DR. CHAMPAK BHAKAT

Hand Book Of
**ANIMAL
HUSBANDRY
SCIENCES**

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CAMEL PRODUCTION AND MANAGEMENT

Dr. Champak Bhakat

As desert land area is prone to frequent draught, the small and marginal farmers rest heavily on livestock enterprise for their sustenance. The livestock should be compatible with crop cultivation instead of competing with it for land and water resources. Camel rearing enterprise fits well with such requirements. In comparison to other livestock species camel remained neglected until this century when it drew attention because of its unique adaptive characteristics for survivability in the harsh conditions of the desert Eco-system. The camel "Ship of the desert" uses various adaptive mechanism rather than bullock for survival in the desert. For instance, cattle in the central desert of Australia with daily temperature of 40°C were reported to have died without water in four days while camels survived for more than 15 days in the same environment. It has been estimated that a well-fed camel could carry some months energy on its back while cattle are unlikely to have more than two-three months if run out of food. Therefore, camel can tolerate high temperature, solar radiation and water deprivation and subsists on poor quality thorny vegetation. Since maximum of the gross cultivated area of our country is non-irrigated camel hold a significant potential for financing. Camel energy is not only cost effective but also profitable and remunerable. The abbreviation of "CAMEL" may be expanded as 'C'-carrier, 'A'-Arid zone, 'M'-multipurpose, 'E'-Eco-friendly and "L"-Livestock. Their ability to survive long period under hot dry climate without water is legendary. Through ages, the anatomy and physiology of camel has evolved mechanisms to combat the hostile environment of the desert, to thrive on scanty food, to dissipate body heat and to survive without water for long periods. Modified structure of the four stomachs, ability to digest coarse vegetation, rise in body temperature, passing of concentrated urine and dry feces are some fine examples. The ratio of camel to other livestock species in different villages of Thar districts are analysed. The camel to sheep and goat ratio is highest (1:12.45) followed by cattle ratio (1:8.56) and buffalo ratio (1:0.31). The overall Camel and Herbivore ratio is 1:21.3.

The total world camel population is estimated to be 19.32 million of which India has of 1.03 million (FAO 2002). Indian camel population is mainly confined to north-western states viz. Rajasthan, Gujarat, Haryana and Punjab (93.12%) of total

PRODUCTION AND MANAGEMENT

camel population higher than.

COM

evaluation of India various quantitative

Bikaneri breed

camels of Bikaneri Bikaneri camels are white is Bikaner region and 700 kg. In general head has a well-marked growth of black hair. The "Jipra" strain of Bikaneri hair around eyes, ears and animals have normal marked 'stop' - a hump on forehead. Muzzle and of the elbows. The hair is curly and erect. Neck hump is very well developed centrally on the back. Ribs cage is broad and all tufts of hair switch are well developed and the lactating females is on the part of abdomen. The girth and height at withers 121.6 cm, respectively and 1.93 cm, respectively. Heart girth in adult camel 200.7 ± 1.09 cm and 184 cm length, height and heart respectively.

Jaisalmeri breed

Jaisalmeri camels are grey home tract in Jaisalmer and thin legs, small head and depression above eyes. Jaisalmeri have very good run average body length, heart girth 183.6 ± 1.57 and 166.7 ± 1.79.8 ± 1.53 and 164.3 ± 1.94.5 ± 1.83 to 198.4 ± 1.

Indian camel population highest density (70.13%) of camel exists in eleven arid districts of Rajasthan.

COMMON BREEDS OF CAMEL

The evaluation of Indian common three breeds of camel has conducted on the basis of various quantitative and qualitative characters over the years. These are as follows :

1. Bikaneri breed

The camels of Bikaneri breed are of good height, strong in build and of active nature. Bikaneri camels are well known for its drought characteristic. The home tract of Bikaneri breed is Bikaner region and near by areas. The average adult weight varies from 500 kg to 700 kg. In general body color varies from brown to dark blackish brown. The forehead has a well-marked depression above the eyes. Some animals have a prominent growth of black hair on the eyebrows, eyelids and ears, they are known as 'Jipra'. The 'Jipra' strain of Bikaneri breed have comparatively more abundant, heavy growth of hair around eyes, ears below the muzzle and neck, thick eye lashes, otherwise, Bikaneri animals have normal hairy coat. The head is of medium size and heavy looking with a well marked 'stop' - a hollow above the eyes causing the nose to tilt upwards on the forehead. Muzzle and chin are small and tight. Chest-pad is placed between the angles of the elbows. The body is symmetrical, elongated and massive. Ears are small, hairy and erect. Neck is medium to long, curved giving graceful carriage of head. Hump is very well developed both in males and females and it is dome shaped and placed centrally on the back. Both fore and hind legs are long, strong and well developed. Ribs cage is broad and well arched. Hindquarters are drooping. Tail is short with small tufts of hair switch at the end. Pinbones are prominent and quadrangular. Mammary glands are well developed and placed high-up on the groin, caudal to anus. The udder in the lactating females is well developed having four teats and is finely suspended from the hind part of abdomen. The milk vein is very prominent. The average body length, heart girth and height at wither in males are 158.6 ± 2.69 , 186.7 ± 1.71 and 173.5 ± 1.93 cm, respectively while in female animals 154.9 ± 2.41 , 176.8 ± 1.53 and 166.7 ± 1.98 cm, respectively. The sex wise pooled average for body length, heart girth and height at wither in adult camels varies from 173.5 ± 2.50 to 184.3 ± 1.72 cm, 195.9 ± 1.09 to 200.7 ± 1.09 cm and 184.9 ± 2.0 to 193.5 ± 1.38 cm, respectively. The heritability for body length, height and heart girth is 0.6 ± 0.37 , 0.8 ± 0.57 and 0.7 ± 0.43 respectively.

Jaisalmeri breed

Jaisalmeri camels are gracious, lightly built and well for riding and race potential. Their home tract is Jaisalmer and nearby areas. The animals are quite tall with long thin legs, small head and mouth, narrow muzzle ; the forehead is not having depression above eyes. Jaisalmeri camels have a thin skin and short hair on the body. They have very good running ability. Body color is predominantly light brown. The average body length, heart girth and height at wither in male camels are 157.6 ± 1.57 , 183.6 ± 1.57 and 166.7 ± 1.98 cm, respectively while in female animals 155.5 ± 1.53 and 164.3 ± 1.94 cm, respectively. The sex wise pooled average body length, heart girth and height at wither for adult camels ranges from 171.6 ± 2.89 to 178.9 ± 1.83 cm, 194.5 ± 1.83 to 198.4 ± 1.24 cm and 181.7 ± 2.31 to 190.8 ± 1.56 cm, respectively.

□ Kachchhi breed

The camels of Kachchhi breed are heavy, well built and good milch animals with home track in Kach and nearby regions of Gujarat. These animals are good in draught, though bit slow. The forehead is not having any depression above eyes, ears are small and lactating females have well developed udder. The body conformation resembles with that of jaisalmeri except coat color which is dark. The hairs are curly type. The females are good milkers and can give about 4 to 6 kg milk per day. In general face has low hair coverage and body color is predominantly dark brown. The average body length, heart girth and height at wither in male animals are 153.1 ± 3.87 cm, 180.5 ± 2.46 cm and 165.9 ± 3.10 cm, respectively while in female camels 149.4 ± 1.97 cm, 168.7 ± 3.16 cm and 154.5 ± 3.98 cm, respectively. Sex wise pooled average body length, height and heart girth in adult camels range from 163.3 ± 5.5 to 181.1 ± 3.13 cm, 182.8 ± 3.49 to 197.9 ± 1.98 cm and 172.6 ± 4.4 to 192.3 ± 2.50 cm, respectively.

SYSTEMS OF MANAGEMENT

The camel has been domesticated more recently than other animals. The most probable period of domestication of camel is prior to 1800 BC. The methods of camel keeping are now changing worldwide because the grazing land is decreasing as more land is put under cultivation reducing the free grazing land. Camels which are largely maintained under extensive system are now facing problem and their management needed a better alternate system which is socially acceptable and economically viable.

□ Camel Management by Raikas

Large camel herds are owned by Raika/Rabri community. Other groups viz. Jat, Rajput, Muslim owned small number of camels. The Raikas are intimately familiar with the lineage of their camel and provide information on the performance of camel of the last 7-8 generations. The recent camel management by Raikas are extremely diverse, varying from free ranging for most of the year at one extreme to continuous closely supervised herding at the other. The ecological setting and the degree of competition from other land use strategies determine which particular herding system is adhered to it. Many of the migratory camel herd return at regular intervals to the villages for water, but they can also range several hundred km from their owners home. The Raikas are able to keep track of their movements because they can identify the footprints of each of their camels.

□ Camel Management by Extensive System

In this system, camels are allowed to graze freely and reproduce freely. All the camels are collected once usually in the spring season for hair shearing, treatment against mange, branding etc. The animals are released for free grazing again after above operations. It is usually necessary to collect camel herds during the 3 months of the rainy season (July to September) to prevent them from damaging crops. Most but not all herders also like to supervise their camels during the breeding season which traditionally falls between the two Hindu festivals of Diwali (around November) and Holi (around March) in order to prevent fight between competing males.

□ Camel Management by Semi-extensive System

In this system camels are maintained around cities and villages in the marginal area. During severe drought period camels are fed special feed lots for 2-4 months during this period daily gain are expected to be more.

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HOUSING MANAGEMENT

The open type shed is provided with 1.5 meter high barbed wire fencing. Studs of those experimental animals which require individual feeding are kept under roofed shed separately. Each animal is provided with 30-35 m² space and a manger of 75 cm × 75 cm × 40 cm internal dimension. Pregnant and recently calved animals should be kept in a separate open type shed. Sick animals are housed in a sick house of 6 m dimension. The soiled sand of the floor is replaced with new sand.

Manger. A manger about 90-120 cm high is constructed. A square pillar about 1 m height is erected and over it, a platform of about 70 cm × 70 cm is constructed. A wall of 15 cm thickness is built on all the four sides of it from 30 to 45 cm height. This is box like manger without lid.

Other types of Manger. The cheapest type is constructed by (i) Digging a hole in the ground of about 50-70 cm diameter and 50 cm deep, (ii) The manger is made up of kachchha bricks or mud and cow dung or pucca bricks.

At an organised farm like NRCC, Bikaner, following three types of shelter of camel are available.

1. Thatched roofed open type Kuchchha shelter. It has constructed according to locally available ecofriendly agricultural materials. It is having covered as well as open area. The roof is made up of Khemp (*Leptadenai Pyrotechnica*). One side of it is to be supported by wall and other side by pillars (14"). Kuchchha manger is constructed with mud plastering in side covered area. The enclosure are made up of balli/bamboo of 6 ft height. Front side of enclosure is having a gate which is sliding type. The height of roof is 15 ft (Back) and 12 ft (front) with sufficient slope. The covered area is 33 ft (length) × 14ft (breath). The floor is kuchchha with loose sand. Total area space of this shelter has length -40 ft, Breath-33 ft. It is open type shelter.

Dimension of manger : Length-32 ft, breadth-2.5 ft, inside depth 1.5 ft, height front wall from ground 3.5 ft.

2. Asbestos roof close type concrete shelter. It is also having covered and open area. The covered area is covered by asbestos roof with concrete wall at 3 sides. The floor has loose sand dune. The manger is of concrete/pucca type. The open area is enclosed with balli/bamboo of having a gate at front side. The gate is of sliding type. The total area space (covered and open), height of roof, dimension of manger and enclosure are almost similar to thatched roofed open type kuchchha shelter.

3. Under tree shed/loose housing system. In this system the open type paddock is provided and it is enclosed by wire fencing. The fence is supported by iron angle. Some Kikar trees (*Prosopis*, *Juliflora*) are kept to provide shed to camels. The floor is Kuchchha with loose sand dune. Kuchchha manger is constructed with mud plastering at beneath the tree sheds. The manger is of round type. The dimension of manger, height of fence etc. are almost equal to other two types of shelter.

FEEDING MANAGEMENT

Camel mostly get feed from trees, bushes and rarely from grasses. In stall feeding conditions the average feed consumption is maximum in the initial 2 hrs which decrease subsequently. The camel continued to consume feed during night time and eat 35-40% of total feed constitution during night alone. The average daily feed consumption during day time ranges from 2.33 ± 0.36 kg to 7.22 ± 0.46 kg per day. The average feed consumption

during night ranges from 2.28 ± 0.51 kg to 4.33 ± 0.42 kg per day. The average daily water consumption varies from 12.91 to 25.23 l per day. The phenotypic correlation between the feed and water intake is high (0.86).

Table 1. Feeding Schedule followed at an Organised Farm (NRCC, Bikaner)

Age (months)	Fodder and Concentrate
Up to 12 month of Age	2.5 kg fodder + 0.5 kg Concentrate Mixture
1-2 year	5 kg fodder + 1 kg Concentrate Mixture + 30 gm salt.
2-3 year	8 kg fodder + 1.5 kg Concentrate Mixture + 90 gm Salt.
Above 3 year	12 kg fodder + 2.5 kg Concentrate Mixture.
Studs.	14 kg fodder + 3 kg Concentrate Mixture.

In semi intensive condition camels are provided with dry fodder viz. moth, guar, mumphali chara. Concentrates mostly include molasses, oil (from groundnut or sesame), and ghee (butter oil processed from milk) and sometimes cereals, pulses, alum (hydrated Aluminium Potassium Sulphate).

□ Feeding Behaviour

The grazing and feeding behaviour reveals that animal eat fodder for 5 to 20 min at stretch and then paused for re-gurgitation for 10-15 min and resume eating. The rate of fodder eating and regurgitation decreases as the day progress. In general camels eat minimum fodder between 6.0 to 8.0 P.M. when they prefer to lie down taking occasional rest by prostrating, squatting or simple standing. The animal should be fed twice in a day if kept at farm. The working animals should be fed thrice a day and animal which go daily for outside browsing may be fed once in a day in the evening.

□ Grazing behaviour

Grazing is highest in the morning time and is reduced to minimum during evening time. Camel prefers such species of plants that are high in moisture like khejri (*Prosopis cineraria*), Pala (*Zizyphus nummularia*), Phog (*Callygonum polygonoides*) during summer and plants high in oxalate contents like kher (*C. decidua*) and sewan grass (*L. indicus*) during rainy season. Camel can eat off leaves of 9 to 11 ft tall trees. The short and young animals follow the leader who is tall and has a trick to catch the high top branches and bring them down by giving a jerk so that the other animals can eat them.

□ Nutritional Requirement of Camel

The DM consumption of an adult camel is 1.8 to 2.0% of body weight. Intake of DM increases with higher energy requirements. The maintenance requirement of 500 kg male are 45 to 55 MJME and 260 to 300 g DCP. For each additional one hour work approximately 8 MJME is needed. For females, the energy requirement is 40-45 MJME and 260 gm DCP and about 5 MJME and 50 gm DCP for each additional one kilogram of milk (Khanna, 2000). Daily requirement for 10 hr. work is 136 MJME and 300 g DCP. Metabolic energy requirement of about 300 kg camel is 5424 kcal per day of 75 cal per kg b 0.75 wt per day. The camels are very efficient utilisers of

CAMEL PRODUCTION AND MANAGEMENT

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□ Different stages

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□ Post partum behaviour

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metabolic energy content of the diet and utilise with about 68-70% efficiency. The metabolizable energy requirement of camel is lower than other ruminants. It has been suggested ME_m of camel is approx. 0.50 MJME m/kg b wt. 0.75 per day. The digestible crude protein requirements has been estimated at 1.4 to 1.5 gm DCP/kg b wt./day.

REPRODUCTIVE MANAGEMENT

Symptoms of labour pain during parturition in camel

Behavioural sign of labour pain of parturient camel are as follows :

- ☛ The parturient camel wants to be alone and separate from the main herd is very common and prominent sign.
- ☛ The showing two grooves on either side of the root of tail.
- ☛ Concavity between the site of pin bone which is mainly due to relaxation of sacro-siatic ligaments.
- ☛ Vulva is visible swollen round.
- ☛ Repeated lying down-standing up.
- ☛ Superficial mammary vein become tense and tortuous.
- ☛ Swelling of udder and teat are very common sign which indicates that delivery process is likely to be start very soon.

Where as some other sign viz. 'Looking to the Flank' and 'aggressiveness' are so common.

Different stages of parturition

Phenomenon during different stages of parturition of camel is given in table 2. In maximum case (80%) allanto-chorion (A-C) bag expelled out only after rupturing where as there are very few cases (20%) where A-C bag expelled out as such and ruptured outside and subsequently released straw color fluid. There is an average of litres of foetal fluids, 80-90% of which is allantoic fluid. Amniotic fluid never exceeds more than 1 litres, which is much less than the volumes in either the cow or the mare. The average time (minute) gape between appearance and expulsion of A-C bag is 3.50 ± 1.00 and it may ranged from 2 to 5 min. The average time (minute) gape between expulsion of A-C bag and appearance of foetus is 5.25 ± 1.66 , where as range value is 3 to 7 min (Bhakat et. al. 2001). The 100% cases show normal presentation which is out stretched foreleg with chin of the calf resting on it. The posture of dam at the time of expulsion of foetus is on sternal recumbence (100%). The average time (min) gape between appearance and expulsion of foetus is 6.23 ± 1.4 (assisted labour case) and 42.50 ± 6.50 (unassisted labour case). Assisted labour means where manual assistance (slight pulling outward by holding head and feet of foetus) has given in the delivery process. The head of the calf appears, usually within an intact amnion. The body gradually appears and the rear portion is then quickly ejected. If it is a breech birth the hind legs appear first, but no additional help is required. The post partum average time (minute) taken for expulsion of placenta is 55.86 ± 10.00 whereas it may ranged from 30 min to 120 min.

Post partum behavioural characteristic of Dam

The dam stands up as soon as the calf has expelled out. The nosing and smelling of calf is very common feature but licking is not there. In normal and natural delivery

process the placenta is not eaten by dam (100%). After parturition maximum dam (80%) adapt their calf very quickly (within 5 to 10 min) but there are few cases (20%) where dam took more time for this adaptation process. In maximum cases (90%) dams are extremely protective of her young and not readily allow anyone to handle her calf but few dams (10%) are reluctant to this behaviour. The mother stands as soon as the calf is out. This severs the umbilical cord. The mother does not bite the cord, lick the calf or eat the afterbirth, as do other ruminants, bitch, sow or mare.

□ Behavioural feature of neonatal calf

The neonatal behavioral feature is presented in Table 3. The average time (minute) taken for the calf to stand on his leg is 25 to 90 min. The average time (minute) taken for 1st suckling attempt is 80.26 ± 8.53 whereas the time interval for suckling varies from 1 to 3 times per hour. The average (minute) time taken for excretion of muonium is 32.00 ± 5.64 . But the average time (minute) taken for 1st urination is 61.50 ± 2.11 . Behavioural pattern appeared immediately following birth of camel calf. The calves in a normal parturition assumed sternal position with head slightly dropping towards the ground. The eyes are generally covered by mucous membrane; then opened up after the birth. The dam nosed and smelled the calf again and again but do not lick the young one. The newborn calf made repeated attempts to stand up until finally the hind legs flexed sufficiently to support the body. On an average, it takes about 50 min (20 to 90 min) for the calves to stand. The average rectal temperature (Degree C), pulse rate and respiration rate (time/min) are 36.58 ± 1.29 , 122.00 ± 8.54 and 35.50 ± 2.66 , respectively. In maximum cases (90%) the locomotary movement of newly born calf become normal within 12 to 24 hr after parturition but some calves (10%) take more time to normalize their locomotary movement. On the other hand maximum calf (90%) can properly walk after 6 to 7 days of parturition even though there are few cases (10%) who can have a proper walk before 6 to 7 days. Shortly after birth the calves make effort to stand and takes about 35-50 min to stand. Initially the movement is unsteady with staggering gait. New born calves keep their forelegs forward with slope and hindlegs stretched behind the forelegs. The locomotion become normal after 10-12 hr, and the calves starts follow the mother, walking by its sides or behind.

Table 2. Phenomenon during different stages of parturition of Camel.

PARAMETER	MEAN (N = 10)	RANGE	RELATED FEATURE
Expulsion of A-C bag			80
After Rapturing			20
Without rapturing			
Time gape between appearance and Expulsion of A-C Bag. (min)	3.50 ± 1.00	2-5	
Time Gape between expulsion of A-C Bag and appearance of Foetus (min)	5.25 ± 1.66	3-7	
Presentation of foetus			100
(%)			NK
Normal			
Abnormal			

PARAMETER	MEAN (N = 10)	RANGE	RELATED FEATURE
Posture of Dam at the time of Expulsion of foetus (%)			100 S.R
Time Gape between Appearance and Assisted Labour	6.23± 2.44	5-10	
Expulsion of foetus (min) Unassisted Labour	42.50± 6.50	25-60	
Postpartum Time taken for Expulsion of Placenta (min)	55.86± 10.00	30-120	

(N.K. No Knowledge, S.R-Sternal Recumbence.)

Neonatal behavioural features

PARAMETER	MEAN (N = 10)	RANGE
Time taken for the calf to stand (Min)	56.23 ± 10.44	25-90
Time taken for 1st suckling attempt (Min)	80.26 ± 8.53	60-100
Time interval for suckling (per hr)		1-3
Time taken for Excretion of Muconium (Min)	32.00± 5.64	10-50
Time taken for 1st Urination (Min)	61.50±2.11	55-70
Rectal Temperature (°C)	36.58±1.29	36-38
Pulse Rate (Time/Min)	122.00± 8.54	115-130
Respiration Rate (Time/Min)	35.50± 2.66	29-43
Locomotary movement Normal-(within 12-24 Hr)	90	
(%) Not Normal	10	
Proper walking (Days) After 6-7	90	
(%) Before 6-7	10	

Care of newly born calf

- ☞ Assistant should be provided in case of difficult situation of expulsion of foetus.
- ☞ The naval cord should be ligate properly and dressed regularly for 2-3 days with antiseptic solution.
- ☞ Just after birth nasal opening of calf should be cleaned with soft and clean cloth, and other part of the body should be cleaned.
- ☞ After 1-2 hr of expulsion of foetus, colostrum must be provided to calf.
- ☞ In order to avoid calf diarrhoea excess amount of colostrum are not provided.
- ☞ Generally parturition are occured during cold season. Special care should be given to avoid direct cold wind to neonate.
- ☞ If parturition occurred in month of April or May then it should be protected from hot climate and try to keep it in some cool place or under tree shade, to avoid heats stroke.
- ☞ To avoid night blindness and calf diarrhoea, 3-4 days after birth of calf vitamin 'A' injection (1to 1.5 ml) and Cloramphenical (1 gm) are given.

- ☛ Generally weaning is not practiced and regular milk feeding from dam should be allowed for 9-10 months.
- ☛ Calf should be allowed to move with dam for proper growth and to develop browsing and grazing activities as earliest possible.

☐ Features of Reproductive Management

☐ Puberty and Sexual Maturity

The sexual maturity in the female camel is attained at the age of 3-4 years. The attainment of sexual maturity is greatly influenced by factors like management, nutrition, breed etc. In Bikaneri breed, the age at first service and age at first calving has found to be 1387 and 1882 days, respectively. In Bikaneri males, although sexual desire has observed from 3-4 years of age but the normal rutting observed only at the age of 5-6 years. Attainment of puberty is greatly influenced by the overall growth and weight of the animal.

☐ Fertility

The animals are not fit for breeding after 20 years of age. In exceptional cases animals even beyond 25 years of age have given birth to healthy calves. The camel reproductive life varies according to plane of nutrition, management health and genetic factors.

☐ Female reproductive features

The Indian camels are seasonal breeder and sexual activity is optimum from December to March during winter. The camels are acyclic and are induced ovulator and it has low reproductive efficiency. The calving rate is 30-40% with long calving interval upto 2 years. The factors for low efficiency in camels are early embryonic deaths, embryonic resorption, abortions and still births. 30-40% calf mortality upto 1 year of age is common in the field. The camels have bicornuate-T shaped uterus, reddish, smooth and shiny in appearance. The smooth uterine mucous membrane is devoid of cotyledons. The left horn is larger than the right. The cervical canal is short, about 3.5 cm long and 5.5 cm in diameter. The reddish vagina, 25-35 cm long, has mucosal folds posterior to the cervical opening. The vulva is about 6-8 cm long and has urethral orifice on the top. The vulva cleft is a short slit 4.5 to 6.5 cm in height and the clitoris is very small. Almost 95-99% pregnancies in the camels have been reported in left horn although, ovum could come from either ovary. The left ovary is more active than the right one. Twins or multiple births are almost entirely absent in this species.

☐ Oestrus cycle and ovulation

The females become sexually mature at the age of about 3-4 years, first calving takes place at the age of 5 years and subsequent calvings are biennial. The females remain sexually active upto 20 years of age. The female remains receptive to the male for 3-4 days at a time followed by 10-12 days of anoestrus. Usually, oestrus is exhibited five times in a breeding season. The usual signs of oestrus are not so prominent which are restlessness and aggressive behaviour of females. The tail is raised and animal urinates frequently. The female in heat mounts the other females. The vagina at this stage is reddish and moist. The cervix is also moist and relaxed. The ovulation follows 36-48 hours after mating.

☐ Male Reproduction

The male camel is sparsely covered with hair in the perineal region. The penis is firm cylindrical. The penile sheath is directed forward at copulation the erect penis forms a hook and terminal gland secretes sperm conc. 3.5 to 7.3% which coagulates and forms a gel. Secretion from the penis is more during the rutting season.

☐ Rutting in male

In India rutting is observed from the testes weigh heavily. Rutting symptoms are as follows:

- ☛ Loss of appetite
- ☛ Aggressive behaviour
- ☛ There is copulation with brown with gland resembling during breeding
- ☛ Characteristic by filling air which it is gula collapses
- ☛ A camel in rut
- ☛ Flapping the tail over back
- ☛ The hind part thick black

Sexual desire can be observed in male to females. A male camel can breed three females in a season. Proper management and handling are required to check inbreeding.

☐ Mating

The mating occurs according to season, status of the female. It is initiated with necking and

□ Male Reproductive Features

The male camel matures at the age of 5 years. The scrotum is oval shaped, sparsely covered with thin hair, bisected by medium raphe and are located in the perineal region. The testes are 7-10 cm in length, weigh 80-100 g at 4-5 years of age. The camel has prostate and cowper's gland but no seminal vesicles. The penis is firm cylindrical organ about 60-70 cm in length. It is fibrous and thin. The penile sheath is directed posteriorly and penis remains concealed in it. However, during copulation the erected penis stretches forward. The glans penis is shaped like a blunt hook and terminal part is cartilaginous. The ejaculated semen varies from 5-7 ml, sperm conc. 3.5 to 7.3×10^8 /ml, motility 70-90% and abnormal sperm 4-5%. The semen coagulates and forms gel after ejaculation. Males ejaculate 3-4 times in a single mating. Secretion from the poll gland in the male camels is a special feature during rutting season.

□ Rutting in male camels

In India rutting in male camels occur during winter season. During rutting season the testes weigh heaviest and the level of spermatozoa in the epididymis reach maximum. Rutting symptoms are as follows :

- ☛ Loss of appetite and weight loss are the main signs of rutting.
- ☛ Aggressiveness, making territory, restlessness.
- ☛ There is copious secretion from poll (occipital) gland. The secretion is dark brown with acrid smell and androgens are present. Histologically the poll gland resembles endocrine gland. The secretion of the poll gland attracts females during breeding season.
- ☛ Characteristically male in the rut eject out soft palate (gula) from its mouth by filling air from trachea. Air is retained for about 5 to 10 seconds, after which it is expired with a gurgling sound, the pressure is released and gula collapses.
- ☛ A camel in rut stands with hind legs apart.
- ☛ Flapping the tail up and down with frequent micturation and throwing urine over back again and again.
- ☛ The hind portion of the back gets soiled with urine and dirt resulting in thick black streak on the back.

Sexual desire can be reduced, if rutting males are put to hard work. Ideal ratio of male to females during breeding season are 1 male to 5-7 females. One camel stud can breed three females per day at the peak of the breeding season subject to good management and health. Keeping extra males is desirable to provide genetic diversity and to check inbreeding for wider and efficient selection.

□ Mating

The mating occur in sitting posture and mating time varies from 5 to 15 minutes according to season, status of rut and frequency of mating. The copulation in camel initiate with necking and courtship. The male smells the female's genitalia and may

occasionally bite her. The male grinds teeth, expands soft palate into balloon, froths out saliva and makes gurgling sound, it induces the female into sitting position, grasps her with fore-legs while his weight is rested on hind legs and buttocks. Animals thus face the same direction and mate in squatting position. During coitus the female makes peculiar bleating sounds. The penis makes rotating movements on longitudinal axis during entrance.

□ Gestation period

Breeding and parturition occur in the same season. The average gestation period is 380 to 390 days.

□ Diagnosis of pregnancy

Pregnant females raise the tail and curl it up in a typical style on approach of males. The lifting of tail is sometimes seen both during anoestrus and oestrus but there is variation in style at these two occasions. This behaviour has been found to be fairly correct method of pregnancy diagnosis after 4 weeks. Rectal palpation of ovaries and uterus can also be done for pregnancy diagnosis.

Care of Breeding Camel. The following points for female and male camel kept for breeding purpose should be followed strictly.

□ Female/Pregnant camel

- ☛ Advanced pregnant camels should be supplemented with mineral mixtures.
- ☛ The first age at mating should be the age of 3-4 years.
- ☛ The vitamin 'A' injection should be given to pregnant camel about 2-3 months before parturition.
- ☛ Proper care should be given in case of first birth in primepara camel.
- ☛ The pregnant camel should not be allowed for grazing at least from one week of the expected date of parturition.
- ☛ The pregnant camel, showing signs of parturition should be kept in isolation.
- ☛ Attention should be given for expulsion of placenta after parturition.
- ☛ If dam does not adopt her calf after parturition, it is of practice that a piece of thin cover placed on the calf and it is made to smell the camel. Sometime in such cases dam and calf should be kept in an enclosure to solve this problems.
- ☛ After milk suckling by calf, if excess milk is in the udder, it should be stripped out.

□ Male/Rutting camel

- ☛ The age should be 5-6 years for breeding purpose.
- ☛ The male breeding camel should be kept away from female camels during rut as they may injure other animals.
- ☛ To prevent bite, male breeding camel should be secured properly and separately.
- ☛ They are not allowed to go for grazing but exercise should be provided daily.
- ☛ Vitamin 'A' should be given as a prophylactic measure.
- ☛ As breeding male camel lose their body weight during rutting season, special feeding/concentrate should be provided.

CAMEL PRODUCTION

□ Common

Camel

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□ Indigenous

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HEALTH MANAGEMENT

Common Ailments and Diseases in Camel

Camels suffer from some common ailments which require surgical intervention. These are given below.

1. Blistering, 2. Firing wounds, 3. Sores, 4. Saddle sores, 5. Abscesses ; haematoma, 6. Tumours, 7. Fistula, 8. Wounds on lips, tongue and eyes caused while browsing or due to other reasons. 9. Torn nostrils, 10. Fractures of limbs, lower jaw and ribs, 11. Opacity in the eyes, 12. Rupture of muscles, 13. Dislocation of joints, 14. Deformity in locomotion, 15. Footpad infection, 16. Injuries to tendons and ligaments, 17. Inflammation of soft palate, 18. Traumatic pododermatitis, 19. Rectal and vaginal prolapse etc.

Common vices of camel are biting on penis, testicles, other body parts and kick off by it's hind legs etc. The camel suffers from following diseases.

1. **External Parasites.** Mange is first and most common skin problems in the camels. Mange caused by *Sarcoptes scabiei* and *Choripotic* mange caused by *C. bovis* are common infestations.

2. **Protozoal Diseases.** Trypanosomiasis (surra) is number second disease (after mange) causing wide spread mortality and morbidity. It is the most important health problem in the camels. The chronic form of disease is more common than the acute form. The other protozoa which cause diseases in the camels are Theileriosis, Balantidium infections, Coccidiosis and toxoplasmosis.

3. **Internal Parasites.** Camel commonly suffer from internal parasitic infection. Common gastrointestinal parasites are nematodes, cestodes and trematodes of different species. Different spp. of hemonchus, trichostrongylous, paragonema, trichuris, stilazia, monezia causing infestations have been reported. The common extra intestinal parasites are Onchocera, Dipetalonema, Echinococcus. Thelazia lesei, the eye worm, cause infection of the eyes.

4. **Viral Diseases.** Three infectious skin diseases of economic importance are camel pox, camel contagious ecthyma (CCE) and papillomatosis caused by Orthopox virus, parapox virus and papilloma virus. These diseases cause both morbidity and mortality.

5. **Deficiency Diseases** Deficiency diseases caused by nutritional deficiencies particularly deficiency of vitamin A and C, and trace elements cause variety of symptoms. These predispose animals to other infections and reproductive inefficiency.

Camel Health Management

There is a large section having ethno-veterinary knowledge on the camel derived from generations of interaction and interdependence with this animals. Even, today camel keepers rarely have access to modern veterinary medicine. They continue to rely on their own system of disease prophylaxis, diagnosis and treatment.

Indigenous knowledge on camel's Health

Camel farmers have long recognised the effectiveness of many plant substances in treatment of diseases. These includes several herbs, shrubs, roots, seeds etc. which are commonly used in Indian medicine for treatment of human being. They have identified

plants which detoxify the venomous action of biting insects and animals like scorpions, snakes and flying insects. Some plants which have hormone like activities are used as galactogogues for lacto stimulation and anthelmintics property. They recognise vegetation and plant products for antibacterial and antifungal characteristics in treatment of infections, fungal skin diseases, oral, diseases etc. In addition, camel keepers have detailed knowledge of poisonous plants and their antidotes, which include drenching of infusions of plant preparations and solution of salts. The ethno-veterinary medicines are low cost, adaptive and accessible to the camel keepers.

In an organised farm (NRRC, Bikaner), the camels are provided both prophylactic and curative measure to control ecto-parasite and internal parasites. The calves and pregnant females are given vitamin-A. A course of antibiotics is given to check diarrhoea.

Schedule of Health Management followed at organised farm. (NRCC, Bikaner)

Month	Activity Schedule
January	Breeding, Calving, Providing Vitamin A, Screening for Ecto and Endo parasites
February	Breeding, Calving, Providing Vitamin A,
March	Calving, Clipping, Deworming, Insecticide spraying, Prophylactic treatment for Surra.
April	Soil treatment (to combat Mange), Branding.
May	Screening for Ecto and Endo parasites
June	Screening for Ecto and Endo parasites
July	Screening for Trypanosomiasis
August	Screening for Trypanosomiasis
September	Deworming and Prophylactic treatment for Surra
October	Spraying for Ecto parasites, Providing Vitamin A to pregnant female, Weaning of calves, Soil treatment (to combat Mange)
November	Providing Vitamin A, Supplementation of concentrate to breeding male and female, Insecticide spraying
December	Breeding, Supplementation of concentrate to Breeding males, Screening for Ecto, Endo parasites.

□ Examinations for soundness of camel

The following points are to be considered for sound health of a camel.

- ☛ The skin should be bright and clean, not matted and dirty.
- ☛ The eyes should be bright and alert not watery and dull.
- ☛ The hump should be well developed and should not be sagging to one side. In some breeds the hump is not so well developed as in others.
- ☛ The neck should be supple, and the head carried on it gracefully. The other end of the neck should be attached deep in the chest.
- ☛ The limbs should be muscular and straight, the hind legs should not have cow-like hocks.
- ☛ The fore legs should be neither too far apart nor too close together. The toes should be straight and not turned out or in.
- ☛ The legs should be proportionate to the body.
- ☛ The hind quarters should be well covered with muscles and the tail set high up and of a moderate length.

CAMEL PRODUCTION

The camel :

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Restraining

The camel is a very sensitive animal. During breeding season, the camel with young is required to be handled with care and restraint. Generally, the camel is restrained by using a muzzle. It is very important to observe the normal behaviour of the camel.

For conducting any operation, the person should be trained. The camel has to be restrained by using a muzzle. It is trained by tying the muzzle firmly into the lips, thus preventing the camel from gurgling and showing its temperament by violent movements of the legs. If camel is handled by strangers, camel can be restrained.

When camel is restrained, the sedative of choice is

- ☛ These paces of the camel should be adequate, and so that it can go freely at the space required without coaxing or beating.
- ☛ The chest should be deep and not round. The ribs should be well sprung and at a fair distance from the pelvis.
- ☛ The breath of the body should be proportionate to height.
- ☛ The skin should not be too thick, especially in riding camels.
- ☛ The teeth should be in level and not irregular or broken.
- ☛ The chest-pad should not brush against the elbows while the camel is walking or running.

The following points are not desirable and should be avoided in all breeds of camel :

- ☛ Narrow or shallow-chested camels are usually weak and can not be put to hard work or long rides.
- ☛ Camels with bent hocks and long shanks are not good for either baggage or riding purpose.
- ☛ Under-developed chest-pad.
- ☛ The skin, especially inside the elbow, should not be so thick or thrown into folds as to lead to rubbing and brushing when the camel walks or runs.
- ☛ Watch the camel while in sitting down and standing up. A slow riser or one who takes a long time in sitting down and whose hind legs show a tremor at the time of sitting down should be discarded.
- ☛ If the camel had firing marks on knees or hocks, it means that he has suffered from arthritis or rheumatism. Brand marks (firing on thigh or shoulders) are not considered a defect.

☐ Restraining/Handling/Controlling of Camel

The camel should be restrained with great precautions. Special care is required during breeding season as the male camel is difficult to control at this time. Female camel with young calf should also be approached with care particularly when calf is required to be handled. The dam can be irritated when her young calf is handled for restraining. Generally, camels can bear pain with stoicism and continue to labour without signs of distress till they reach the limit of complete exhaustion. So, it is very important to handle the sick camel with precautions, as some times apparently normal behaviour might be deceptive and may lead to serious complications.

For conducting clinical examination of camels, it should be approached cautiously. The person should be familiar with the temperament of the animal. The camel for clinical examination has to be secured properly to avoid accidents. Trained camels can be easily restrained by using rope attached to the nose peg. The young and untrained camel are restrained by tying the legs with a strong ropes and then by holding the nostril and lower lips firmly into the grip. The camel can protest it by showing constant groaning, producing gurgling sound, frothing and regurgitation. The camel can exhibit nervous temperament by violently shaking their heads and throwing or kicking both fore and hind legs. If camel is handled properly then it is very obedient but if mishandled or approached by strangers, camel can show savage, obstinate, and revengeful temperament.

When camel is not easily handled, it requires sedation. Xylazine 10% solution is the sedative of choice and is administered by intra-muscular injection. For quick

action it may be administered through intravenous route. For minor task dose rate may be 0.25-5 mg/kg body wt. which will initiate a period of sedation for 20-30 minutes. For immobilization, recumbence and muscle relaxation and for surgical intervention the dose may be increased to 1-2 mg/kg body weight which affords a sedative effect for 40-80 minutes.

SADDLING OF CAMEL

In India, following different types of saddles are used for carting, riding and baggage etc. purposes.

- (1) The local saddle are used to attach shafts of the camel cart to its wooden bars with iron chains or ropes. This gives the camel uniform weight on its back and makes it easy to haul the cart. It also saves the expense of preparing a separate harness for the camel cart.
- (2) Load saddled are made of 3 to 5 wooden bars on each side and 2 arches, one in front of the saddle and one at the rear. Under these arches and wooden bars 2 long pads covered either with sack-cloth or leather and filled with cotton-wool or soft straw are attached. The pads and arches are so made as to fit on the camel's back. There is usually one girth attached to the bottom bar tied on the chest of the camel behind the chest-pad to keep the saddle in position and firm on the camel's back. The load is placed and tied on both sides of the saddle so that the saddle bears an equal weight on each side over the back of the camel.
- (3) The riding saddle should be the best for the rider as well as for the camel. It consists of 2 curved wooden side bars, on which fitted with 3 wooden arches-one in front, one in the middle of the bars, and one at the rear; a space of 15 cm is left in front of the bars in fitting the first arch and about 30 to 45 cm in fitting the rear arch.

UTILITY OF CAMEL

The various aspects of use of camel and its products and by products are given below.

1. Utility of Camel Hair

The camel hair and its products can be an important source of additional income for camel keepers. The handicraft articles made up of camel hair, provide work to rural women in the field of grading of hair, tops preparation, spinning of hair, weaving, embroidery with 100% specialty hair and blending with sheep wool, goat hair, cotton and other products. Camel hair is used in village cottage industry for preparation of common utility items, viz : Blankets, bags, mattresses, ropes, floor rugs etc. It is widely used in rural cottage industry of Rajasthan and Gujarat for preparation of various items. The preliminary results of camel hair blends with wool, silk waste and polyester have shown encouraging results. Blended products may also be prepared with sheep wool, goat hair and cotton. It is worth while to blend camel hair with polyester, wool or silk. The camel hair is being utilised in India since ancient times. It has been estimated that a camel hair fabric of 620 gm weight will be as warm as a pure wool fabric of 900 gm weight. The hair is spun by camel keepers by using traditional simple techniques. The coarse variety is spun by Hand Dheyria. The other method of spinning fine quality camel hair is by hand charkas. In the recent times machine

CAMEL PRODUCT

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Spinning is becoming popular for carpets, dunes clothing. The camel hair is strong and is twice as warm as wool. The main body sites of hair coverage in the dromedary camels are shoulders, mid portion of body, neck and hump regions. The hair of dromedary camels are durable, strong and have low conductivity. The camels of Bikaneri breed of 2-3 years of age produce higher annual hair yield as compared to other age groups and breeds. The utilisation of camel hair is having great importance in exploitation of the hair production potential and quality of hair for its future utility as pure camel hair as well as blends with other animal fibres, synthetic waste fibres and its uses in the rural cottage industry. The investigation is carrying out at NRCC as an attempt to explore the different factors influencing hair quality attributes in Indian dromedary camel managed in an organised farm and there can be help full in effective utilisation of camel hair in the form of blends etc. The fineness of hair of Indian camels ranges from 25 to 40 micron. The proportion of medulated fibres ranges from 50 to 80%. The fibre length ranges from 5 to 7 cm. The vegetable matter contents are from 4 to 5%. The pH is 7.02. The single fibre tenacity is better than wool which ranged from 15 to 17 g/tex. The camel hair and wool blend, polyester blend and silk waste of blend have good commercial prospects. The blend slivers exhibit sliver strength of 11 to 19 g/txt.

2. Utility of Camel Milk

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 of milk from other domesticated milch animals. The keeping quality of camel milk is very good and the milk is a rich source of vitamin C. The calculated average lactation yield of 305 days. The average daily yield varies from 3.5 to 4.5 liters. The fat percentage in camel milk varies from 2.9 to 3.5, SNF 8.2 to 14.3, lactose 3.4 to 5.8, protein 3.5 to 4.6, ash 0.7 to 0.9 and water 81.4 to 87%. The camel milk contains per kilo about 2930.8 KJ of energy and about 35 g of proteins. The total daily energy requirement of a man can be met by 4 kg camel milk and his entire protein requirement by 1.75 kg camel milk. It has, therefore, considerable potential to combat malnutrition of arid lands. Camel milk has comparatively better keeping quality and is reported to have medicinal properties.

3. Utility of Camel Meat

It is not a common practice to eat camel meat in India, although it is used in substantial quantities in several other countries. Dressing percentage of camel carcass ranges from 40 to 60%. Camel meat contains about 22% protein and only 1% fat. It has been estimated that an average carcass weighing 210 kg would yield 10 kg fat, 160 kg meat and 40 kg bones would thus yield 35 kg protein and 9973125 KJ energy which will be sufficient to meet the protein requirement of about 35 peoples. The optimum age for camel slaughter is around 3-4 years when the meat is similar to that of beef.

4. Utility of Camel Hide

Camel hide, if processed properly can be used for making leather goods, viz., shoes, sandals etc. Recently camel hides are used for making fancy items of tourist interest, viz; Purse, Bag, Stool cover, Jewellery box and various decorative items etc. In the olden times, camels hides were utilised to make containers for storing and carrying

water, oil and ghee etc. It is well suited for the application of color and in Rajasthan there is a tradition of making elaborately painted small container (*Kuppi*) by using camel hide.

□ 5. Utility of Camel Bone

Camel bones are important raw materials for the manufacture of jewellery in some parts of the world. In India, since ivory has been banned, it has often been replaced by camel bone. Recently, camel long bones are used for making fancy and decorative items. Camel bone is also made into bone-meal for fertilizer.

□ 6. Utility of Camel Dung

Dung ranks as an important byproduct. Camel dung is good source of organic manure and dry dung is also used as fuel. For pastoralists inhabiting barren territories it can be the most important source of fuel. In the semi-arid parts of India it has values as a fertilizer and sold by camel herd owners. Land owners compensate camel breeders in cash or in kind for overnight stays on their fields. Brick factory are also using camel dung as fuel.

□ 7. Utility of Camel as Game Animal

In recent times, the use of camel as a race animal in the Gulf countries and certain Arabian countries has gained enormous importance. Very large sum of money is involved and the economic importance of camel as race animal has increased tremendously. Camel safari is very much popular for tourist.

□ 8. Utility aspect of camel marketing

The animal husbandry nevertheless plays a vital role in the economy of India and contributes more than 60% of the GDP of the region. The camel marketing through livestock fairs in western Rajasthan has opened new avenues for farmers. Marketing of camel is considered an important trade in the Rajasthan where it is widely used as draft animal. The camels are mostly marketed at big animal fair such as Nagour, Pushkar, Tilwara, Phalodi and Gogameri. The camel keeping at farmer's household level varies in a wide proportion. Generally it ranges from 0 to 80 camels per farmer. 70% of farmer owned only one camel, 20% owned 2-3 camels, 4% owned 4-10 camels, 3% owned more than 10 camels and only 1% owned 80 camels whereas 2% owned no camel. The average number of camel owned per farmer at the village/house level is 4.90 out of which 3.50 are male and 1.40 are female camel. The average number of camel used to brought for sale is 2.54.

The average cost of camel varies according to age and sex. The camel of either sex and more than 7 year age group is costlier (Rs. 9000 to 10000/-), followed by 4-7 year (Rs. 8000 to 9000/-) and less than 3 year (Rs. 4000 to 5000/-) age group. On the other hand male camel is costlier than female in all age group cases. Three fourth of the marginal farmers (75%) used to attend the fair with desire to buy at least one camel. Among them 60% has planned to buy only one camel, 20% plan to buy from 2 to 8 camels and 15% marginal farmers are interested to exchange their camel. The remaining 5% generally has not plant any number in advance because their purchase depended on sale of their camels at the fair. A meticulous analysis of use of camels revealed that working life period is 20 years and average age of carting varies from 6 to 8 years.

The cost of camel since traders always complete transaction whereas the average sale usually 90% of the nearer to their expected appears to be going of this livestock (camel)

□ 9. Utility aspect

□ I. Draught Capa

Indian camel may of 30-40 km on two and for 4 hours at a stretch force, work performance. The comparative study back period is almost whereas the Benefit Co bullock carting. Due carting is profitable and the hot arid Thar de

□ II. Ploughing Cap

Camels could plough 136 ± 168 sq m. The generated is 1.1 and the be 523 Sq m. The can recommended not produce upto 1 HP plough 500 kg sq meter

□ III. Riding Potentia

The characteristic expression, symmetrical strong knees joints. The speed of 15-20 km/hr over day at an average speed. Knanna et al. (199) covered distance ranging camel safari across the stretch at the speed of camels indicated better camels.

□ IV. Racing Potentia

Camel racing in the which emphasizes the to the maintained even

The cost of camel may be at variance with actual sale price at the transaction since traders always expect a higher price than what they actually get. In almost all complete transaction cases, the average expected cost prior to sale is Rs. 9000 to 10000/- whereas the average actual cost of the transaction is Rs. 8000 to 8500/-. The cost at sale usually 90% of the expected cost which shows that farmers achieved cost very nearer to their expectation. Continuous drought since last three years the cost of camel appears to be going down but still farmers get maximum of their expectation from this livestock (camel) in hot arid region.

9. Utility aspect of camel bio-energy

I. Draught Capacity

Indian camel may carry the load of 1.5 to 2 tons for 4-6 hours covering a distance of 30-40 km on two and four wheel cart without showing signs of distress. It can work for 4 hours at a stretch and 6 hours with 2 hours rest in between. The speed, draught force, work performance and power output reduces with the increase in distance covered. The comparative study between camel and bullock carting system revealed that pay back period is almost double in case of bullock carting as compared to camel carting, whereas the Benefit Cost Ratio is 3/4 the time high in case of camel carting as compared to bullock carting. Due to short pay back period and higher benefit cost ratio camel carting is profitable and advantageous over the bullock carting for small dry land farmer in the hot arid Thar desert.

II. Ploughing Capacity

Camels could plough continuously for 4.25 ± 0.27 hours and covered an area of 136 ± 168 sq m. The drought produced is 14.0% of body weight, the horse power generated is 1.1 and the average ploughing capacity per 100 kg body weight has found to be 523 Sq m. The camel is capable of ploughing of approx 2.5 km/hour and has been recommended not to work a camel for longer than 6 hours at a stretch. Camel can produce upto 1 HP energy during ploughing covering 1 HP in 11 hours and could plough 500 kg sq meter/hour at a depth of 16".

III. Riding Potential

The characteristics of good riding camel are long legs, display boldness, alert expression, symmetrical hump, broad muscular full thighs, small-sized foot-pads and strong knees joints. The 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 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. Knanna et al. (1996) reported that the camels traveled 950 km in 29 days and covered distance ranging from 24 to 70 km/day at an average of 43.2 km/day in a camel safari across the desert of Rajasthan. Riding camels could complete 15 km at a stretch at the speed of 8-9 km/hr. The level of lactate and cortisol in the riding camels indicated better riding endurance in females than male amongst Indian camels.

IV. Racing Potential

Camel racing in the Gulf and certain arabian countries is an important cultural event which emphasizes the Bedouin traditions. The long limb length enabled the pacing gait to be maintained even at high speeds. This gait would therefore appear to allow

grater mechanical efficiency and therefore speeds around 9-10 m/sec. to be maintained despite of relatively low oxygen availability. Better race potential could be noted in Jaisalmeri than Bikaneri female camels. Average race speed (Km/hr) for 1,2 and 3 km distances ranged from 29 ± 2.6 to 37 ± 3.2 and 25 ± 3.2 to 30 ± 1.8 for Jaisalmeri and Bikaneri camels, respectively.

□ V. Use in defence

Presently the camel corps contributes an important wing of the border security force of the Indian Para military services and used for patrolling purpose in desert belt of border.

Camel is an important component of the desert ecosystem because of its adaptation in behavioural, anatomical, and physiological functions. Rapid change in agro-ecological condition and industrialisation in recent past has its impact on camel production and management systems. It is essential in future to adopt scientific management practices to get efficient utilization of camel resources round the year for different purposes.

SALIENT FEATURES OF CAMEL PHYSIOLOGY

The pathways of water losses and adaptive changes that occur in camel minimize the effects of the losses. Water is lost from the body in various ways viz : through the skin and respiratory tract by evaporation, and from the alimentary tract and kidneys by excretion. Sweating is limited in camel to periods when the animal's body temperature rises above 40°C . When the camel does sweat the system is economic and utilizes less energy and water than the more expensive and wasteful respiratory panting of sheep and goats or the more copious sweating of cattle. Losses of water from the respiratory tract are reduced by a decline in metabolism resulting in reduced oxygen consumption and respiratory rate. Fecal water losses are minimized by excreting dry feces while urine water losses are minimized by absorption of urea and water leaving a concentrated urine. By decreasing all the pathways of water losses to a minimum and by reducing water turnover the camel utilizes the large water 'reservoir' in its alimentary canal to maintain homeostasis.

□ Body temperature, Pulse rate, Respiration rate of camel :

Camel can increase core temperature as environmental temperature gets increased. The camels have remarkable ability to fluctuate body temperature according to environmental temperature. The body temperature of camel varies with an individual, season, climate and degree of dehydration. In the early morning the temperature of healthy camel is lower and rises up to $2-3^{\circ}\text{C}$ through the day to the evening. This is mainly due to diurnal variation. The pulse of the camel is counted at the middle of coccygeal artery located in the midline of the ventral part of the tail. The frequency of pulse in camels varies with time of the day and environmental temperature. The pulse rate in the morning is lower as compared to evening hours. The normal respiratory rate of camel is lower than evening time. The respiratory rate is affected by time of the day, status of health and disease condition. The Mean $\pm$ SE of rectal temperature, respiration rate, pulse rate in camel is presented in table 1. The anatomical shape of the nostrils of camel helps in avoiding the entry of sand and dust in to the respiratory passages. The respiratory system of camel, its larynx and particularly the lungs are more akin to horse. Both camels and horses have a biphasic breathing pattern at rest. Like horse, camel is an obligatory nose breather and can cope with huge quantities of oxygen during race. Maximum minute ventilations in working camel is 150-170/min. with a breathing rate of 30-40/min.

CAMEL PRODUCTION

□ Characteristic

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Mean

Time of Observation

Morning
Evening
After Work/fatigue
After 20 hr Rest

□ Characteristic Features of Camel urine :

The kidney of the camel has remarkable capacity to concentrate urine. Urine output in camel is relatively less than other ruminants. This is due to lower glomerular filtration rate, better counter current multiplier system at medullary region of the kidney and greater absorption of water from renal tubules. The camels on an average excretes urine 3.8 ± 0.40 ml/kg b. wt. The volume of urine increased by almost 123% after watering. It is reduced by 25.0, 48.7 and 55.2% respectively after 1, 2 and 3 days of watering. Urine becomes dark brown in colour and of thick consistency ; often-white crystals are seen after seven day. It has been observed that the volume of urine is not come to normal just after rehydration. There is a gradual increase in the volume and normal urine output.

The excretion of sodium in urine of camel ranges from 0.65 to 2.16 g/d and average is 1.16 ± 0.14 . On dehydration, sodium excretion per day increased sharply from day 4 to day 7 and after rehydration the excretion of sodium returned to normal level within 24 hrs. Total potassium voided through urine ranged from 9.4 ± 5.45 to 45.2 ± 11.21 g/d and average is 30.8 ± 2.76 g/d. The total urea in urine per day is 53.2 ± 2.60 g and range varies from 37.9 ± 15.41 to 69.9 ± 10.80 g/d. Urea excretion in dehydrated camels gradually increase from day 3 to day 10. The normal level of urea in urine attains within 5 days of rehydration. The average value of creatinine in urine of camels is 0.95 ± 0.14 mg/ml and it ranges from 0.23 ± 0.15 to 1.80 ± 0.78 mg/ml. The level of creatinine in urine of dehydrated camels increase from 0.40 ± 0.13 on day 1 to 4.60 ± 1.69 mg/ml on day 10. The normal level of creatinine in urine attains on 15th day i.e. after 5 days of rehydration.

The capillary system of camel is better equipped to dissipate heat from the body surface. The RBC is ellipsoid in shape and can pass more easily through the narrow blood vessels. The RBC can also resist wide osmotic changes in blood and do not shrink or rupture on dehydration and rehydration. The haemoglobin has greater affinity for oxygen and the quantity of albumin relatively more in the blood. The camel red blood cells are exceptional in every respect when compared to the red cells of other mammals. Not only is their shape different but also their resistance to extreme changes in their environment, i.e. changes in plasma composition. Red blood cells play a vital role in mammalian gas exchange in the lungs and the tissues. Any changes in numbers or function of these cells directly affect all metabolic processes in the body. The camel red blood cell is ovaloid and non-nucleated and cells are fairly flat. After dehydration there is no change in shape of the red blood cells. However, after rapid rehydration the cells become round. It must be stressed that rounding of the red cells is the only change of the cells that is observed in vivo. Normal values for haematological parameters in camel is presented in Table.

Mean $\pm$ SE of Rectal Temperature, Respiration Rate, Pulse Rate in camel.

Time of Observation	Rectal Temperature (°C)	Respiration Rate (Beats/min)	Pulse Rate (Beats/min)
Morning	36.59 ± 0.12	10.24 ± 0.37	45.00 ± 1.08
Evening	38.39 ± 0.13	12.29 ± 0.40	50.23 ± 1.27
After Work/fatigue	39.62 ± 0.12	27.47 ± 0.91	68.14 ± 1.44
After 20 hr Rest	36.60 ± 0.11	10.28 ± 0.36	45.28 ± 1.01

Normal values of haematological parameters in camel.

Parameters		Normal value
Haemoglobin		11.00 to 15.50 g/dl
Haematocrit value		28.50 to 35.00%
Total RBC count		7.00 to 11.00 $\times 10^6$ /cmm
Mean Corpuscular Volume		28.50 μm^3
Mean Corpuscular Haemoglobin		12.00 to 15.50 pg
Mean Corpuscular haemoglobin Concentration		54.40%
Erythrocyte Sedimentation Rate		5.00 to 12.00 mm/3 hr
Osmolality		300 to 310 mOsm/Kg
Osmotic fragility		Resistant to wide range of salt concentration 0.2–20%
Total WBC		3 to 10 $\times 10^3$ /cm
Differential leucocyte count	Average	Range
Lymphocyte	40%	21–60%
Neutrophil	51%	33–70%
Monocyte	4%	1–7%
Eosionophil	2%	0–4%
Basophil	0.5%	0–4%
Platelet size		1–2 μm
Total Platelet		400 to 500 $\times 10^3$ /ml

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