nd month of lactation) i.e. 1st week of June and 6 in the second stage (7th month of lactation) i.e. 1st week of November. All the selected camels were calved in the month of April and were belonging to the pastoral herds. The remoteness of the area, lack of transportation, poor civic amenities, lack of sufficient number of camel at one place and the continuous herds’ moment, etc make it impossible to conduct such study on a large number of
animals on regular basis, therefore, this study was conducted on 12 animals and sampling was done twice in the whole lactation period. The same protocol of study has already been reported by Sahani et al (1998) from India.

7.2.2 Study Area

The study area of this research endeavor lies in the northeastern Balochistan famously known as Suleiman mountainous region. The region is categorized as semi-arid, receiving 200-500 mm precipitation bimodal. The region is situated from 29º-37’ to 31º-70’ at North latitudes and from 68º-06’ to 70º-20’ at East longitudes; the climate can be placed in the "arid to semi arid with warm summer and cool winter" category. The average temperature of summers (21-32 ºC) and winter (below 0 ºC) have been reported (GOB, 1999).

7.2.3 Grazing management

The camels used for this study belonged to the pastoral herders grazing on natural vegetation. The animals were let to move in the grazing area with the onset of the dawn. The animals were watered 3 times per day i.e. in the morning before proceeding to the grazing area, in the noon and in the evening while returning home from the rangelands.

The area was rich in vegetation in both stage of milk sampling, especially the mountainous region. The vegetation of the area is composed of Palosa (Aacia modesta), Showan (Olea ferragina), Gorgula (Reptonia buxifolia), Makhie (Caragina ambigua), Bararr (Periploca aphylla), Shorie (Haloxilon griffithii) and Barwazi (Heteropogon contrutus).

7.2.4 Milking practice and sampling

In the start the calves were allowed to suckle for stimulation of let down, and camel was milked completely for its all quarters, while the calves were suckling simultaneously. One handler was controlling the calf so that equal suckling for all quarters could make possible. The milk was collected from all four quarters in a clean utensil, and was let to settle down (almost 30 minutes), so that the fat foam settles. The milk was stirred and homogenous sample was collected. A sample of 100 ml (morning and evening) was
mixed to make 200 ml composite sample. Samples were stored in ice box and transported to the laboratory within 24 hr. The milk was stored in deep freezer (-20°C) in the lab till the samples were subjected to analyses.

**7.2.5 Proximate analysis**

The milk samples were analyzed for fat, protein, lactose and ash. Ultrasonic milk analyzer (Model Ekomilk Total Ultrasonic Milk Analyzer, Bulltek 2000, Stara Zaqora, Bulgharia) was used for the analysis of fat, protein and lactose in Department of Livestock Management, NWFP Agricultural University Peshawar and ash was determined by using the standard method (AOAC, 1999). The protocol of cow was used for this purpose, as the camel milk is believed to be close to that of cow milk compare to sheep, goat and buffalo milk. The amount of protein, fats and lactose are in the range of Friesian cow while higher in buffalo and sheep and goat (Knoess, 1984). Data collected were thoroughly checked, coded and entered into data files and analyzed by using Microsoft excel program.

**7.2.6 Mineral composition**

To determine the levels of Sodium (Na), Magnesium (Mg), Iron (Fe), Manganese (Mn), Copper (Cu) and Zinc (Zn) in the milk samples, a total of 6 milk samples of six parities (one from each parity) were collected. The milk samples were analyzed in Food Lab of Institute of Food Science and Technology (IFST), University of Agriculture, Faisalabad by the atomic absorption spectrophotometer (Varian AA-240). Minitab 12.21, 1998 software for the analysis of this study.

**7.3 Results and Discussion**

**7.3.1 Milk production potential of Kohi camel**

The Kohi camel is well praised for its milk production in ordinary pastoral grazing system and the mean daily yield was determined as 10.22±0.43 kg/day with a lactation length of 259 days. There was a significant difference in the milk production based on the stage of lactation. The mean daily yield was 11.217±0.31 and 10.100±0.33 kg/day in the
months of June and November respectively. The detailed results regarding the milk production data has been presented in detail (Raziq and younas, 2008).

7.3.2 Proximate analysis

The results of Kohi camel milk sample analyses and mean values for different parity (1-6) and stages of lactation (first and second stage) for fat, protein, lactose and ash are presented in Table 7.1. The various milk components are described in detail in the ensuing lines.

1. Fat: The fat% in the milk samples of first and second stage of lactation ranged from 2.50-2.70 and 2.60-2.80 with an average of 2.57 and 2.7 respectively in all parities (1-6). The average fat percentage of both stage of lactations for all six parities ranged from 2.55-2.75% with an average of 2.63% (Table 7.1). The findings of this study are inline with the results reported by several authors, i.e. 2.90% (El-Agamy, 1983) from Egypt, 2.7% (Kouniba et al, 2005) from Morocco, 2.5% (Bengoumi et al, 2005) from Sub-Saharan Africa, 2.9% (Bhakat and Sahani, 2006) from India, and 2.47% (Zeleke, 2007) from Ethiopia.

Table 7.1 Milk composition of Kohi camel at first stage and second stage of lactation.

<table>
<thead>
<tr>
<th>Contents</th>
<th>Stage of lactation</th>
<th>Parity 1</th>
<th>Parity 2</th>
<th>Parity 3</th>
<th>Parity 4</th>
<th>Parity 5</th>
<th>Parity 6</th>
<th>Mean</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fat</td>
<td>1st</td>
<td>2.70</td>
<td>2.50</td>
<td>2.50</td>
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<td>2.70</td>
<td>2.80</td>
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</tr>
<tr>
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<td>Mean</td>
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<td>2.55</td>
<td>2.65</td>
<td>2.65</td>
<td>2.65</td>
<td>2.63</td>
</tr>
<tr>
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<td>4.30</td>
<td>4.20</td>
<td>4.15</td>
</tr>
<tr>
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<td>2nd</td>
<td>3.60</td>
<td>3.40</td>
<td>3.10</td>
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<td>4.40</td>
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<tr>
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<td>4.37</td>
<td>4.30</td>
<td>4.30</td>
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<td>3.92</td>
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<td>2.70</td>
<td>2.43</td>
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<tr>
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<td>Mean</td>
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<td>2.99</td>
<td>3.31</td>
<td>3.02</td>
<td>3.11</td>
</tr>
<tr>
<td>Ash</td>
<td>1st</td>
<td>0.66</td>
<td>0.68</td>
<td>0.68</td>
<td>0.70</td>
<td>0.66</td>
<td>0.70</td>
<td>0.68</td>
</tr>
<tr>
<td></td>
<td>2nd</td>
<td>0.72</td>
<td>0.76</td>
<td>0.72</td>
<td>0.78</td>
<td>0.70</td>
<td>0.72</td>
<td>0.73</td>
</tr>
<tr>
<td></td>
<td>Mean</td>
<td>0.69</td>
<td>0.72</td>
<td>0.70</td>
<td>0.74</td>
<td>0.68</td>
<td>0.71</td>
<td>0.70</td>
</tr>
</tbody>
</table>
The fat findings of our study are lower compared to the findings of other fellow scientists, who reported fat percentage as 3.78 (Ohri and Joshi, 1961) from India, 3.8 (El-Bahay, 1962) from Egypt, 3.08 (Khan and Appanna, 1964) from India, 3.6 (Sawaya, 1984) from Saudi Arabia while working on the Najdi camel, 3.3 (Gnan and Sheriha, 1986) from Libya, 3.1 (Sahani et al, 1998) from India, 3.45 (Ahmed, 1989) from UAE, 3.15 (Farah and Ruegg, 1989) from Kenya, 3.15 (El-Amin and Wilcox, 1992) from Saudi Arabia, 3.9 (Farag and Kebary, 1992) from Egypt, 3.5 (Mehaia, 1994) and 3.22 (Mehaia et al, 1995) from Saudi Arabia, 3.28 (Ali-Gorban and Izzeldin, 1997) from Saudi Arabia, 3.39 (Guliye et al, 2000) from Israel, 3.57 (Iqbal et al, 2001) from Pakistan and 3.16 (Dukwal et al, 2007) from India.

The basic cause of the lower fat contents in the milk of Kohi camel might be the high mean daily milk yield (10.22±0.43 kg/d with a lactation length of 259 days). Our study is in agreement with the finding of Sheriha (1986) who reported that there is a negative correlation between the milk yield and the fat contents in the camel milk. The breed of the camel also affects the fat contents of the milk. A study conducted by Mehaia et al (1995) reported a significant variation in the camel milk fat contents while studying the Majaheim, Qadah and Hamra camel breeds of Saudi Arabia. A wide variation in camel milk fat has also been observed in different areas of Morocco, ranging from 1.85%-3.47% as reported by Kouniba et al (2005).

However the fat percentage of our study was higher than that of the 1.5-3.1% reported by Knoess et al (1986) working in Pakistan and 2.20% Raghvendar et al (2005) from India. The above studies were conducted on the experimental animals with high milk production and optimum nutrition. The above studies also proved the statement that there is negative correlation between milk yield and fat contents in camel.

The findings of our study are close to the fat percentage values as reported by Kheraskov (1953) from USSR 4.5%; Mukasa Mugerwa (1981) from Ethiopia 4.33% and Yagil and Etzion (1983) from Israel 4.3%. The milk fats reported from the horn of Africa were higher 5.5% and 5.4% from Ethiopia and Somalia by Knoess (1976) and Hjort and Dhal (1984) respectively than our findings.
A vide variation in camel’s milk fat has been reported in different parts of the world. This difference may be due to available vegetation, topography of the area, frequency of milking, stage of lactation, season (hot cold, dry and wet), breed and the methodology of the analyses (El-Amin, 1984; Rodriguez et al, 1985; Knoess et al, 1986; Mehaia et al, 1995 and Zia-ur-Rahman, 1998).

**Effect of Stage of lactation on Fat:** The pictorial presentation of the milk fat values of the both stages of lactation is presented in Fig. 7.2. The mean fat percentage was higher (2.70) in the second stage of lactation (7th month) than (2.57) in the first stage of lactation (2nd month). This study is very much inline with the finding of Bekele et al (2002) who reported that the fat% were significantly higher during late phase of lactation in the camel milk. The higher fats contents in the second stage of lactation might be due to many factors i.e. the lower average milk yield in the second stage of lactation with mild ambient temperature and vice versa. This statement is in agreement with the finding of Lakosa and Shokin (1964) and Knoess et al (1986), which reported that the seasons of the year and yields of the milk, affects the fat percentage in camel milk. Zeleke (2007) also reported that season of the year had significant effects on daily milk yield and composition of fat.

![Figure 7.2](image-url)  
*Fig. 7.2 Effect of stage of lactation on the fat percentage in milk of Kohi camel*
The season of the year and weather of the area also affects the fat content of the milk. In the dry season the milk quantity decreased and increases in the wet season which affects the milk composition. Our study was conducted in the wet season, when the milk yield was optimum. This statement is in agreement with the finding of Wernery (2006) who reported that one-humped camel lives in hot climate zones, hence reducing the fat contents with water contents being high.

In our study the milk production was higher (11.00 kg/day) in first stage of sampling (2nd month of lactation) and the weather was hotter compare to the second stage of sampling (7th month of lactation) with an average production of (10.00 kg/day) and the fat contents were higher in the second stage of lactation and lower in the first stage of lactation. This finding is in agreement with the finding of Sheriha (1986), who reported negative correlations between milk yield and fat contents in camel. In the hot weather the calves need more water and the milk is one of the important sources of water for these growing calves. This is in the agreement with the finding of Yagil and Etizion (1983), who reported that not only the environment but the need of the young calves themselves dictates the quality of the milk.

The vegetation of the study area of Balochistan in both the wet seasons Pasarlai (spring rains in the area, mostly in the month of March and April) and Wasa (monsoon rains, in the month of July and August) is different in nature. This change of the vegetation might have affects on the milk composition. This statement is supported by the finding of Al-Shaikh and Salah (1994), who reported that the variations in milk fat have been attributed to nutritional variation.

But the studies of the other scientists reported that the stage of lactation have no significant effect on the milk composition (Al-Shaikh and Salah, 1994; Guliye et al, 2000). Scientists from Tunisia reported that the fat content of the camel milk decreased from the beginning of lactation to reach a minimum value at week 21 of stage of lactation (El-Hatmi et al, 2004).

**Effect of parity on Fat:** The average fat percentage was higher in the first parity, lowered in the coming lactations i.e. parity 2 and 3, but again increased in the parity 4 and remained constant in parity 5 and 6, which is presented in Fig. 7.3. Our study is in agreement with
the findings of (Zeleke, 2007) who reported that parity had significant effect on daily composition of fat and milk fat was significantly higher in parity 3 as compared to other parities.

In our study the fat percentage increased in 4th parity. The probable difference in the parity might be the early maturity of the camel in the study area. And the increased fat percentage might be correlated with the maturity of the camel. Our camel’s falls in the age of 12 years when it is in the 4th parity and that is the age of completes maturity. As our camel reaches to the mature body size in the later parities as compare to the African camel which reach in earlier parities to mature body size. As the body size completes the nutrient shift to the milk results in higher fat contents. While the other scientists reported that the number of lactation (parity) had no effect on fat (Al-Sultan and Muhammad, 2007; Al-Shaikh and Salah, 1994).

![Fig. 7.3 Effect of parity on the fat percentage in milk of Kohi camel](image)

2. Protein: The protein% in the milk samples of first and second stage of lactation ranged from 3.70-4.30 and 3.10-4.40 with an average of 4.15 and 3.87, respectively in parities
The average protein percentage of both stage of lactations for all six parities ranged from 3.55-4.37 with an average of 4.01 as presented in Table 7.1.

The findings of our study are well in the range of many studies reported by various authors i.e. 3.50% by Kheraskov (1953), 3.95% by Ohri and Joshi (1961), 3.50% by El-Bahay (1962), 3.76% by Khan and Appanna (1964), 4.50% by Knoess (1976), 4.02% by Mukasa Mugerwa (1981), 3.70% by El-Agamy (1983), 3.50-4.50% by Bengoumi et al (2005) and 3.5-4.6% by Bhakat and Sahani (2006). The only findings reported by Yagil and Etzion (1983) with 4.60% protein disclosed a higher protein contents than that of our study.

The findings of the following scientists reported from the different parts of the world are considerably lower than the finding of our study reported by Knoess et al (1986) 2.20-2.59%; El-Amin and Wilcox (1992) 2.81%; Mehaia (1994) 2.80%; Guliye et al (2000) 2.79%; Iqbal et al (2001) 2.85%; Raghvendar et al (2005) 2.1-2.5% and Zeleke (2007) 2.67%.

The factors contributed for the variation of fat and were also responsible for the variation in protein contents of the Kohi camel milk. The higher protein contents of our study might be correlated with the quality of the available vegetation. The available vegetation in the study area is predominantly composed of leguminous flora like *Acacia* (15.31% CP) and *Caragana* (11.00%CP) species. The protein contents further increase, while the plant hanging with the pods especially *Caragan* specie with red lustering pods.

*Effect of Stage of Lactation on Protein*: The protein percentage was higher (4.15) in the first stage of lactation, than (3.87) in the second stage of lactation as presented in Table 7.1. The protein contents were comparatively higher in first stage of lactation in the first three parities (Fig. 7.4). Results of our study are in agreement with the findings of Bekele et al (2002), Zeleke (2007) and El-Hatmi et al (2004), who reported that the proteins were
higher in the first stage of lactation in camel milk. Actually the stage of lactation affects the milk protein not because of the involvement of one factor, but many factors are involved. The vegetation differs in nature between the first stage and second stage and not always available in the same quantity, as earlier stated by Al-Shaikh and Salah (1994), that the variation in milk protein have been attributed to nutritional management. The change in the milk quantity, advancement in the lactation and the physiological and hormonal change etc might be the cause of this variation. Detailed study is needed to know the cause responsible for the change in protein contents of Kohi camel milk.

Another cause of the variation might be the state of the calf, the calf needs high protein contents in the start of the life for speedy growth and solely depends on the dam’s milk. With the advancement in growth the calf start browsing and they take some of the protein requirements from the vegetation. Therefore the protein requirements decrease with the advancement of the age. This statement is in the agreement with that of Yagil and Etzion (1983), who stated the not only the environment but the need of the calf also dictate the milk quality.

![Graph](image)

**Fig. 7.4** Effect of stage of lactation on protein percentage in milk of Kohi camel
Effect of Parity on Protein: The protein percentage in the milk was lower in parity 1, 2 and 3 and increased and remained constant in the commencing parities of 4, 5 and 6 (Fig. 7.5). Our study results are not in agreement with the finding of (Zeleke, 2007) who reported that parity had significant effects on daily composition of protein and milk protein was significantly higher in parity 3, as compared to other parities.

![Graph showing the effect of parity on protein percentage in milk of Kohi camel](image)

Fig. 7.5 Effect of parity on protein percentage in milk of Kohi camel

In our study, the protein percentage increased in 4th parity. The probable difference in the parity might be the early maturity of the camel in the study area. And the increased protein percentage might be correlated with the body maturity of the camel. As the body size completes, the nutrient shift to the milk results in higher protein contents in the milk.

While some studies are in contrast with the finding of our study, i.e. study from Saudi Arabia Al-Sultan and Muhammad (2007) reported that the number of lactation (parity) had no effect on protein. Composition of the milk is not effected by lactation number and that variations in milk protein have been attributed to nutritional management, (Al-Shaikh and Salah, 1994).
3. Lactose: The lactose% in the milk samples of first and second stage of lactation ranged from 3.45-3.92 and 2.43-2.70 with an average of 3.67 and 2.55 respectively in all parities. The average lactose percentage of both stage of lactations for all six parities ranged from 2.97-3.31 with an average of 3.11 as presented in (Table 7.1) and the graphical form is presented in Fig. 7.6. The findings for lactose in our study are well in the range of 3.36% by Barthe (1905), 3.9% by El-Bahay (1962), 3.4% by Knoess (1976), 3.30% by Hjort and Dhal (1984), 3.4% by Bengoumi at el (2005) and 3.8% by Raghvendar et al (2005).

While the findings of the following studies are reported with the higher lactose contents than our study i.e. 5.0% by Kheraskov (1953), 4.88% by Ohri and Joshi (1961), 5.43% by Khan and Appanna (1964), 4.21% by Mukasa Mugerwa (1981), 4.6% by Yagil and Etzion (1983), 5.8% by El-Agamy (1983), 4.4% by Sawaya (1984), 4.59-5.33% by Knoess et el (1986), 5.61% by Gnan and Sheriha (1986), 4.17% by Ahmed, (1989), 5.24% by Farah and Ruegg (1989), 4.16% by El-Amin and Wilcox (1992), 4.47% by Farag and Kebary (1992) 4.6% by Mehaia (1994), 4.81% by Guliye et al (2000), 4.1% by Kouniba et al (2005), 4.4% by Bhakat and Sahani (2006) and 4.67% by Zeleke (2007).

But the only study reported by Ali-Gorban and Izzeldin (1997) from Saudi Arabia, states lower lactose contents (2.56%) than our study.

Our study is in contrast with the finding of Abdoun et al (2007), who reported that the lactose content of the camel milk was depressed in the dry season due to nutritional scarcity during that period. Our study was conducted in the wet season with almost lower lactose contents compared to the above studies conducted. However, there was difference in the lactose contents of this study regarding the stage of lactation.
Fig. 7.6 Effect of stage of lactation on the lactose percentage in milk of Kohi camel

The lactose contents were higher (3.67%) in first stage than (2.55%) the second stage of lactation. The lactose content was very irregular in all the parities and the line diagram signify this irregularity (Fig. 7.7), but Al-Sultan and Muhammad (2007) from Saudi Arabia reported that the number of lactation (parity) had no affect on lactose contents of camel milk.

Fig. 7.7 Effect of the parity on the lactose percentage in milk of Kohi camel
4. Ash: The ash% in the milk samples of first and second stage of lactation ranged from 0.66-0.70 and 0.70-0.78 with an average of 0.68 and 0.73, respectively among different parities (1-6). The average ash percentage of both stage of lactations for all six parities ranged from 0.68-0.73 with an average of 0.70 presented in (Table 7.8).

The findings of this study are in line with the studies of the following authors i.e. 0.70% by Kheraskov (1953), 0.76% by El-Bahay (1962), 0.73% by Khan and Appanna (1964), 0.70% by El-Agamy (1983), 0.70% by Hjort and Dhal (1984), 0.77% by Ali-Gorban and Izzeldin (1997), 0.77% by Guliye et al (2000), 0.79-0.90% by Bengoumi et el (2005), 0.70-0.90% by Bhakat and Sahani (2006) and 0.70% by Dukwal et al (2007).

On the hand the following studies reported from the different parts of the world are higher in ash contents than our study i.e. Ohri and Joshi (1961) 0.95%, Knoess (1976) 0.90%, Mukasa Mugerwa (1981) 0.79%, Yagil and Etzion, (1983) 0.60%, Sawaya (1984) 0.8%, Gnan and Sheriha (1986) 0.82%, Ahmed (1989) 0.82%, Farah and Ruegg (1989) 0.80%, El-Amin and Wilcox (1992) 0.83%, Farag and Kebary (1992) 0.80%, Mehaia (1994) 0.79% and Kouniba et al (2005) 0.83%.

The difference was observed in the ash contents based on the stage of lactation (Fig. 7.9). The ash was 0.68% in the first stage of lactation and 0.73 in the second stage of lactation. This statement agrees with the finding of El-Hatmi et al (2004) who reported that the ash contents increases at the 30 weeks of lactation and continue its increase in the commencing weeks and reached to its peak (1%) at 40 week of lactation.

The higher ash contents of the Kohi camel milk in the second stage of lactation might be correlated with the milk yield. The milk production lowered in the second stage of lactation and ultimately the ash contents increased. One other cause of this difference can be correlated to the change in the nature of the vegetation available during the both stages. In the second stage the camels of the study area graze on the salt bushes mainly because the other vegetation decreases in the autumn months in the region.
The ash contents followed an asymmetrical pattern (Fig. 7.9). The ash was (0.69%) in the first parity, increased to (0.72%) in parity 2 and again decreased to (0.70%) in the parity 3, this decrease was continued and reached to (0.76%) in the parity 4. The ash again increased in the parity 5 (0.68%) and reached to (0.71%) in the parity 6 and above.

Fig. 7.8 Effect of stage of lactation on the ash percentage in milk of Kohi camel

Fig. 7.9 Effect of parity on the ash percentage in milk of Kohi camel
7.3.3 Mineral contents of camel milk

The mineral (Na, Mg, Fe, Mn, Cu and Zn) composition of this study are presented in the Table 7.2. The affect of parity on the mineral content of the camel milk is presented in the Fig. 7.10.

![Graph showing mineral content across different parities](image)

**Fig. 7.10** Effect of parity on the mineral of the milk in milk of Kohi camel

1. Sodium (Na): The Na of this study ranges from 40.53-68.90 mg/100g with an average of 49.42 mg/100g (Table 7.2). Our results are well in the range of 43.10 mg/100g reported by El-Amin and Wilcox (1992). The findings of this study are higher than the findings of 23 mg/100g reported by Yagil and Etzion (1980c) and 31.2 mg/100g reported by Farag and Kebary (1992). Our study finding is lower than the findings of 67.7 mg/100g reported by 69 mg/100g by Sawaya et al (1984), 58.8 mg/100g by Abu-Lehia (1987), 69 by El-Hatmi et al (2004), 69 mg/100g Mehaia et al (2005) and 63.86 mg/100 by (Dukwal, 2007). The levels of sodium can be affected by seasonal heat and water intake (Yagil & Etzion, 1980c). The cause of higher Na contents of our study might be the nature of the topography of the habitat, where the camel live. The area is mountainous...
in nature with a good quantity and quality of the available vegetation, which might have caused the higher Na contents.

Table 7.2. Mineral composition of camel milk (mg/100g)

<table>
<thead>
<tr>
<th>Parity</th>
<th>Na</th>
<th>Mg</th>
<th>Fe</th>
<th>Mn</th>
<th>Cu</th>
<th>Zn</th>
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<td>0.073</td>
<td>0.22</td>
<td>1.93</td>
</tr>
<tr>
<td>6</td>
<td>42.52</td>
<td>14.75</td>
<td>0.56</td>
<td>0.073</td>
<td>0.27</td>
<td>1.34</td>
</tr>
<tr>
<td>Average</td>
<td>49.42</td>
<td>15.04</td>
<td>0.55</td>
<td>0.066</td>
<td>0.22</td>
<td>1.42</td>
</tr>
</tbody>
</table>

2. Magnesium (Mg): The finding of this study varies from 14.52-15.81 mg/100g with an average of 15.04 mg/100g (Table 7.2). Our study is well in the range of the finding of the other authors i.e. 18.1 mg/100g by Khan and Appanna (1964), 12 mg/100g by Sawaya et al (1984), 13.5 mg/100g by Abu-Lehia (1987) and 12.3 mg/100g by Mehaia et al (2005).

The finding of this study is higher than the findings of 10 mg/100g (Yagil and Etzion, 1980c), 8.3 mg/100g (Farah and Ruegg, 1989), 4.50 mg/100g (El-Amin and Wilcox, 1992) and 8.8 mg/100g (Farag and Kebary, 1992). The results reported by Ahmed et al, 1977 are much higher (21.0 mg/100g) than ours findings.

3. Iron: The iron (Fe) contents of this study ranges from 0.51-0.58 mg/100g with an average of 0.55 mg/100g (Table 7.2). The findings of this study are in line with the findings of 0.5 mg/100g reported by Knoess (1976) who reported the mineral contents in Ethiopian camel.

The findings reported by other authors are lower than the finding of this study, i.e. Indian (0.32 mg/100g; Khan and Appanna, 1964), Egyptian (0.37mg/100g; Ahmed et al, 1977), Saudi Arabian (0.26 mg/100g; Sawaya et al, 1984), (0.21mg/100g; Abu-Lehia, 1987),
The difference found between the different studies may be due to breed as earlier stated by (Ali-Gorban and Izzeldin, 1997). Not only the breed but the nature of vegetation and the topography of the habitat where the camel live also affect the iron quantity in the camel milk. The mountainous regions having higher iron contents in soil than that of the deserts. Most of the studies reported on the camel milk relate to the desert camel.

4. Manganese (Mn): The Mn of this study ranges from 0.060-0.073 mg/100g with an average of 0.066 mg/100g (Table 7.2). The finding of our study is very close to the finding of 0.050 mg/100g reported by Haddadin et al (2008), higher than the finding of 0.018 mg/100g reported by Abu-Lehia (1987).

5. Copper (Cu): The finding of this study varied from 0.19-0.27 mg/100g with an average of 0.22 mg/100g (Table 7.2). Our study is in the range of the studies reported by other authors i.e. 0.49 22 mg/100g by Ahmed et al (1977), 0.1522 mg/100g by Abu-Lehia (1987) and 0.14 22 mg/100g by Mehaia et al (2005).

6. Zinc (Zn): The zinc content of this study ranges from 1.12-1.93 mg/100g with an average of 1.42 mg/100g (Table 7.2). The findings of this study are higher than reported by other authors i.e. 0.44 22 mg/100g by Abu-Lehia (1987), 0.59 22 mg/100g by Mehaia et al (2005) and 0.58 22 mg/100g by Haddadin et al (2008). The higher zinc contents in our findings could be related with the composition of the soil. Further study is needed to know the correlation of the nature of the soil and the zinc contents of the milk.

In general there was no significant affect of the parity on the mineral composition of the camel’s milk except on the Na and Mn, where both the mineral were higher in the later parities than the earlier parities. The cause of this variation could be correlated with the age of the animal. The camel need minerals in their growing stage for growth and in the later stages for the compensation of the loss occurred due to increased wear and tear process.
Conclusion

Kohi camel is high milk producing animal in the ordinary grazing conditions of the Suleiman mountainous region. The milk quality of this breed of camel is additionally superior to other camels breed, reported from the different parts of the world. The high protein, iron, zinc and low fats and lactose contents illustrate the quality of the Kohi camel’s milk. The ash contents of Kohi camel is comparable with the other findings reported by many authors. The stage of lactation and the advancement in the lactation number (parity), no doubt affect the milk composition. The difference in the milk composition based on the parity could be correlated with the milk yield and age of the animals. The milk yields are medium in the early parities, increase in the following parities and lower in the later parities, therefore, affects the composition of the milk. The yield and fats contents relationship is well known as negatively correlated to each other. The stage of the lactation also affected the milk composition, and this change might be correlated with the yield of the camel, season of the year, availability of the vegetation and the physical and physiological status of the animal. The yield was generally high in the first stage of lactation and hence affected the composition. The fat contents were lower while the protein was higher in the first stage of lactation and vice verse.

The very interesting part of this study was the higher contents of the iron and zinc contents in the Kohi camel milk compared to the other studies reported by many scientists from the different parts of the world. This high level of these important minerals could be correlated with the nature of the mountainous soil and the breed of the camel.

The studies on camel milk in general are rare in Pakistan and very especially on the mountainous camel breeds of Balochistan like Kohi. Internationally the camel milk studies especially on its composition are scarce and mainly available on limited data and stationed camels. The milk studies for the pastoral herds are scarcely reported.

The author has personally observed that in the peak milk production the camels are milk only for the purpose to empty the udder of the animal and the milk is feed to the trees. The moving herd nature and remoteness of the herders make this bad state of condition. It is so for suggested if safe and sound storage could be made available especially in the
peak period so that the milk could be canalized which on one hand will be a source of income for the poor camel herders and the other hand as a food security of the country. The camel’s milk wastage is not only the wastage of the milk but a loss of the natural medicine available without any negative health hazards like the medicines available in the market.

Camel production can be profitable production system, based on introduction of marketable products from the lands where the milch camel exists. The value addition to the camel milk like common consumer products like Kulfi, ice cream and flavored milk could be a great help of the farmers and the introduction of new quality food in the food chain of the country. It is strongly recommended to inform the mass of the country about the importance of the camel milk and to remove the taboos related to it.

The low and quality lactose contents of the Kohi camel milk make it convenient to be well consumed by the lactose resistant kids where breast milk is not available to the requirements. On the other hand the low level of fats makes it friendly for the people with the complaint of the arteriosclerosis.

Protein and mineral deficiency are the major problems of the people in the country and malnutrition especially hit the remote areas of the country where camel milk could be making available easily.

Reference:


CONCLUSION

Camel plays a very pivotal role in the socioeconomic life of the herders in the northeastern Balochistan. The highest number of camel is found in the Kohlu district raised by the Marri tribe. Kohlu District of Suleiman mountainous region, Mari tribe is facing a lot of riddles in camel production and protection. Their problems of deforestation, expanding agriculture, decreasing rangelands, lack of infrastructure and marketing facilities, illegal export of camels and lack of modern veterinary facilities need to be addressed by the Livestock and Dairy Development Department and other policy makers. To save this financial loss to the public, as well as to the economy of Suleiman region, some drastic measures are warranted, so that this area can play a leading role in the camel preservation, enhanced milk production and even value addition to access the market of the area in particular and the country at large. This area can further act as a hub of camel production activities involving the Marri tribe who are the custodian of this unique animal genetic resource.

The Mangrota camel fair is the important socioeconomic activity of the camel herders of northeastern Balochistan. Thousands of camels and camel herders and businessmen participate in this fair each year. The herders of the Suleiman mountainous region catch reasonable prices of their camel in this event. The fair is a good place for the gathering of the camel herders annually. Moreover the herders especially, from Balochistan face some hurdles in the fair which must be rectified. The management of the fair was poor and there was no proper control of any authority. The contractor is the only person who halts the pastorals in the way what ever he wants. Fresh and clean water is scarcely available for the people here in fair. The muddy water of the rains was collected in pounds, was available for animals.

Camels are found to be the most persistent milk producer in arid and semi-arid areas of Eastern Balochistan with a little decline in milk yield as stage of lactation advances. Camel should accept a worthwhile milch animal and might be properly placed in the research and development projects of the country. The quality of camel milk must be
publicities at national and international level. In the context of the advancing urbanization, camel milk is increasingly commercialized and consumed in urban areas worldwide but why not in Pakistan. Camel milk is well suited for the kids devoid of breast milk

Kohi camel is high milk producing animal in the ordinary grazing conditions of the Suleiman mountainous region. The milk quality of this breed of camel is additionally superior to other camels breed, reported from the different parts of the world. The high protein, iron, zinc and low fats and lactose contents illustrate the quality of the Kohi camel’s milk. The ash contents of Kohi camel is comparable with the other findings reported by many authors. The stage of the lactation also affected the milk composition, and this change might be correlated with the yield of the camel, season of the year, availability of the vegetation and the physical and physiological status of the animal. The yield was generally high in the first stage of lactation and hence affected the composition. The fat contents were lower while the protein was higher in the first stage of lactation and vice versa.

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Protein and mineral deficiency are the major problems of the people in the country and malnutrition especially hit the remote areas of the country where camel milk could be making available easily.

Camel production can be profitable production system, based on introduction of marketable products from the lands where the milch camel exists. The value addition to the camel milk like common consumer products like Kulfi, ice cream and flavored milk could be a great help of the farmers and the introduction of new quality food in the food chain of the country. It is strongly recommended to inform the mass of the country about the importance of the camel milk and to remove the taboos related to it.

In short camel play a very important socioeconomic role in the life of the herders of the northeastern Balochistan and is a very important food animal for the nomadic and transhumant people. As the food crisis increasing worldwide and the countries like Pakistan is severely affected by this dilemma, the untapped source like camel must utilize based on its potentials. Developmental and institutional steps are needed to coup the old world camel of the pastoral people with the modern pace of the world especially in Balochistan.
APPENDICES

Table Appendix 2.1 Male hormonal profile during rutting and non rutting seasons

<table>
<thead>
<tr>
<th>No</th>
<th>Testos</th>
<th>Cortisol µg/dl</th>
<th>FSH I.U/ml</th>
<th>LH I.U/ml</th>
<th>Prol.</th>
<th>Methodology</th>
<th>Scientist</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>A</td>
<td>B</td>
<td>A</td>
<td>B</td>
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<td>B</td>
<td>A</td>
</tr>
<tr>
<td>1</td>
<td>24</td>
<td>4</td>
<td></td>
<td></td>
<td>4.62</td>
<td>2.07</td>
<td>2.98</td>
</tr>
<tr>
<td>2</td>
<td>2.99</td>
<td>0.60</td>
<td>3.6</td>
<td>0.96</td>
<td></td>
<td></td>
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</tr>
<tr>
<td>3</td>
<td>9.25</td>
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<td></td>
<td></td>
<td>0.88</td>
<td>0.22</td>
<td>1.02</td>
</tr>
<tr>
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<td>1.92</td>
<td>.99</td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>5</td>
<td>19.36</td>
<td>0.35</td>
<td></td>
<td></td>
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<td>6</td>
<td>8658.2</td>
<td>616.83</td>
<td></td>
<td></td>
<td></td>
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</table>

Note: A stands for rutting season, while B stands for non-rutting season
### Appendix Table 2.2 Daily & Lactation yield potential reported by various camel workers

<table>
<thead>
<tr>
<th>Country</th>
<th>Av. body wt. (kg)</th>
<th>Av. daily yield</th>
<th>Av. Lact. Yield</th>
<th>Av. Lact. length</th>
<th>Calculated Av. Lact. Yield of 305 days</th>
<th>Author</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pakistan</td>
<td>-</td>
<td>8-10</td>
<td>4,179</td>
<td>One year</td>
<td>-</td>
<td>Stal, 1950</td>
</tr>
<tr>
<td>Pakistan</td>
<td>3.5-13.5</td>
<td>1350-3660</td>
<td>-</td>
<td>1068-4118</td>
<td></td>
<td>Yasin and Wahid, 1957</td>
</tr>
<tr>
<td>Egypt</td>
<td>380-400</td>
<td>3.5-4.5</td>
<td>1600-4000</td>
<td>-</td>
<td>1068-1373</td>
<td>El-Baby, 1962</td>
</tr>
<tr>
<td>Pakistan (Heavy)</td>
<td>450</td>
<td>15-35</td>
<td>5475-12775</td>
<td>12</td>
<td>4575-10675</td>
<td>Knoess, 1968</td>
</tr>
<tr>
<td>India</td>
<td>-</td>
<td>10.8</td>
<td>-</td>
<td>-</td>
<td>3294</td>
<td>India, 1970</td>
</tr>
<tr>
<td>Pakistan</td>
<td>1195 kg</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Kiwowa, 1973</td>
</tr>
<tr>
<td>India</td>
<td>350</td>
<td>4.5-9.1</td>
<td>2430-4914</td>
<td>15</td>
<td>1373-2776</td>
<td>Rao, 1973</td>
</tr>
<tr>
<td>India</td>
<td>450</td>
<td>6.9-18.2</td>
<td>3105-8190</td>
<td>-</td>
<td>2105-5551</td>
<td>Rao, 1974</td>
</tr>
<tr>
<td>Tunisia</td>
<td>-</td>
<td>4</td>
<td>-</td>
<td>12</td>
<td>1220</td>
<td>Burgermeister, 1974</td>
</tr>
<tr>
<td>Libya</td>
<td>380-400</td>
<td>8.3-10</td>
<td>2700-4000</td>
<td>9-16</td>
<td>2532-3050</td>
<td>GEFL, 1977</td>
</tr>
<tr>
<td>Ethiopia</td>
<td>360</td>
<td>5-13</td>
<td>1872-2592</td>
<td>12-18</td>
<td>1525-3965</td>
<td>Knoess, 1977</td>
</tr>
<tr>
<td>Pakistan</td>
<td>-</td>
<td>6.7-10</td>
<td>2700-3600</td>
<td>9-18</td>
<td>2044-3050</td>
<td>Leopold, 1978</td>
</tr>
<tr>
<td>Somalia &amp; Egypt,</td>
<td>5 kg</td>
<td></td>
<td></td>
<td>353 days</td>
<td></td>
<td>Yagil, 1982</td>
</tr>
<tr>
<td>Pakistan</td>
<td>-</td>
<td>12000</td>
<td>9-18</td>
<td></td>
<td></td>
<td>Schwartz, 1992</td>
</tr>
<tr>
<td>Syria</td>
<td>-</td>
<td>2550-2900 kg</td>
<td>300 days</td>
<td></td>
<td></td>
<td>Wardeh, 1994</td>
</tr>
<tr>
<td>Pakistan</td>
<td>-</td>
<td>(11.66)10.3</td>
<td>4260</td>
<td>12</td>
<td></td>
<td>Iqbal, 2002</td>
</tr>
<tr>
<td>Pakistan</td>
<td>-</td>
<td>1894.93</td>
<td>15 mo</td>
<td></td>
<td></td>
<td>Baloch, 2001</td>
</tr>
<tr>
<td>Somalia &amp; Egypt,</td>
<td>3-10</td>
<td></td>
<td></td>
<td>12-18</td>
<td></td>
<td>Farah et al, 2004</td>
</tr>
<tr>
<td>Kenya</td>
<td>3.24-5.39</td>
<td>12 mo</td>
<td></td>
<td></td>
<td></td>
<td>Reta and Mekonnen, 2002</td>
</tr>
<tr>
<td>Eastern Ethiopia</td>
<td>1244-2009 kg</td>
<td>13-15 months</td>
<td></td>
<td></td>
<td></td>
<td>Belay and Getahun, 2002</td>
</tr>
<tr>
<td>UAE</td>
<td>8-9</td>
<td></td>
<td>11</td>
<td></td>
<td></td>
<td>Wernery et al, 2004</td>
</tr>
<tr>
<td>Somalia</td>
<td>3-10</td>
<td></td>
<td>12-18</td>
<td></td>
<td></td>
<td>Farah et al, 2004</td>
</tr>
<tr>
<td>Kenya</td>
<td>4-7</td>
<td>12</td>
<td></td>
<td></td>
<td></td>
<td>Dell’Orto et al, 2000; Mehari et al, 2007</td>
</tr>
<tr>
<td>Somalia</td>
<td>3-10</td>
<td></td>
<td>12-18 mo</td>
<td></td>
<td></td>
<td>Farah et al, 2007</td>
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### Appendix Table 2.3 Milk compositions reported from the different parts of the world

<table>
<thead>
<tr>
<th>No</th>
<th>Fat</th>
<th>SNF</th>
<th>CP</th>
<th>Lactose</th>
<th>Ash</th>
<th>TS</th>
<th>Density</th>
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<tr>
<td>1</td>
<td>3.8</td>
<td>12.12</td>
<td>3.5</td>
<td>3.9</td>
<td>0.76</td>
<td></td>
<td></td>
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<tr>
<td>2</td>
<td>4.1</td>
<td>2.0</td>
<td>4.2</td>
<td>0.7</td>
<td></td>
<td></td>
<td></td>
<td>FAO/USDA, 1968</td>
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<tr>
<td>3</td>
<td>5.5</td>
<td>8.9</td>
<td>4.5</td>
<td>3.4</td>
<td>0.9</td>
<td>14.4</td>
<td></td>
<td>Knoess, 1976 (Ethiopia)</td>
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<tr>
<td>4</td>
<td>4.3</td>
<td>4.6</td>
<td>4.6</td>
<td>0.6</td>
<td></td>
<td></td>
<td></td>
<td>Yagil and Etzion, 1983 (Israel)</td>
</tr>
<tr>
<td>5</td>
<td>3.6</td>
<td>3.0</td>
<td>4.4</td>
<td>0.8</td>
<td></td>
<td>11.7</td>
<td></td>
<td>Sawaya, 1984</td>
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<tr>
<td>6</td>
<td>3.45</td>
<td>7.98</td>
<td>3.00</td>
<td>4.17</td>
<td>0.82</td>
<td>11.49</td>
<td>1.027</td>
<td>Ahmed, 1989 (UAE)</td>
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<tr>
<td>7</td>
<td>3.15%</td>
<td>2.81%</td>
<td>4.16%</td>
<td>.83%</td>
<td></td>
<td>10.95</td>
<td></td>
<td>El-Amin and Wilcox, 1992. (Kingdom of Saudi Arabia)</td>
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<tr>
<td>8</td>
<td>3.39</td>
<td>2.79</td>
<td>4.81</td>
<td>0.77</td>
<td></td>
<td>11.5</td>
<td></td>
<td>Guliye et al, 2000 (Arabian Peninsula)</td>
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<tr>
<td>9</td>
<td>3.57</td>
<td>9.00</td>
<td>2.85</td>
<td></td>
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<td>12.36</td>
<td></td>
<td>Iqbal et al, 2001a. (Pakistan)</td>
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<tr>
<td>10</td>
<td>2.7</td>
<td>3.3</td>
<td>4.1</td>
<td>0.83</td>
<td></td>
<td>10.8</td>
<td></td>
<td>Kouniba et al, 2005 (Morocco)</td>
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<tr>
<td>11</td>
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<td>3.5-4.5</td>
<td>3.4-5.6</td>
<td>0.7-0.9</td>
<td>8-15</td>
<td></td>
<td></td>
<td>Bengoumi et el. 2005 (Sub-Saharan Africa)</td>
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<tr>
<td>12</td>
<td>5.65</td>
<td>3.55</td>
<td>4.24</td>
<td>0.87</td>
<td></td>
<td>14.31</td>
<td></td>
<td>Zhang et al, 2005. (Chinese Mongolia)</td>
</tr>
<tr>
<td>13</td>
<td>1.5-3.1</td>
<td>7-8</td>
<td>2.1-2.5</td>
<td>3.8-4.3</td>
<td></td>
<td>8-11</td>
<td></td>
<td>Raghivendar et al 2005 (India)</td>
</tr>
<tr>
<td>14</td>
<td>2.9-3.5</td>
<td>8.2-14.3</td>
<td>3.5-4.6</td>
<td>3.4-5.8</td>
<td>0.7-0.9</td>
<td></td>
<td></td>
<td>Bhakat and Sahani, 2006 (India)</td>
</tr>
<tr>
<td>15</td>
<td>2.47</td>
<td>2.67</td>
<td>4.67</td>
<td>10.44</td>
<td></td>
<td></td>
<td></td>
<td>Zeleke, 2007 (Ethiopia)</td>
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### Appendix Table 2.4 Preferred plants reported from the different parts of the world

<table>
<thead>
<tr>
<th>No</th>
<th>Study Area</th>
<th>Preferred plant spp.</th>
<th>Workers</th>
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</thead>
<tbody>
<tr>
<td>1</td>
<td>Australia</td>
<td><em>Euphorbia tannenis</em> &amp; <em>Trichodesma zyelianicum</em></td>
<td><em>Newman</em> (1975)</td>
</tr>
<tr>
<td>2</td>
<td>East Africa</td>
<td><em>Aristida adscension</em> &amp; <em>Deuosperma eremophilum</em></td>
<td><em>Schwartz</em> (1992)</td>
</tr>
<tr>
<td>3</td>
<td>Ethiopia</td>
<td>Acacia, Balanites, Salsola, Tamarix and Alfalfa and Panicum maximum</td>
<td><em>Knoess</em> (1977)</td>
</tr>
<tr>
<td>4</td>
<td>India</td>
<td><em>Acacia prosopis</em>, salvadora, wild olive, zizyphus, indigofera, Zizyphus nummularia, Prosopies sineraria, Callygonum polygonodes, Capparis deciduas, Lasirus sindicus, salt bushes, green foders and dry forages</td>
<td><em>(Ranjan, 1997; Chaudhary et al, 2003)</em></td>
</tr>
<tr>
<td>5</td>
<td>Kuwait</td>
<td><em>Rhanterium eppaposum</em>, <em>Penicum turgidum</em>, <em>Haloxylon salicornicium</em> &amp; <em>Sovignia perviflora</em></td>
<td><em>Ibnoaf</em> (1987)</td>
</tr>
<tr>
<td>6</td>
<td>Pakistan</td>
<td>Acacia, Aristidia, Albezia, Atriplex, Calligonum, Capparis, Gymnocarpos, Helianthimum, Parkinsonia, Prosopis, Saheadora, Salsola, Salvador, Suaeda, Tamarix, Tecom &amp; Zizyphus</td>
<td><em>Khan, 1996</em></td>
</tr>
<tr>
<td>7</td>
<td>Pakistan</td>
<td><em>Acacia modesta</em>, <em>Acacia nilotica</em>, <em>Alhagi camelarum</em>, <em>Heteropogon contortus</em> &amp; <em>Olea ferruginea</em></td>
<td><em>Iqbal, (2002)</em></td>
</tr>
</tbody>
</table>
**Appendix Table 3.1** Description of the individual animals

<table>
<thead>
<tr>
<th>No</th>
<th>Measurement</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Wither height</td>
<td>measured from the ground to the level of the top end of the Vertebra thoracica</td>
</tr>
<tr>
<td>2</td>
<td>Thoracic girth</td>
<td>measured directly behind the sternal pad</td>
</tr>
<tr>
<td>3</td>
<td>Abd. girth</td>
<td>The girth above the hump behind the naval card</td>
</tr>
<tr>
<td>4</td>
<td>Breast width</td>
<td>from the head of one Olecranon to the one on the opposite side in a horizontal line</td>
</tr>
<tr>
<td>5</td>
<td>Rump Length</td>
<td>from the shoulder Pars caudalis tuberculi majoris to the hip Tuber ischiadicum</td>
</tr>
<tr>
<td>6</td>
<td>Dist b/w ulna</td>
<td>determined at the parallel part of the fore arms Ulnae</td>
</tr>
<tr>
<td>7</td>
<td>Foot/pad fore</td>
<td>measured parallel to the soles including the nails on the left side of the animal</td>
</tr>
<tr>
<td>8</td>
<td>Foot/pad hind</td>
<td>measured parallel to the soles including the nails on the left side of the animal</td>
</tr>
<tr>
<td>9</td>
<td>Hip length</td>
<td>measured as the distance from the Tuber ischiadicum to the Tuber sacral</td>
</tr>
<tr>
<td>10</td>
<td>Ster. pad dist.</td>
<td>from the lowest point of the pad to the ground</td>
</tr>
<tr>
<td>11</td>
<td>Can. Bon. Circ.</td>
<td>measured around the metacarpus below it’s proximal end</td>
</tr>
<tr>
<td>12</td>
<td>Tail length</td>
<td>determined from the point the tail starts to the end of the vertebrae</td>
</tr>
<tr>
<td>13</td>
<td>Tail circ.</td>
<td>Near the base of the tail</td>
</tr>
<tr>
<td>14</td>
<td>Head lth</td>
<td>measured from the lateral end of the Os nasale to the Protub. Occipitalis externa</td>
</tr>
<tr>
<td>15</td>
<td>Head wth</td>
<td>measured between the widest point across approximately at the level of the lateral end of the Squama frontalis</td>
</tr>
<tr>
<td>16</td>
<td>Neck length</td>
<td>Start from the first cervical vertebra to the last cervical vertebra</td>
</tr>
<tr>
<td>17</td>
<td>Neck circ.</td>
<td>The circumference at the mid of the neck</td>
</tr>
<tr>
<td>18</td>
<td>Ear length</td>
<td>From the base to the tip of the ear</td>
</tr>
<tr>
<td>19</td>
<td>Ear width</td>
<td>From the one end to the other horizontally from external side</td>
</tr>
<tr>
<td>20</td>
<td>BCS</td>
<td>for descriptions see below</td>
</tr>
</tbody>
</table>
CV

Mr Abdul Raziq Kakar s/o Haji Hassan Khan is a bona fide tribesman of Tahsil Bori, Distt Loralai, Balochistan. He graduated from High School Loralai (1978) and entered to Govt Degree College, Loralai to clear his F.Sc. pre-medical from BISE, Quetta (1990). He qualified his BA exam in Sociology (1993) from University of Balochistan, Quetta and then came up to Faisalabad and joined the Faculty of Animal Husbandry, University of Agriculture (UAF), Faisalabad, Punjab, Pakistan. He graduated from the Faculty in 1996 and earned his Baccalaureate degree of B.Sc. (Hons.) Animal Husbandry with good grades. Having completed his Bachelor degree, he joined College of Veterinary Science, Lahore for Master program in Animal Nutrition. He completed his M.Sc.(Hons.) Animal Nutrition in 2004 from UAF.

He joined the Dept of Livestock & Dairy Dev Dept, Balochistan and served there in capacity of ADLO (Loralai, Musakhel & Usta Muhammad Khan), DDO (Loralai) and got leave for icing on his cake and joined his PhD program in Dept of Livestock Management, considering camel as his special subject. His interest grew in camel specie and he made an extensive touring of his area, rather most of Balochistan, and collected extensive data for his PhD research from whole Suleiman Mountainous Region. He collected lot of information on his subject, analyzed and presented his findings in ISOCARD Conf at Al-Ain, UAE (Apr 2006), accompanied his supervisor to International Camel Conf in Bikaner, Rajasthan, India, (Feb 2007) and later he presented the plight of his pastoral people in International Tech Conf on AGR Interlaken, Switzerland (Sep 2007). He is a member of many learned subject societies and patron of the herders association of his area.

He has published his research work in world renowned national and international Journals and other useful proceedings. Much of his work is expected to be published in near future in journals with impact factor and will bring a lot of fame for his Dept of Livestock Management and himself, pertaining to his PhD Program for which he is a candidate right now.