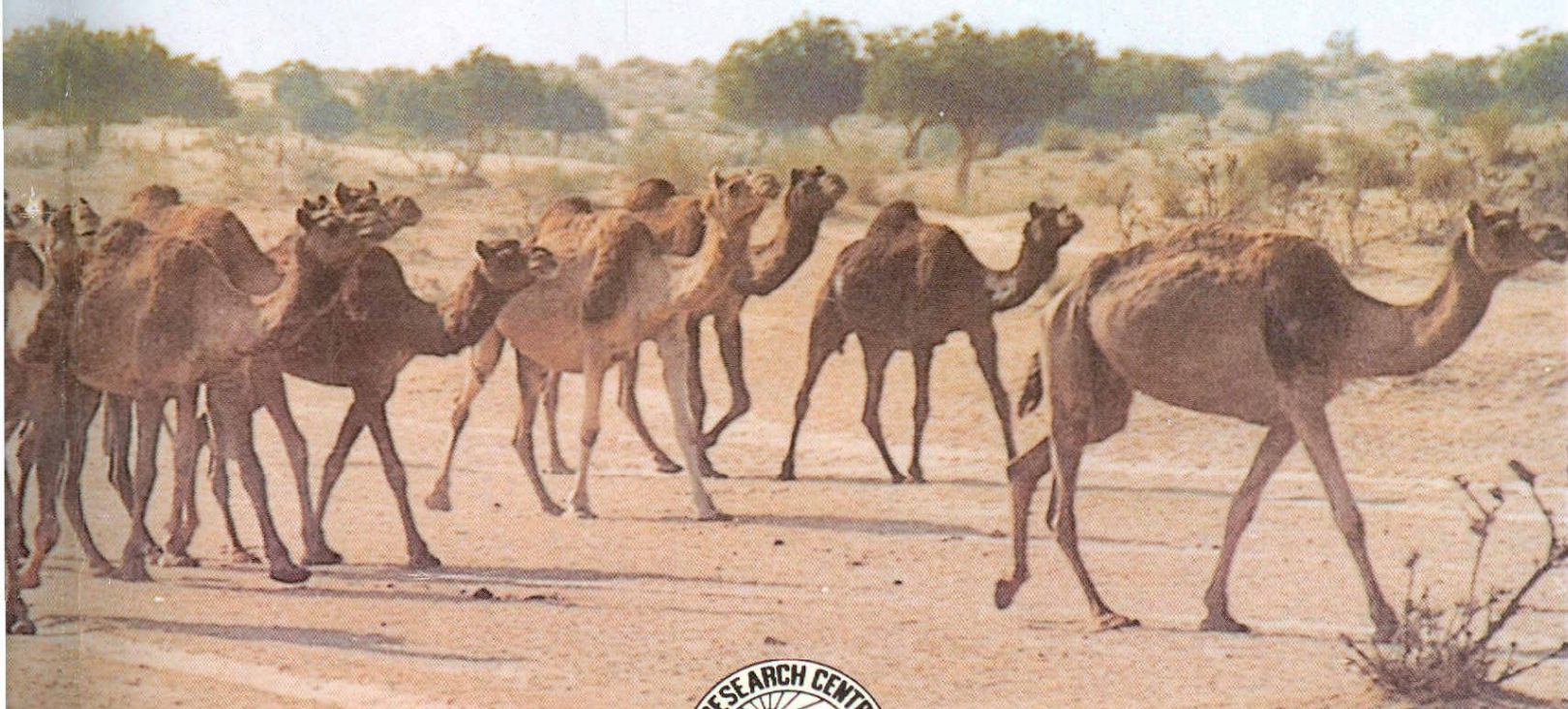




वार्षिक प्रतिवेदन
ANNUAL REPORT 2000-2001

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JORBEER, BIKANER

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निदेशक : डा. एम. एस. साहनी

Director : Dr. M.S. Sahani



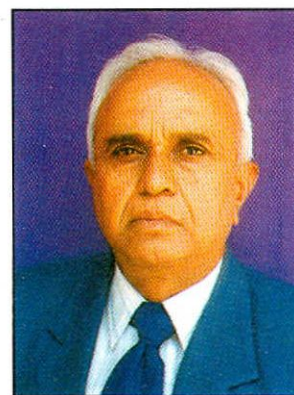
राष्ट्रीय उष्ट्र अनुसन्धान केन्द्र
जोड़बीड़, बीकानेर

National Research Centre on Camel
Jorbeer, BIKANER

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PREFACE



I have a great pleasure in presenting the Annual Report (2000-2001) of National Research Centre on Camel (NRCC), Bikaner. The report provides an overview of various ongoing research projects, organizational set up, infrastructural development, manpower, budget account, ad-hoc schemes, collaborative programmes both at National and International level along with extension, educational and other activities. Under scientific programme indigenous camel breeds were evaluated for race potential and other related parameters as a part of major programme. Cryo-preservation of camel semen and Artificial Insemination in camels was attempted. The reproductive efficiency of farm camel herd during the regular breeding season indicated significant improvement in overall percent conception by adopting modified research techniques. Different qualitative and quantitative genetic traits of indigenous breeds of camel were undertaken and database on inventory of centre's camel herd, biometry of camel breeds in farm and Jaisalmer area, reproduction, health and production parameters (milk & hair) was prepared. Genomic DNA amplification with a single set of NCAM microsatellite primers was attempted in bactrian and dromedary camels as well as in other species of livestock viz. buffalo, cattle, sheep, goat, donkey and horse. Research on camel lactoferrin with regard to its iron binding and release was conducted. Detailed studies on biochemical aspects and shelf life of camel milk and milk products and evaluation of dietary urea supplementation on digestibility coefficient was undertaken. Economics of early weaning of camel calves through supplementation was compared with traditional system of management. Comparative economics of camel versus bullock cart as source of employment, extension, education and socio economic survey was carried. One new research project on improving reproductive efficiency in camel was initiated at the Centre under NATP programme.

Development works included modification of nutrition and RIA laboratories, extension of LT overhead line from tube well No.2 to newly constructed farm office and camel dispensary in farm area Block No.2, establishment of electric panel board, paddock fencing of range land with barbed wire in 4 km area, construction of new post mortem room and pit, installation of street light extending from campus to Block No.1, fixing of iron grill and safety gates at main building and nutrition laboratory, display board in museum and water pipe line for connecting campus and farm area and construction of two ground water tanks.

The NRCC has also taken concrete steps to act as national repository of scientific informations regarding

camel. The dissemination of knowledge and technology, human resource development and staff welfare activities have been given due priority. Revenue generation programme was initiated and the target fixed by the Council was achieved. Research data under the AP Cess Fund scheme "Evaluation and Conservation of Double Humped Camel in Cold Desert Region" of Nobra Valley, Ladakh (J&K) were collected and analysed. Detailed evaluation of locally available trees, bushes, shrubs and grasses was carried out under Network Collaborative Programme on crop based animal production system along with grazing behaviour studies and carrying capacity per hectare in hot arid region. Shelf life of camel milk, quality evaluation and their product technology, disease monitoring and surveillance were taken up during the year.

Two students of State Agricultural Universities and one from All India Institute of Medical Sciences were provided necessary laboratory facilities as well as technical assistance for completion of their doctoral programme in collaboration with the Centre.

I express my sincere gratitude to Secretary (DARE) & Director General, ICAR, DDG (Animal Science), ADG (AN&P) and other officials of ICAR headquarter for their cooperation, guidance and support from time to time. The credit for overall implementation of activities goes to the Scientists, Technical and Administrative staff, Incharge Technical Cell, Publication committee, ARIS cell and other staff members.



(M. S. Sahani)

Director

EXECUTIVE SUMMARY

During the year 2000-01, the sanctioned staff strength under various categories was 74 and staff in position was 69 consisting of 1 RMP, 15 Scientific, 22 Technical, 10 Administrative and 21 Supporting Staff. The budget allocation under Plan was 126 lakhs and under Non-Plan was 116.65 lakhs. The expenditure under plan and non-plan was 126 lakhs and 111.88 lakhs, respectively.

The camel herd strength at the beginning and close of year was 260 and 272 camels. The herd comprised mainly of three indigenous breeds Bikaneri, Jaisalmeri and Kachchhi. Database was developed on various research aspects for the first time on camel.

Under infrastructural development, the Library was further strengthened and the total number of books stands to be 1506 including 260 books of Hindi. During the year 145 books including 9 Hindi books were procured.

The research agenda of National Research Centre on Camel, Bikaner, was pursued through institutional research projects, ad-hoc research schemes under AP-CESS fund and collaborative research programmes.

Highlight of Research

The comparative study on race potential of 2 indigenous breeds of camel aged 4-5 years for a distance of 12 km revealed that average race speed of Jaisalmeri females was greater (18 ± 1.4 km/hr) than Bikaneri (16 ± 1.7 km/hr). Percent increase over the basal level in blood pO₂, pCO₂, glucose, cortisol and lactate were recorded as 65, 72, 84, 197 and 285 in Jaisalmeri and 90, 60, 62, 234 and 287 in Bikaneri females, respectively due to race stress. The recovery from stress after race was faster in Jaisalmeri than Bikaneri females.

Tremendous variation in copulation reaction and ejaculation of semen in artificial vagina was observed among camels. Some camels consistently performed good while some were average and yet others which performed poor. Performance was adjudged to be good, fair, poor and very poor in 6, 1, 4 and 3 camels, respectively. Comparison of performance of camels over 2 consecutive years in 6 males revealed that the performance improved in 2, remained static in 1 and declined in 3 camels. Allowing the male for natural mating deteriorates its performance in artificial vagina. Gelation of semen is a specialised mechanism which enables semen to stick to the uterine wall thus avoiding losses due to drainage and escape of semen into vagina and vulva. Moreover, a dense network of fibres is formed around spermatozoa which does not provide space for sperm motility and thus conserve sperm energy. It thus creates a sort of sperm bank from where spermatozoa can be released for fertilisation over a prolonged period of time and thus improves reproductive efficiency. Progressive sperm motility develops only after liquefaction of semen. There has been tremendous variation in freezability of semen from different males. The initial data based on post thaw motility test, overall success rate of cryopreservation of semen was adjudged to be 44.26%.

Under artificial insemination experiment, the hCG treatment was found to be effective in inducing ovulation in female camels, but low conception rate after insemination still needs to be investigated.

Major helminthic infections in camel were *Haemonchus*, *Nematodirella*, *Nematodirus*, *Trichuris* and other strongyles: *Sarcoptes* mite, *Hyalomma dromedarii*, *H. anatolicum anatolicum*, *Ornithodoros* ticks and *Chrysomya* spp. fly were the major arthropod infestations of camel in the area. Balantidium has been found to be a common protozoan infection.

The comparative economic analysis of camel versus bullock carting under arid region indicated that although camel cart is slightly costlier at initial stage but superior to bullock cart with respect to effective life period of camel, load carrying capacity, distance covered per day, total income per day, shorter pay back period and higher cost benefit ratio.

Digestibility coefficient of crude protein & crude fibre was higher on khejri leaves and 2% urea supplemented guar chara than guar chara alone. Although cost of feed was lower on guar chara but the cost of available nutrient was cheaper on urea supplementation. The camel calves can be successfully raised after early weaning on concentrate, guar/moth or groundnut chara. Out of commonly grown leguminous dry fodder, diet composed of groundnut chara was superior in terms of per kg body weight gain than guar chara. Similarly dry matter intake was greater when guar chara was supplemented with moth chara than guar chara alone.

On comparison among the three indigenous breeds of camel, Bikaneri camels were found to be heaviest (527.09 ± 4.95 kg) followed by Jaisalmeri (484.18 ± 7.90 kg) and Kachchhi (473.72 ± 7.86 kg). The effect of sex on body weight was non-significant ($P > 0.05$) at this stage but when the interaction of sex with age was considered, the effect of sex and age was observed to be highly significant ($P < 0.01$). The overall conception rate was 67.53%. Jaisalmeri breed had highest conception rate (76%) followed by Bikaneri (68.57%) and Kachchhi (52.94%). Age at first calving averaged 2026.02 ± 95.41 days. It was lowest in Kachchhi (1971.33 ± 200.59 days) followed by Bikaneri (2017.93 ± 87.65 days) and Jaisalmeri (2088.79 ± 170.78 days). The gestation length averaged 388.30 ± 0.68 days. The Kachchhi females took significantly less gestation period (385.17 ± 11.53 days) as compared to Bikaneri (390.21 ± 0.93 days) and Jaisalmeri (398.521 ± 0.98 days).

Amplification of Neural Cell Adhesion Molecule microsatellite with a single set of primers revealed a single band of 237 bp in bactrian camel and 2 bands of 237 bp and 288 bp in dromedary camel. Neural Cell Adhesion Molecule microsatellite was also amplified in cattle, buffalo, sheep, goat, donkey and horse.

Although hair is of secondary importance in camel husbandry but looking to its use in village cottage industry and future prospects in the form of blends indicated annual hair production to be 763.50 ± 12.72 gm/camel. Bikaneri breed of camel produced maximum annual hair yield (933.85 ± 17.19 gm) followed by Jaisalmeri and Kachchhi breeds. Male camels (717.24 ± 16.45 gm) produced more hair than females. (809.77 ± 18.20). The hair production was observed to be highest at around 3 years of age followed by 2, 4-6, 1 year and above 6 year age groups.

Study was carried on carrying capacity of camel under hot arid region kept in silvipasture farm area, it was observed that one camel can easily sustain on 5.33 hectare area. The grazing/ browsing behaviour study indicated that during summer, camel prefers lopped Jal tree leaves followed by Murali, Tortlis, Pala and Phog. After rains, it prefers grasses, creepers as Dudheli, Bakeria, Bhurat, Kanti, Sata and Ganthia. While in winter it primarily depends on available bushes and shrubs (Phog, Pala, Tortlis, Murali followed by Ker, Bui and Kheemp). Supplementation of green grammana grass to lactating female camels resulted in greater total dry matter intake, DCP, TDN, ME and overall milk production as compared to non supplemented group.

Under silvipasture development programme in range land area new plantations of Khejri (*Prosopis cineraria*), Jharberi (*Zizyphus nummularia*), Neem, Ardu and Israli babool along with a nursery was taken up in collaboration with Rajasthan State Forest Department, Bikaner.

Feeding camel calves on complete diet composed of guar phalgati (80%) supplemented with jaggery (8.5%), wheat bran (5%), guar churi (5%), mineral mixture (0.5%) and common salt(1%) resulted in greater DMI and digestibility coefficients of all proximate parameters except crude fibre than feeding on guar phalgati alone.

Analysis of milk samples of Bikaneri camels during late lactation stage revealed total solids, SNF, fat, protein, lactose and ash to be 9.70, 6.45, 3.25, 2.76, 2.84 and 0.85%, respectively. Based on changes in acidity and pH of camel milk kept at 37°C and 4°C, shelf life of camel milk was adjudged to be longer at 4°C (8 days) than at 37°C (8 hours). Analysis of colostrum and milk samples for four weeks after parturition revealed that initially colostrum is rich in protein (17.6%), low in fat (0.1%) and high in acidity but with the passage of time protein content of milk is reduced to 2.66%, while fat content increased to 3.78%.

Camel lactoferrin has been found to display the characteristic functions of iron binding and release of both lactoferrin and transferrin simultaneously. The release of iron from C- and N- terminals was accomplished at different pH values of 6.5 and 4.0-2.0, respectively.

In addition four NATP projects were initiated during 1999-2000, one more NATP project entitled "Improving reproductive efficiency in cattle, buffalo, sheep, goat and camel" was initiated this year.

Extension activities

During breeding season free breeding input through superior quality Bikaneri studs was provided to about 200 she camels belonging to camel breeders of nearby villages. The Centre organised animal health camps at adopted village. The health related problems were discussed and solved during these camps. Three Kisan gosthies were also organised. The camel owners visited the camel farm and were demonstrated about the camel management practices and breeding. The different specialists of the Centre delivered seven radio talks in Hindi on different aspects of camel farming. The Centre participated in national level camel breed competition and won many prizes. Five scientific exhibitions on camel husbandry practices and latest technology were organised which included Indian International Trade Fair, New Delhi, The 88th Indian Science Congress, New Delhi, Camel Festival 2001, Ramdev Animal Fair, Nagore, State Krishi Vigyan Mela, Bikaner.

Under Rajbhasha Golden Jubilee year, the Centre organised a Hindi debate on "Is Sadan Ki Rai mein Hindi ko hi Mahatav Milna chahiye". Hindi magazine "Karabh" was published. General Knowledge, Hindi essay competition and cultural programme were organised.

Infrastructure

The development work includes modification of existing Nutrition and RIA laboratories, providing of new electric street light in Block No.1 of farm area, extension of electric overhead line and establishment of new electric panel board, paddock fencing in range land area with barbed wire for 4 km, construction of new post mortem room and pit, installation of street light extending up to Block No.1 of farm complex, restoration of iron grills and safety gates, display board in museum and separate pipe line for residential complex and rangeland. Construction of two new irrigation water tanks in Block No.1 of farm area was initiated.

3. INTRODUCTION

3.1. HISTORY

The National Research Centre on Camel was established on 5th July 1984. Prior to this, the Centre was known as Camel Breeding Farm under the aegis of College of Veterinary and Animal Science, Rajasthan Agricultural University, Bikaner and before that with Department of Animal Husbandry, Government of Rajasthan. Over the years NRCC has developed modern laboratories with very good infrastructural facilities and a camel museum. The Centre has generated substantial scientific data on various aspects and developed the database on disease surveillance, biometry, reproduction, milk and hair production in Indian camels.

The National Research Centre on Camel, Bikaner is located in the Jorbeer area at a distance of about 10 km from Bikaner City. The geographical location is 28.3° North Latitude and 73.5° East Longitude at 234.84 m above MSL. The topography of the area is arid undulating desert with vast range of sand dunes. The soil type is mostly loose and sandy. The climate is mostly dry and hot with average annual rainfall of around 260-270 mm. The temperature ranges between 30°C to 45°C in summer season and between 4°C to 28°C in winter season. The Centre maintains a camel herd of about 270 camels of different age groups mainly belonging to three indigenous breeds Bikaneri, Jaisalmeri and Kachchhi.

3.2. PAST ACHIEVEMENTS

- NRC on Camel has developed an elite camel herd consisting of Bikaneri, Jaisalmeri and Kachchhi breeds.
- Genetic parameters have been estimated in indigenous breeds for several traits viz. biometry, growth, milk and hair production.
- Reduction in early calf mortality from 20-30% under field conditions to around 5-7% under farm condition through improved management practices.
- Random amplification of polymorphic DNA technique showed genetic variability in Indian dromedary camel.
- Useful baseline data has been generated on draughtability, ploughing capacity and fatigue index of Indian camel.
- Research data on raw camel milk as nutritional adjuvant indicated significant role in faster recovery against human tuberculosis along with routine therapy as compared to other patients.
- Standardised the technique of ETT in camel and produced two Embryo transplanted camel calves during the year 1998-99.
- Study on race potential of indigenous female camels indicated Jaisalmeri has higher potential as compared to Bikaneri camels.
- Cryo preservation of camel semen was successfully attempted.

3.3. MANDATE

- To undertake basic and applied research for improvement of camel.
- To act as a repository of information on camel research and development.
- To provide leadership and co-ordinate camel research with state agricultural universities for generating location specific technologies.
- To act as a Centre for training in research methodologies specific to camels.
- To collaborate with national and international agencies for camel research and development.
- To provide consultancy.

3.4. ORGANOGRAM

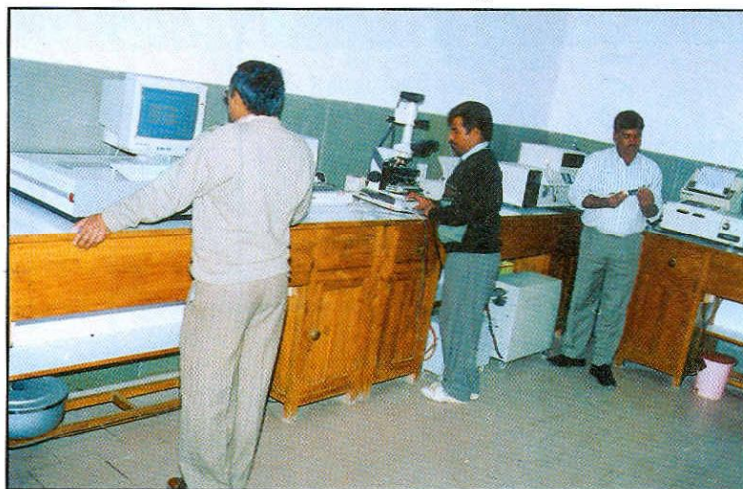
The organogram shown in Fig 3.4.1

3.5 INFRASTRUCTURE

The NRC on Camel has a Livestock farming unit, Research Laboratories in various disciplines, vast Range land of 824 ha, residential complex, small animal house and guest house as a part of infrastructural facilities.

3.5.1 Livestock farm: The farm maintains a herd of about 270 camels mainly comprising of three indigenous breeds viz. Bikaneri, Jaisalmeri and Kachchhi camels. The unit is equipped with one camel dispensary and a disease diagnostic laboratory, 6 sheds, 3 camel boxes, 1 metabolic shed and a shed with provision of individual feeding. The farm also has fodder and feed godown and three weigh bridge, two mechanical and other electro-mechanical weight bridges. Four camel corrals, camel dispensary and agriculture farm office have been constructed recently in the Block No.1 of range land area.

3.5.2 Laboratories: NRC on Camel has modern laboratories situated in 2 different complexes. Main complex has laboratories for Camel Physiology, Camel Genetics, Camel Reproduction, Camel Management, Camel Health, ARIS Section, Administrative Wing and Museum. The other complex has Camel Nutrition and Field Reproduction laboratories. The research unit has one seminar hall of 100 seat capacity. Renovation of Genetics laboratory has been completed.



Laboratory

NATIONAL RESEARCH CENTRE ON CAMEL, BIKANER

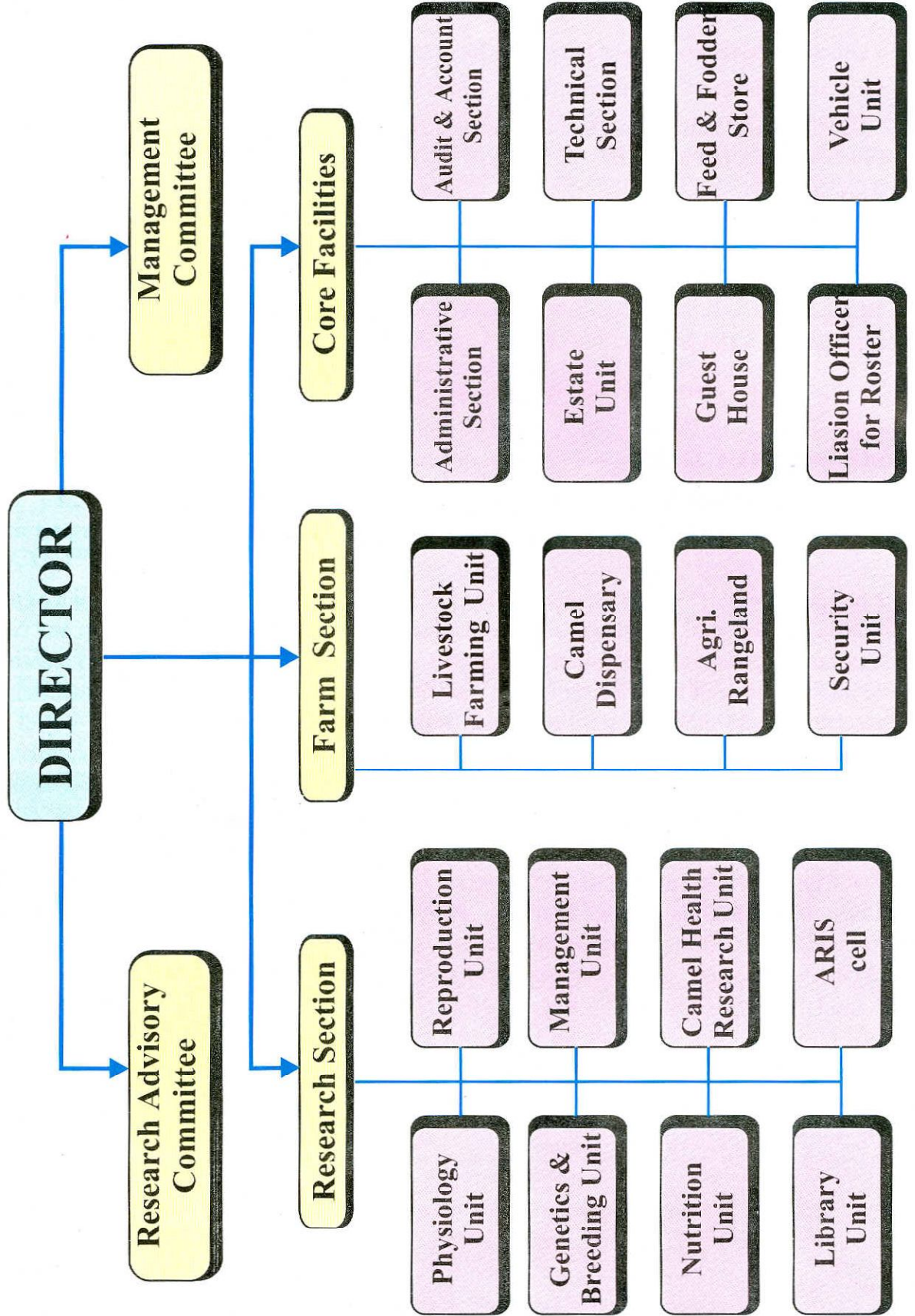
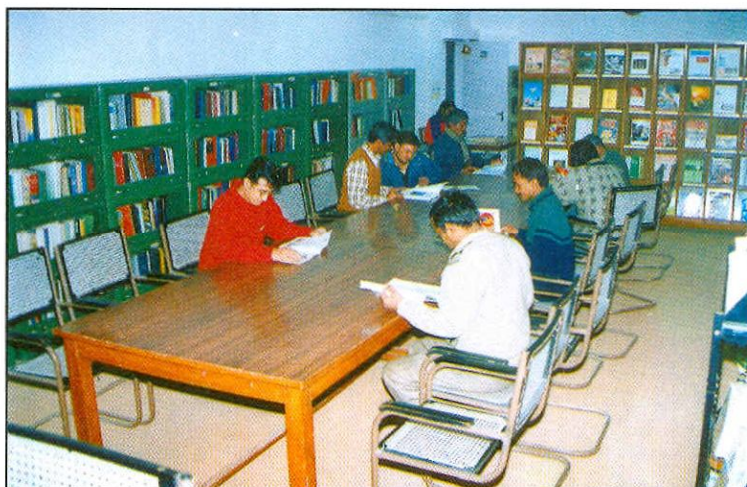


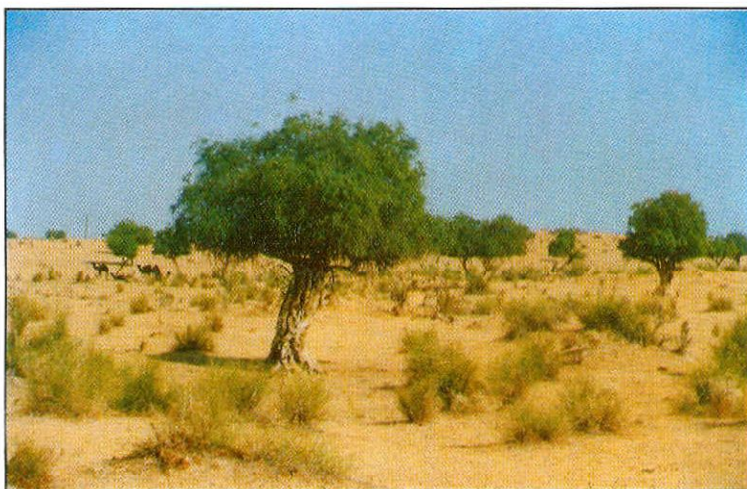
Fig. 3.4.1 ORGANOGRAM

3.5.3 Library: The library subscribes around 40 journals and other abstracting services. Subject-wise reference database has been created for over more than last six decades. The library is equipped with photo copying facility. In addition to research literature & books it has also been strengthened with Hindi books.



Library

3.5.4 Rangeland: The NRC on Camel has 824 ha land partitioned in 5 blocks with 3 tube wells. About 650 ha of area has been fenced and 35 ha of land has been brought under perennial silvipasture comprising of grasses, shrubs and trees. Main grasses are sewan (*Lasiurus indicus*) and Blue panic (*Panicum antidotale*). Pasture development in 4.5 ha and tree plantation in 16.5 ha area has also been under taken under Network Collaborative Programme. Tree plantation programme has also been taken up in collaboration with State Forest Department, Rajasthan in Block No.1 of rangeland. Plantation of about 6,500 sapling was taken up.



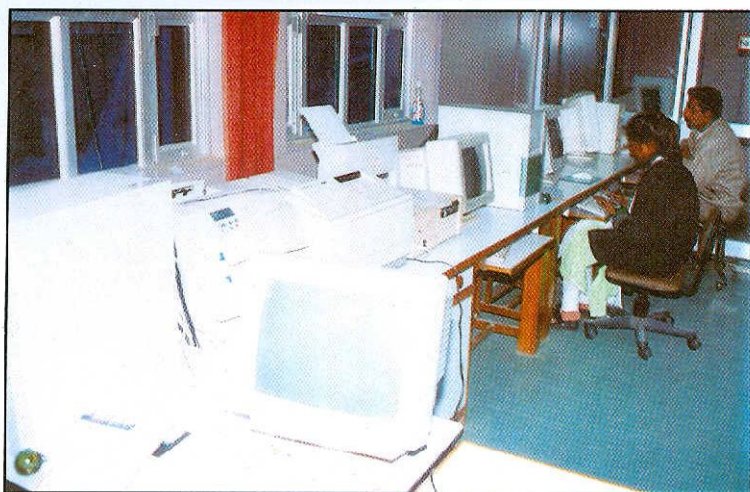
Range land area

3.5.5. Residential complex: NRC on Camel has residential colony comprising of 2 Type-V, 4 Type-IV, 5 Type-III, 9 Type-II and 13 type I staff quarters.

3.5.6. Guest House: Centre has one guest house with 4 rooms which includes two rooms with AC. It can accommodate 8 guests.



Guest House



ARIS Cell

3.5.7.ARIS: VSAT was installed in the month of August 2000. The installation of MS Back Office Server software and LAN was accomplished. The Centre's computers are linked with Internet and e-mail server through Local Area Network. Web site of NRCC development is under progress.



Camel Museum

3.5.8. Camel Museum : Main building possesses small camel museum highlighting various activities on Camel research and development, products of camel hide, bone and hair along with extension activities.

3.6 Staff position (2000-2001)

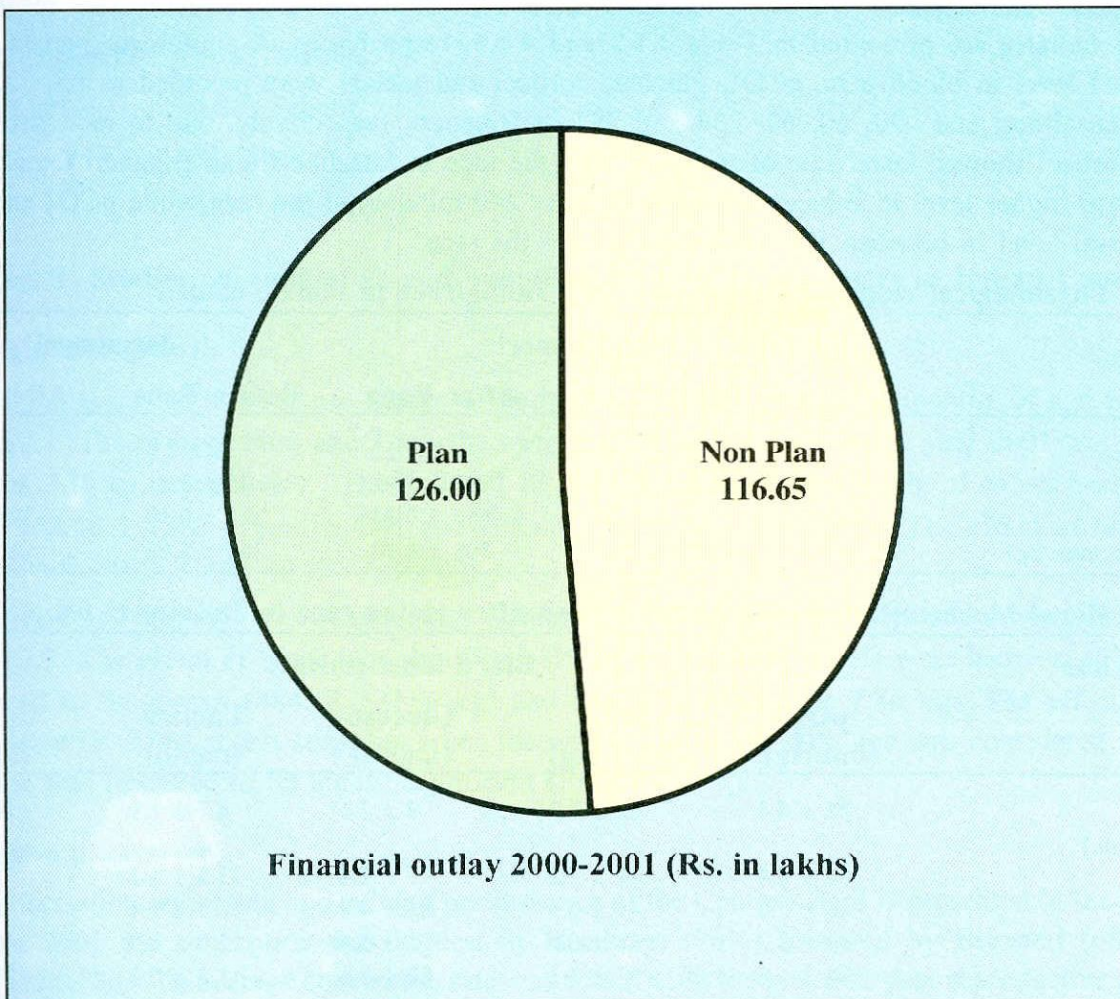
Cadre	Sanctioned	In position	Vacant
RMP	1	1	—
Scientific	20	15	5
Technical	4	4	—
Category III	7	7	—
Category II	11	11	—
Category I	10	10	—
Administrative	21	21*	—
Supporting			
Total	74	69	5

*One position has come under 10% cut

3.7. FINANCIAL STATEMENT AND REVENUE RECEIPT (2000-2001)

(Rs. in lakhs)

Head of accounts	Plan		Non-Plan	
	Budget	Expenditure	Budget	Expenditure
Estt. Charges	—	—	83.91	83.91
Wages	10.50	11.41	—	—
O.T.A	—	—	0.19	0.17
T.A.	0.20	0.20	0.15	1.15
HRD	1.00	1.00	—	—
Other charges including Equipments	86.30	85.67	31.40	26.65
Works	28.00	27.72	—	—
	126.00	126.00	116.65	111.88



4 RESEARCH ACHIEVEMENTS

4.1. Improvement of working efficiency of camel under arid and semi arid conditions

Project leader : Raghvendar Singh

Associate : M. S. Sahnii

Sub project 1: Evaluation of race-rest cycle using biochemical tools in female camels

A total of six female camels, three each from Bikaneri and Jaisalmeri breed of 4-5 year age were taken for race trial. All camels were given basic training for three months followed by 12 km race endurance training for four months. The final race trails of 12 km was conducted on kachha desert track. The environmental temperature during race trial was 23°C. The average race speed of Jaisalmeri and Bikaneri females were recorded as 18 ± 1.4 and 16 ± 1.7 km/h, respectively. The data on cardinal responses are presented in Table 4.1.1 which indicated that race resulted in significant increase in pulse and respiration in both Jaisalmeri and Bikaneri females. Data on blood bio-chemicals before and after race for Jaisalmeri and Bikaneri females are presented in Table 4.1.2 and 4.1.3, respectively. A significant percent increase from the basal level in blood pO₂, pCO₂, glucose, cortisol and lactate were recorded as 65, 72, 84, 197 and 285 in Jaisalmeri and 90, 60, 62, 234 and 287 in Bikaneri, respectively, due to race stress. Blood lactate and cortisol showed faster rate of recovery after the race in Jaisalmeri than Bikaneri females. Blood pO₂ maintained higher level in Bikaneri breed even after 240 minutes of the race while pCO₂ and glucose attains the basal level in between 150-240 minutes after the race.

Table-4.1.1: Physiological response before and after riding/race in female camels

Parameters	Bikaneri		Jaisalmeri	
	Before Race	After Race	Before Race	After Race
Respiration/min	9 ± 1.24	30 ± 1.12	8 ± 1.8	29 ± 0.9
Pulse/min	46 ± 2.38	87 ± 1.92	45 ± 3.21	86 ± 1.62
Rectal temp °C	36.8 ± 0.20	39.5 ± 0.33	36.5 ± 0.10	39.6 ± 0.2
Osmolarity (m mol /kg)	289 ± 3.33	308 ± 4.10	262 ± 2.69	291 ± 1.8

Table-4.1.2: Blood biochemicals responses before and after riding/race in Jaisalmeri female

Sampling Time	Blood biochemicals				
	pO ₂ (mmHg)	pCO ₂ (mm Hg)	Glucose (mg/dl)	Lactate (mg/dl)	Cortisol (ng/dl)
Before Race	35 ± 4.4	52 ± 3.2	7.9 ± 3.6	6.7 ± 1.1	14 ± 0.4
After Race (min)					
5	54 ± 6.4	72 ± 2.2	93 ± 2.4	23.5 ± 1.1	71 ± 7.1
15	46 ± 2.0	47 ± 0.5	81 ± 4.9	15.5 ± 1.4	48 ± 4.5
30	43 ± 3.7	51 ± 0.6	75 ± 5.4	13.0 ± 0.9	46 ± 3.3
60	44 ± 1.6	53 ± 1.3	80 ± 0.6	11.2 ± 0.2	29 ± 1.7
90	37 ± 0.4	55 ± 2.7	83 ± 4.1	8.9 ± 0.5	24 ± 0.1
150	36 ± 4.1	53 ± 4.9	84 ± 0.6	6.6 ± 0.5	17 ± 2.9
240	33 ± 1.6	53 ± 0.5	77 ± 0.6	6.3 ± 0.4	14 ± 0.4

Table-4.1.3: Blood biochemical responses before and after riding/race in Bikaneri females

Sampling Time	Blood biochemicals				
	pO ₂ (mmHg)	pCO ₂ (mm Hg)	Glucose (mg/dl)	Lactate (mg/dl)	Cortisol (ng/dl)
Before Race	37 ± 3.7	58 ± 2.9	88 ± 6.1	6.0 ± 1.0	11 ± 0.8
After Race (min)					
5	41 ± 1.2	97 ± 8.6	140 ± 7.2	20.9 ± 2.9	47 ± 5.4
15	46 ± 4.8	57 ± 8.4	139 ± 6.4	17.8 ± 2.5	61 ± 0.8
30	56 ± 8.8	86 ± 9.1	140 ± 3.8	14.4 ± 2.2	55 ± 4.1
60	55 ± 6.9	74 ± 1.1	135 ± 5.4	11.9 ± 1.9	50 ± 0.1
90	51 ± 4.4	68 ± 3.5	141 ± 9.6	11.0 ± 1.9	55 ± 4.5
150	46 ± 7.7	58 ± 7.2	125 ± 2.4	9.5 ± 1.1	44 ± 4.1
240	47 ± 4.8	57 ± 6.6	99 ± 0.8	6.3 ± 0.7	13 ± 0.4

4.2 Genetic characterisation, evaluation and conservation of indigenous camel breeds

Project Leader : S. C. Mehta

Associates : M.S. Sahani

C. Bhakat

B.L. Chirania

Sub Project 1: Studies on qualitative and quantitative genetic parameters in Indian Camel

Body weight and growth

Breed and sex wise leastsquares means of body weight from birth to 12 months of age are presented in Table 4.2.1. The average birth and 3 months weight of the calves born in the year 2001 was 35.35 ± 1.42 and 68.55 ± 5.19 kg, respectively. The 6, 9 and 12 months average body weight of calves born in the year 2000 was 122.56 ± 4.89, 171.68 ± 4.41 and 205.40 ± 6.17 kg, respectively. The effect of breed and sex was non-significant (P>0.05) up to 12 months age.

The breed, sex and age wise leastsquares means of adult body weight (4,6 and 8 years) are presented in Table 4.2.2. The effect of breed was significant (P<0.01). Bikaneri camels were heaviest (527.09 ± 4.95 kg) followed by Jaisalmeri (484.18 ± 7.90 kg) and Kachchhi (473.72 ± 7.86 kg). The effect of sex was non-significant (P>0.05) at this stage but when the interaction of sex with age was considered the effect of sex and age was observed to be highly significant (P<0.01).

Reproductive parameter

The information on mating and calving performance of the Centre's herd is presented in the Table-4.2.3. In the year 2001 the conception was highest in Jaisalmeri (76%) followed by Bikaneri (68.57 %) and Kachchhi (52.94%). The average conception rate was 67.53 %. In the previous year reproductive performance was slightly better. The percent conception and calving was highest in Jaisalmeri (85.71 & 71.43) followed by Bikaneri (70.59 & 58.82) and Kachchhi (33.33 & 33.33).

Table-4.2.1: Age, breed and sex wise leastsquares means of body weight of camel calves

(Weight in kg)

Effects	Birth Wt.	3 mth	6 mth	9 mth	12 mth
	2001			2000	
Year of birth					
Mean	35.35 ± 1.42 (24)	68.55±5.19 (22)	122.56±4.89 (29)	171.4.41 (28)	205±6.17 (31)
Breed	NS	NS	NS	NS	NS
Bikaneri	38.21±1.40 (10)	66.98±5.45 (9)	115.56±6.08 (14)	179.46±5.85 (13)	217.00±6.93 (13)
Jaisalmeri	38.7±1.40 (11)	70.22±5.25 (10)	127.10±6.84 (11)	175.79±6.78 (10)	214.87±6.93 (15)
Kachchhi	37.46±3.25 (2)	72.05±11.88 (2)	125.04±11.52 (4)	159.80±9.34 (5)	184.33±15.56 (3)
Arab cross	27.04±4.48 (1)	64.95±16.34 (1)	—	—	—
Sex	NS	NS	NS	NS	NS
Male	36.31±1.79 (10)	67.60±6.54 (10)	124.49±6.08 (15)	170.70±5.20 (18)	210.38±7.92 (17)
Female	34.40±1.71 (14)	69.50±6.46 (12)	120.64±6.93 (14)	172.66±6.77 (10)	200.42±7.85 (14)

The data belonging to the year 1992 to 2000 were analysed for age at 1st calving, calving interval and gestation length (Table-4.2.4). The age at 1st calving, pooled over breeds, was found to be 2026.029±5.41 days. Though the effect of breed & sex of progeny was non-significant (P>0.05), there exists great variation and hence scope for the improvement in attaining the puberty at an early age. The age at 1st calving was observed to be 2017.93±87.65, 2088.79±170.78 and 1971.3±200.59 days in Bikaneri, Jaisalmeri and Kachchhi breeds, respectively. The effect of year and sex of the progeny was found non-significant (P>0.05). Camel being seasonal breeder, the calving interval was observed to be 740.76±10.67 days with non-significant effect of breed, sex of the progeny, parity and year of calving. The gestation length, pooled over breed, was found to be 388.30±0.68 days. The effect of breed was significant at 1% probability level with no interaction and at 5% probability level with all possible interactions. The Kachchhi females took 385.17±1.53 days as compared to 390.2±0.93 and 389.52±0.98 days taken by the Bikaneri and Jaisalmeri females, respectively. The effect of sex of the progeny and parity of the mother had no significant (P>0.05) effect on gestation length. The year to year variation was significant (P<0.05), probably due to climatic and managemental factors, such as nutrition. All possible interactions viz. Breed and Sex, Breed and Parity, Breed and Year, were non-significant (P>0.05).

Table-4.2.2: Leastsquares means of body weight of different camel breeds

(Weight in kg)

Effects	Pooled	Bikaneri	Jaisalmeri	Kachchhi
Breed	** 494.99±4.13 (435)	527.09±4.95 (255)	484.18±7.90 (89)	473.72±7.86 (91)
Sex	NS			
Male	498.41±6.91 (119)	531.14±8.58 (65)	493.52±13.12 (27)	470.59±13.16 (27)
Female	491.57±4.39 (316)	523.03±4.93 (190)	474.83±8.69 (62)	476.86±8.51 (64)
Effects	Pooled Sex	Male	Female	
Sex	**			
μ	501.67±4.00 (435)	514.64±6.58 (119)	489.30±4.03 (316)	
Age	**			
4-Year	408.02±5.15 (186)	388.49±8.20 (64)	427.57±5.96 (122)	
6-Year	517.87±6.70 (130)	532.73±11.49 (32)	503.01±6.79 (98)	
8-Year	579.11±7.66 (119)	620.92±13.51 (23)	537.3±6.86 (96)	

Table-4.2.3: Year wise reproductive performance of the farm camel herd

Year	Traits	Bikaneri	Jaisalmeri	Kachchhi	Crossbred	Pooled Breeds
2000	Total Mating	17	14	6	1	38
	Conception (%)	12 (70.59%)	12 (85.71%)	2 (33.33%)	1 (100%)	27 (71.05%)
	Calving (%)	10 (58.82%)	10 (71.43%)	2 (33.33%)	1 (100%)	23 (60.53%)
2001	Mating	35	25	17	—	77
	Conception (%)	24 (68.57%)	19 (76.00%)	9 (52.94%)	—	52 (67.53%)

Table-4.2.4: Breed wise leastsquares means of reproductive traits in farm camel herd

(in days)

Trait & Effect	Pooled Breed	Bikaneri	Jaisalmeri	Kachchhi
Age at 1 st Calving	NS 2026.02±95.41 (64)	2017.93±87.65 (44)	2088.79±70.78 (12)	1971.33±200.59 (8)
Calving Interval	NS 740.76±10.67 (101)	735.65±10.79 (55)	740.90±11.75 (26)	745.73±12.39 (20)
Gestation Length	** 388.30±0.68 (201)	390.20±0.93 (94)	389.52±0.98 (69)	385.17±1.53 (38)
Sex Effect	NS	Bread * Sex		NS
Male	388.98±0.79 (119)	390.90±1.05 (53)	389.87±1.06 (44)	386.18±1.84 (22)
Female	387.61±0.95 (82)	389.50±1.31 (41)	389.17±1.59 (25)	384.16±1.97 (16)
Parity Effect	NS	Breed * Parity		
1	388.30±1.42 (35)	391.08±1.93 (14)	389.58±2.04 (15)	384.24±3.20 (6)
2	389.55±1.33 (48)	390.32±1.47 (22)	390.07±1.59 (21)	388.27±3.35 (5)
3#	387.04±0.73 (118)	389.20±1.04 (58)	388.91±1.29 (33)	383.01±1.44 (27)
Year Effect	*	Breed * Year		NS
1992	386.26±1.66 (24)	387.55±1.91 (14)	386.38±2.94 (6)	384.85±3.54 (4)
1993	387.35±1.86 (15)	388.09±3.43 (4)	387.24±2.94 (6)	386.71±3.26 (5)
1994	389.99±1.41 (29)	389.18±1.86 (14)	390.32±2.26 (9)	390.45±3.06 (6)
1995	386.48±2.23 (10)	388.40±3.91 (3)	387.36±3.46 (4)	383.68±4.19 (3)
1996	391.62±1.41 (30)	394.69±1.64 (18)	392.11±2.74 (6)	388.04±2.78 (6)
1997	388.68±2.09 (14)	393.23±2.54 (7)	390.27±3.04 (5)	382.53±4.86 (2)
1998	391.18±1.54 (23)	392.44±2.05 (11)	384.03±2.61 (7)	387.06±3.20 (5)
1999	386.79±2.05 (21)	390.99±2.22 (10)	390.75±2.57 (9)	378.65±5.11 (2)
2000	386.35±1.43 (35)	387.25±1.91 (13)	387.24±1.66 (17)	384.56±3.46 (5)

*Significant (p<0.05), ** Significant (p<0.01), NS: Non Significant, # Parity ≥ 3

Table 4.2.5. Opening and closing Camel herd strength (2000-2001)

Breed/Age	Opening		Calving		Purchase		Death		Disposal		Closing	
	M	F	M	F	M	F	M	F	M	F	M	F
BIKANERI												
Up to 3 months	11	8	7	5	—	—	—	—	—	—	6	4
3-12 months	4	5	—	—	—	—	2	1	—	—	12	11
1-3 years	8	8	—	—	—	—	—	—	4	1	6	9
Above 3 years	19	53	—	—	—	—	—	1	3	3	16	49
Total	42	74	7	5	—	—	2	2	7	4	40	73
JAISALMERI												
Up to 3 months	11	9	4	8	—	—	—	—	—	—	3	7
3-12 months	7	1	—	—	—	—	3	2	—	—	15	9
1-3 years	9	6	—	—	—	—	—	—	1	1	9	5
Above 3 years	17	43	—	—	10	—	1	2	4	2	22	39
Total	44	59	4	8	10	—	4	4	5	3	49	60
KACHCHHI												
Up to 3 months	3	2	—	2	—	—	—	—	—	—	—	2
3-12 months	2	1	—	—	—	—	—	—	—	—	5	3
1-3 years	3	2	—	—	1	—	1	—	1	—	2	2
Above 3 years	8	14	—	—	1	10	1	4	5	—	3	20
Total	16	19	—	2	2	10	2	4	6	—	10	27
ARAB X BIKANERI												
Up to 3 months	1	—	2	—	—	—	—	—	—	—	1	—
3-12 months	1	1	—	—	—	—	1	—	—	—	—	—
1-3 years	—	3	—	—	—	—	2	—	—	—	—	4
Above 3 years	2	8	—	—	—	—	—	—	—	—	2	8
Total	4	12	2	—	—	—	3	—	—	—	3	12
MARWARI												
	1	—	—	—	—	—	—	—	—	—	1	—
SANCHORI												
	1	—	—	—	—	—	—	—	—	—	1	—
OVER ALL	108	164	13	15	12	10	11	10	18	7	104	172

Hair production parameters

Annual camel hair production data of (1998-1999, 1999-2000 and 2000-2001) were recorded and classified according to breed, sex, age group and year of production. Data were pooled and analysed by applying mixed mode leastsquare and maximum likelihood computer programme. Breed and sex wise leastsquares means for annual hair production (gm) of Indian dromedary camel are presented in Table 4.2.6. The Bikaneri breed indicated higher annual hair production (933.85 ± 17.19 gm) followed by Jaisalmeri and Kachchhi breed. The overall annual hair production was 763.50 ± 12.72 gm. Bikaneri Males produced higher quality (1014.08 ± 26.36) than the females (853.63 ± 20.61). Similar trend was observed in case of Jaisalmeri and Kachchhi breed. The overall average hair production for male and female camels were 809.77 ± 18.20 gm and 717.24 ± 16.45 gm, respectively. Table 4.2.7 reveals the age and year wise LSQ mean with SE for annual hair production (gm) in indigenous camels. The 3 year age group produced maximum hair yield (1035.64 ± 29.14) followed by 2 yr, 4-6 yr, 1 yr. and above 6 yrs age group. Almost similar trend of production was found in every year. The breed sex and age had significant ($P < 0.01$) effect on annual yield. The interaction between breed and sex had non-significants effect on annual hair production. The results of study concludes that Bikaneri breed of 2-3 year age group produces higher annual hair yield as compared to other age groups and breeds.

Table-4.2.6: Breed and sex wise leastsquares mean of annual hair production in indigenous camel

(Weight in gm)

Breed	Annual Production	SEX	
		Male	Female
Bikaneri	933.85 ± 17.90 (26.5)	1014.08 ± 26.36 (91)	853.63 ± 20.61 (174)
Jaisalmeri	733.43 ± 17.84 (227)	771.28 ± 25.42 (97)	695.59 ± 23.92 (130)
Kachchhi	623.22 ± 25.97 (98)	643.95 ± 39.91 (39)	602.50 ± 32.90 (59)
Overall	763.50 ± 12.72 (590)	809.77 ± 18.20 (227)	717.24 ± 16.45 (363)

Table-4.2.7: Age and year wise leastsquares mean of annual hair production in indigenous camel

(Weight in gm)

AGE GROUP / (Year)	Number	MEAN \pm S.E.
1	70	630.68 \pm 30.39
2	62	879.50 \pm 31.85
3	74	1035.64 \pm 29.14
4 - 6	110	729.03 \pm 24.20
Above 6	274	542.67 \pm 16.95
Overall	590	763.50 \pm 12.72
Years		
1998 - 1999	159	771.84 \pm 20.67
1999 - 2000	204	731.83 \pm 19.52
2000 - 2001	227	786.84 \pm 18.18
Overall	590	763.50 \pm 12.72

Sub Project 2: Creation of Database

Inventory of the Centre's camel herd: This includes pedigree information on all available animals of Bikaneri, Jaisalmeri, Kachchhi and Arab cross camels maintained at the Centre's farm.

Database on biometry of Centre's herd: This includes information on 17 traits (body measurements) of the camels maintained at the Centre.

Breeding tract database on Jaisalmeri camel: This includes information on district, tehsil, village, camel breeder and biometry on 17 traits of true to the breed animals of Jaisalmeri breed as found in the breeding tract.

Reproduction database: This includes information on reproductive performance of the Centre's herd from 1992 to 2000.

Health database: This includes information on month and yearwise mortality of animal at farm since 1984 to 2000.

Production database: This includes information on sex, age and breedwise hair and milk production of camels of farm herd.

Sub Project 3: Selection for improvement of draughtability of camel breeds

Body measurements of complete NRCC herd were taken and the breed, age and sex wise leastsquares means are presented in Table 4.2.8–4.2.10. The variation due to breed was found significant for body length, leg length (hind), foot pad width (front) and hump circumference (horizontal and vertical). The effect of sex was significant for most of the traits studied except heart girth, height at wither, hump circumference (H&V) and ear length. As expected the effect of age was significant for all traits.

Body measurements at 4 years of age were of particular interest, hence the range of some of the traits having great bearing on draughtability was envisaged. The body length ranged from 117 to 157 cm whereas heart girth, height at wither, neck length, leg length (front) and leg length (hind) varied from 175 - 200, 95 -123, 128-148 and 132-153 cm, respectively. Selection can therefore be made on the basis of body length while fixing independent culling level for other traits. In general the Bikaneri breed is better in most of the body conformation traits followed by Kachchhi and Jaisalmeri. The variation in hump circumference (horizontal and vertical) was highly significant. The horizontal and vertical hump circumference in crossbred animals was highest (96.03 ± 6.02 & 42.19 ± 3.08 cm) followed by Bikaneri (92.00 ± 2.49 & 38.45 ± 1.27 cm), Kachchhi (87.80 ± 3.48 & 35.73 ± 1.78 cm) and Jaisalmeri (80.86 ± 2.39 & 33.89 ± 1.22 cm).

Sub Project 4: Molecular genetic studies in Indian camel

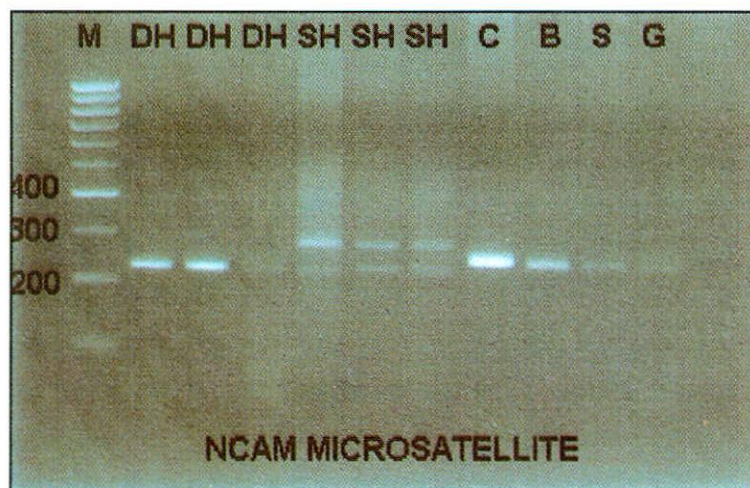


Fig. 4.2.1 NCAM Microsatellite in double humped camel (DH), single humped camel (SH), cattle (C), buffalo (B), sheep (S) and goat (G)

Neural Cell Adhesion Molecule (NCAM) gene is highly conserved in eutherian mammals both in coding and 3' untranslated region. Genomic DNA samples of double humped camel along with that of single humped camel, cattle, buffalo, sheep, goat, horse & donkey were studied with a single set of primers. A single band of 237 bp was amplified in bactrian camel whereas two bands of 237 bp and 288 bp were amplified in dromedary camel even at annealing temperature, as high as, 65°C . Lower annealing temperatures were used to amplify the NCAM microsatellite in cattle (255 bp), buffalo (255 bp), sheep (255 bp), goat (255 bp), donkey (226 bp) and horse (226 bp) (Table-4.2.11)

Table-4.2.8: Breed, sex and year wise leastsquares mean of body measurements of camel

(in cm)

Traits/ Effects	Body length	Heart girth	Height at withers	Neck length	Leg length (F)	Leg length (H)
Over all mean	129.52±0.96 (251)	181.34±1.33 (251)	173.98±0.99 (251)	94.88±0.77 (251)	128.59±0.64 (251)	134.78±0.66 (251)
Breed	*	NS	NS	NS	NS	*
Breed 1	131.68±1.10 (102)	182.92±1.54 (102)	176.06±1.14 (102)	96.81±0.89 (102)	129.67±0.74 (102)	136.0.76 (102)
Breed 2	127.85±1.06 (97)	179.46±1.48 (97)	174.92±1.10 (97)	94.15±0.85 (97)	128.90±0.71 (97)	135.26±0.73 (97)
Breed 3	131.64±1.54 (39)	180.51±2.15 (39)	175.12±1.60 (39)	95.48±1.24 (39)	130.42±1.03 (39)	135.82±1.06 (39)
Breed 4	126.91±2.67 (13)	182.45±3.72 (13)	169.82±2.76 (13)	93.07±2.15 (13)	125.38±1.78 (13)	131.42±1.84 (13)
Sex	**	NS	NS	**	**	**
Male	131.28±1.25 (94)	182.17±1.74 (94)	175.17±1.29 (94)	96.57±1.00 (94)	131.08±0.83 (94)	137.47±0.86 (94)
Female	127.76±1.08 (157)	180.50±1.50 (157)	172.79±1.11 (157)	93.18±0.87 (157)	126.10±0.72 (157)	132.10±0.74 (157)
Age**	129.52±0.96 (251)	181.34±1.33 (251)	173.98±0.99 (251)	94.88±0.77 (251)	128.59±0.64 (251)	134.78±0.66 (251)
<1 Year	73.08±2.07 (22)	103.09±2.89 (22)	120.39±2.14 (22)	55.42±1.67 (22)	95.51±1.38 (22)	101.51±1.43 (22)
1 Year	112.00±3.54 (7)	152.77±4.92 (7)	148.74±3.65 (7)	81.22±2.84 (7)	112.86±2.36 (7)	118.95±2.43 (7)
2 Years	117.73±1.83 (31)	169.11±2.55 (31)	171.10±1.89 (31)	88.84±1.47 (31)	128.18±1.22 (31)	134.33±1.26 (31)
3 Years	131.02±2.04 (23)	185.59±2.84 (23)	177.67±2.11 (23)	97.94±1.64 (23)	130.33±1.36 (23)	136.78±1.41 (23)
4 Years	117-157 142.75±1.80 (29)	178-220 203.12±2.50 (29)	175-200 189.13±1.86 (29)	95-123 107.80±1.45 (29)	128-148 136.31±1.20 (29)	132-153 142.57±1.24 (29)
5 Years	146.31±2.11 (22)	207.34±2.93 (22)	196.13±2.17 (22)	108.51±1.69 (22)	141.40±1.40 (22)	147.81±1.45 (22)
6 Years	155.25±2.80 (12)	210.41±3.89 (12)	191.80±2.89 (12)	107.05±2.25 (12)	142.07±1.86 (12)	147.92±1.93 (12)
≥ 7 Years	158.03±1.16 (105)	219.26±1.62 (105)	196.86±1.20 (105)	112.0.93 (105)	142.07±0.77 (105)	148.39±0.80 (105)

*(P<0.05) ***(P<0.01) F - Front, H - Hind

Table-4.2.9: Breed, sex and year wise leastsquares means of body measurements of indigenous camel

(in cm)

Traits/ Effects	Foot pad length (F)	Foot pad Width (F)	Foot pad length (H)	Foot pad Width (H)	Hump Circum (H)	Hump Circum (V)
Over all mean	16.94±18 (251)	16.08±0.13 (251)	15.48±0.14 (251)	14.51±0.14 (251)	89.17±2.16 (251)	37.56±1.10 (251)
Breed	NS	**	NS	NS	**	**
Breed 1	17.10±0.20 (102)	16.10±0.17 (102)	15.35±0.17 (102)	14.43±0.16 (102)	92.00±2.49 (102)	38.45±1.27 (102)
Breed 2	16.84±0.19 (97)	15.94±0.14 (97)	15.30±0.16 (97)	14.38±0.15 (97)	80.86±2.39 (97)	33.89±1.22 (97)
Breed 3	17.26±0.28 (39)	16.76±0.21 (39)	15.93±0.23 (39)	14.95±0.22 (39)	87.80±3.48 (39)	35.73±1.78 (39)
Breed 4	16.56±0.49 (13)	15.41±0.36 (13)	15.32±0.40 (13)	14.30±0.39 (13)	96.03±6.02 (13)	42.19±3.08 (13)
Sex	**	**	**	**	NS	NS
Male	17.28±0.23 (94)	16.32±0.17 (94)	15.76±0.19 (94)	14.78±0.18 (94)	89.31±2.81 (94)	37.84±1.4 (94)
Female	16.60±0.20 (157)	15.83±0.15 (157)	15.19±0.16 (157)	14.25±0.16 (157)	89.04±2.42 (167)	37.29±1.24 (157)
Age**	16.94±0.18 (251)	16.08±0.13 (251)	15.48±0.14 (251)	14.51±0.14 (251)	89.17±2.16 (251)	37.56±1.10 (251)
<1 Year	8.77±0.38 (22)	8.12±0.28 (22)	7.80±0.31 (22)	7.13±0.30 (22)	46.57±4.67 (22)	19.63±2.38 (22)
1 Year	15.60±0.65 (7)	14.55±0.48 (7)	13.74±0.53 (7)	12.73±0.51 (7)	64.88±7.95 (7)	31.35±4.07 (7)
2 Years	16.08±0.34 (31)	15.26±0.25 (31)	14.53±0.27 (31)	13.54±0.27 (31)	81.68±4.12 (31)	34.62±2.10 (31)
3 Years	17.53±0.37 (23)	16.54±0.28 (23)	16.16±0.31 (23)	15.13±0.30 (23)	85.95±4.60 (23)	38.73±2.35 (23)
4 Years	18.35±0.33 (29)	17.92±0.24 (29)	17.45±0.27 (29)	16.50±0.26 (29)	102.04±4.05 (29)	42.24±2.07 (29)
5 Years	19.02±0.39 (22)	18.09±0.29 (22)	17.63±0.31 (22)	16.56±0.31 (22)	101.39±4.74 (22)	39.75±2.42 (22)
6 Years	19.90±0.51 (12)	18.67±0.38 (12)	18.26±0.42 (12)	17.23±0.41 (12)	114.61±6.30 (12)	46.56±3.22 (12)
≥ 7 Years	20.26±0.21 (105)	19.47±0.16 (105)	18.26±0.17 (105)	17.31±0.17 (105)	116.24±2.62 (105)	47.64±1.34 (105)

NS- Non-significant, *(P<0.05) **(P<0.01) F - Front H - Hind

Table-4.2.10: Breed, sex and year wise leastsquares mean of body measurements of camel.

(in cm)

Traits/ Effects	Face length	Distance between eyes	Distance between ears	Ear length	Tail length
Over all mean	47.06±0.38 (251)	20.05±0.20 (251)	15.89±0.20 (251)	11.08±0.12 (251)	49.22±0.41 (251)
Breed	NS	NS	NS	NS	NS
Breed 1	46.72±0.44 (102)	20.28±0.23 (102)	15.67±0.23 (102)	11.15±0.13 (102)	48.68±0.27 (102)
Breed	47.00±0.42 (97)	19.83±0.22 (97)	15.80±0.22 (97)	11.01±0.13 (97)	50.08±0.45 (97)
Breed	47.98±0.62 (39)	20.38±0.32 (39)	16.41±0.32 (39)	11.50±0.19 (39)	49.40±0.66 (39)
Breed	46.55±1.06 (13)	19.70±0.56 (13)	15.69±0.55 (13)	10.67±0.32 (13)	48.71±1.14 (13)
Sex	**	**	**	NS	*
Male	48.55±0.50 (94)	20.86±0.26 (94)	16.74±0.26 (94)	11.11±0.15 (94)	49.81±0.53 (94)
Female	45.57±0.43 (157)	19.23±0.23 (157)	15.04±0.22 (157)	11.05±0.13 (157)	48.64±0.46 (157)
Age**	47.06±0.38 (251)	20.05±0.20 (251)	15.89±0.20 (251)	15.89±0.20 (251)	49.22±0.41 (251)
<1 Year	29.38±0.83 (22)	12.51±0.43 (22)	9.43±0.43 (22)	5.78±0.25 (22)	31.55±0.88 (22)
1 Year	41.38±1.41 (7)	17.70±0.74 (7)	15.07±0.73 (7)	10.11±0.43 (7)	46.38±1.50 (7)
2 Years	44.46±0.73 (31)	19.67±0.38 (31)	15.15±0.38 (31)	11.27±0.22 (31)	47.91±0.78 (31)
3 Years	49.05±0.81 (23)	20.49±0.43 (23)	16.64±0.42 (23)	11.24±0.25 (23)	49.59±0.87 (23)
4 Years	50.93±0.72 (29)	21.76±0.38 (29)	17.05±0.37 (29)	12.35±0.22 (29)	51.72±0.76 (29)
5 Years	53.84±0.84 (22)	21.91±0.44 (22)	17.28±0.44 (22)	12.52±0.26 (22)	56.15±0.90 (22)
6 Years	53.13±1.11 (12)	22.58±0.59 (12)	17.76±0.58 (12)	12.72±0.34 (12)	54.42±1.19 (12)
≥ 7 Years	54.34±0.46 (105)	23.74±0.24 (105)	18.98±0.24 (105)	12.65±0.14 (105)	56.05±0.49 (105)

NS- Non-significant, *(P<0.05) and **(P<0.01)

Table-4.2.11: NCAM Microsatellite in two species of camel and other livestock species

Species	Number	No. of Copies	Molecular Size (bp)
<i>C. bactrianus</i>	3	1	237
<i>C. dromedarius</i>	4	2	237, 288
Cattle	4	1	255
Buffalo	4	1	255
Goat	4	1	255
Sheep	4	1	255
Donkey	4	1	226
Horse	4	1	226

4.3. Improvement of reproductive efficiency and to study the reproductive failures in camel

Project leader : Aminu Deen

Associate : M.S. Sahani

Sub project 1 Collection of semen through AV method in dromedary camels

Collection of semen:

A total of 14 males were used for collection of semen over 2 consecutive years i.e. 1999-2000 and 2000-01. A total of 465 collections were attempted.

Copulation in AV

Majority of camels readily mounts on a female restrained in sitting position and readily adopts squatting posture. They spend few seconds rubbing open end of AV with partially extruded glans before fully erecting penis to accomplish intromission into AV. Two types of behaviour are generally noted, either the male is reluctant to serve in AV and do not develop orgasm or vigorously copulate in AV and develop characteristic orgasm.

The reluctant male erects penis, copulate in AV for few seconds and withdraw without developing full orgasm. This is followed by repeated thrusting and withdrawal without a characteristic orgasm. Finally these dismounts as disgusted with AV. Ejaculates from these males contain little spermatozoa. Probably

these male withdraw to relocate vagina but because the prepuce is firmly held by the operator, camel remains unable to hit at area other than AV. Contrary to this, males willing to copulate in AV pull up themselves, make a firm grip over female, raise hind quarter to firmly grip on AV held on dorsolateral aspect of left thigh, vigorously copulate in AV for 3-10 minutes and exhibit characteristic grinding of teeth, whistling sound, extension of neck, abdominal and gluteal muscle tenesmus, pressing of hock joint against the ground and lifting of footpad above the ground. Finally, when it gets exhausted, it dismounts and falls on right side or gets up abruptly.

Performance of collection of semen through AV involving 14 dromedarius camels over 2 consecutive years has been presented in Table 4.3.1. Performance has been graded on the basis of percent successful collections. Performance was adjudged as good, fair, poor, and very poor respectively for 2, 3, 0 and 1 of the 6 camels during 99-2000 and 6, 1, 4 and 3 of the 14 camels used in year 2000-2001. Comparison of the performance of six camels over 2 years revealed that performance improved in 2, remained static in 1 and declined in 3 of the 6 camels. Copulation time and volume of semen obtained during December 2000-May 2001 using 14 male camels have been graphically presented in Fig. 4.3.1. A cut out line of 200 seconds for copulation time and 3ml of volume of semen was set. Copulation time and volume of semen below cut out line may be considered as reluctance to serve in AV and incomplete ejaculation. Data regarding number of copulation below and above 200 seconds limit and volume of semen below and above 3 ml have been presented in Table 4.3.2. Data indicated that on an average 62.86% time, the males copulated for 200 seconds or more and 37.13 % copulation were of shorter duration. Similarly 49.26% ejaculates were either 3 ml or above and 50.73% ejaculates were below 3ml including no ejaculate. The data indicated that there is tremendous variation in copulation reaction and ejaculation of semen among different male camels. Some male consistently performs good while some are average and yet other which are poor.

Sub Project 2 : Semen evaluation

Volume

Average volume of semen and copulation time along with range have been presented in Table 4.3.3. The data indicate that it varied greatly between ejaculates.

Individual sperm motility

Frequency distribution of individual sperm motility of semen samples from 13 camels has been presented in Table 4.3.4. The data show that as many as 48/164 (29.26%) semen samples exhibited no individual sperm motility. Another 54/164 (32.92%) exhibited low to fair grade individual sperm motility while only 62/164 (37.80%) samples exhibited greater than 50% sperm motility.

Fig. 4.3.1 Copulation time and volume of semen

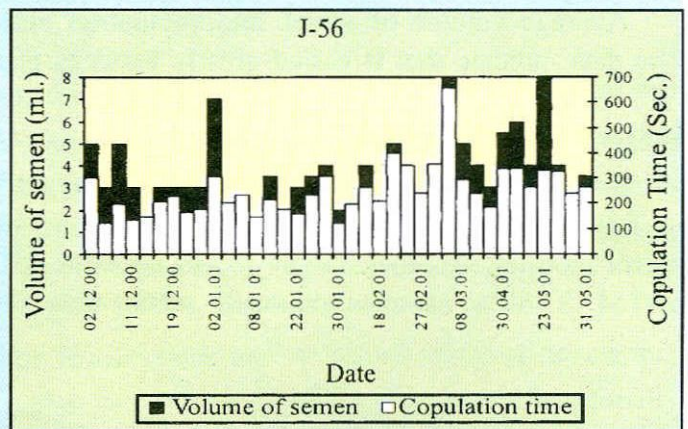
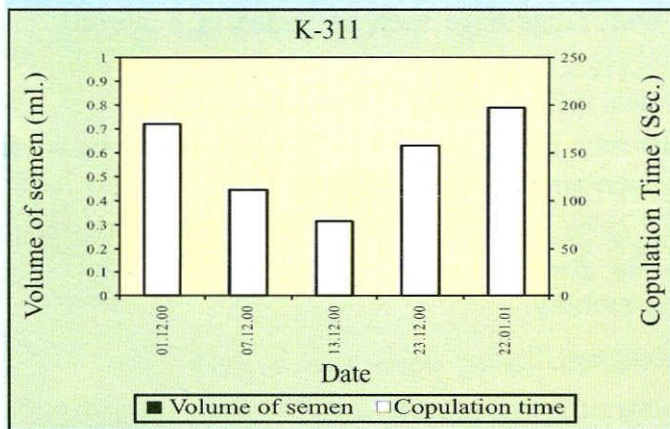
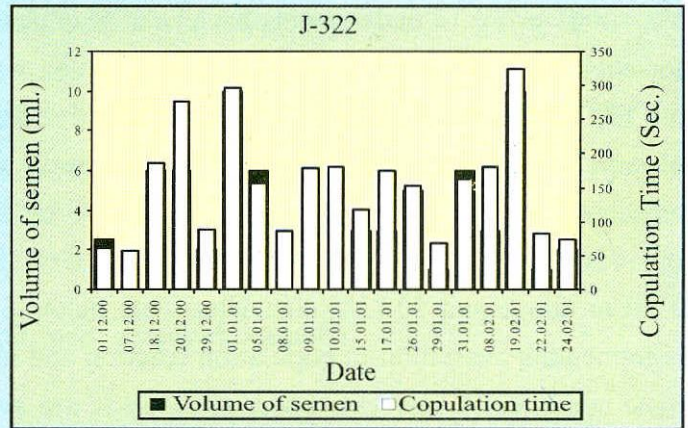
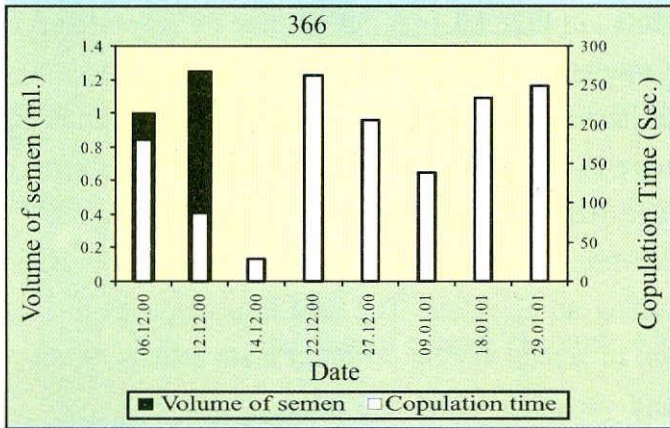
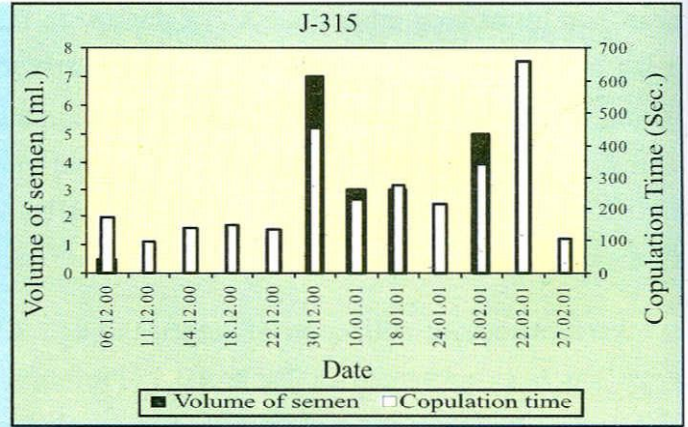
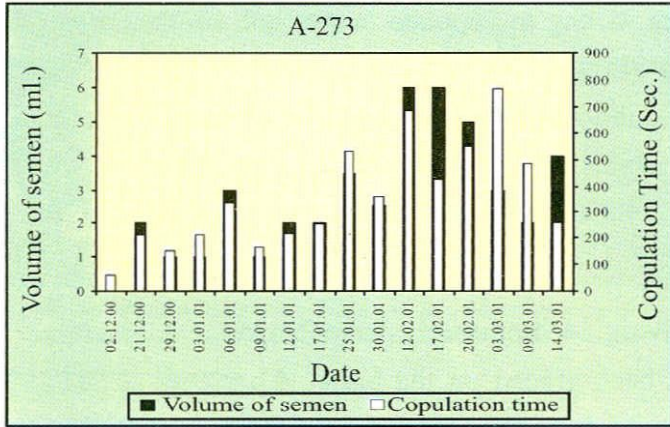


Fig. 4.3.1 (Contd.)

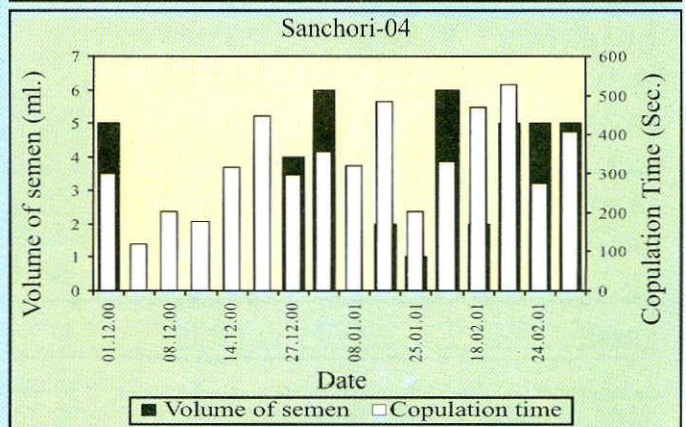
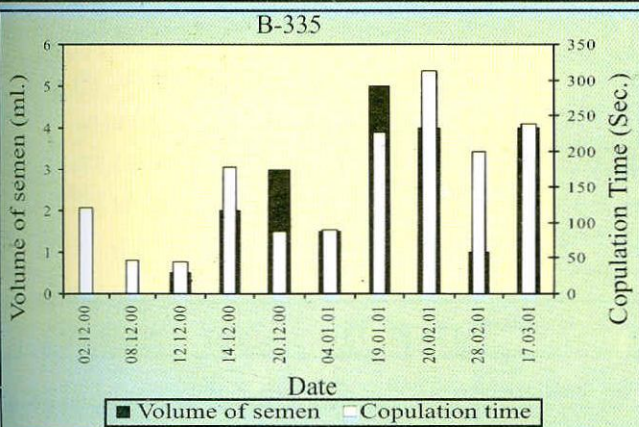
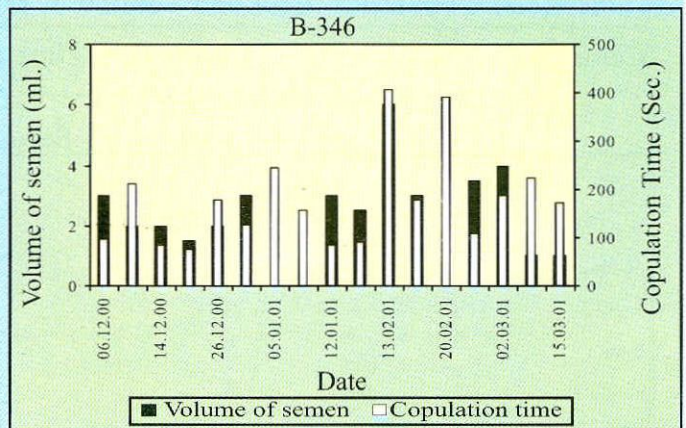
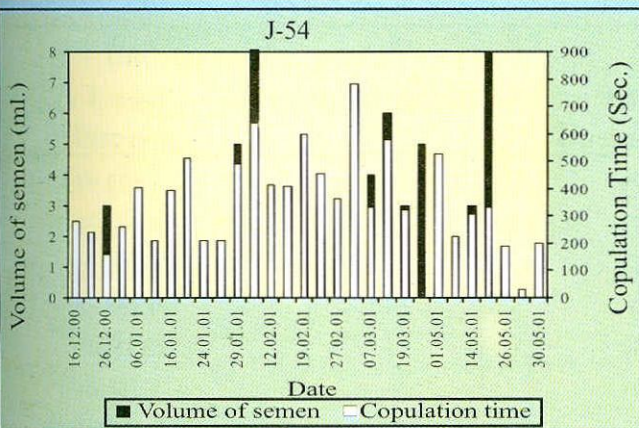
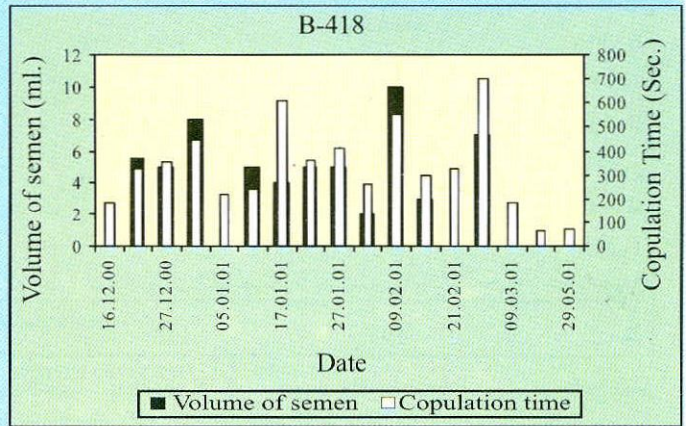
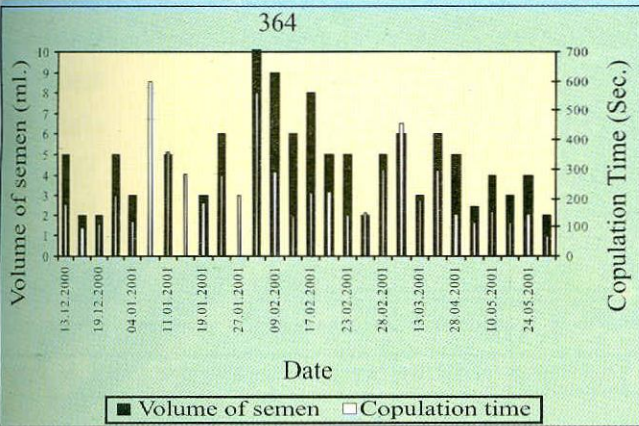
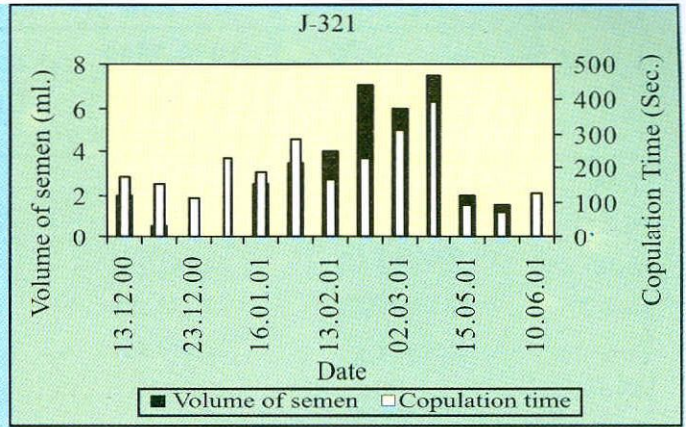
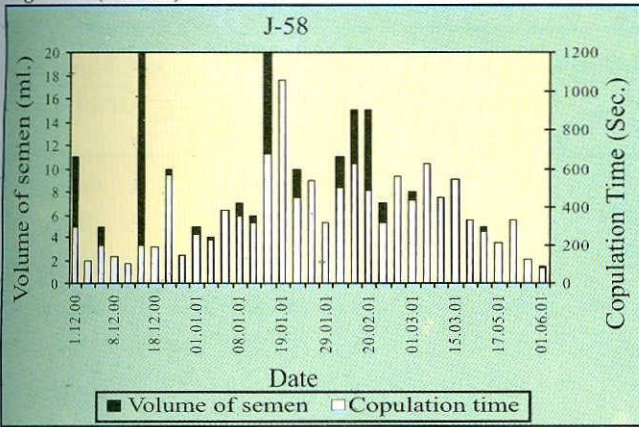


Table-4.3.1: Performance of collection of semen through AV in dromedary camel (1999-2001)

Camel No.	1999-2000			2000-2001		
	Total attempts	Successful collections (%)	Gradation	Total attempts	Successful collections (%)	Gradation
J-56	27	18 (66.66)	Fair	37	35 (94.59)	Good
A-273	29	20 (75.40)	Fair	16	15 (93.75)	Good
J-58	29	24 (82.75)	Good	34	28 (82.35)	Good
J-322	47	37 (78.22)	Good	24	16 (66.66)	Poor
S-4	31	22 (70.96)	Fair	17	10 (58.82)	Poor
K-311	30	1 (3.33%)	Very poor	5	0	Very poor
364	—	—	—	28	25 (89.28)	Good
B-346	—	—	—	17	14 (82.35)	Good
J-54	—	—	—	30	24 (80)	Good
B-335	—	—	—	11	8 (72.72)	Fair
J-321	—	—	—	15	10 (66.66)	Poor
B-418	—	—	—	18	11 (61.11)	Poor
J-315	—	—	—	12	5 (41.66)	Very Poor
366	—	—	—	8	2 (25)	Very Poor
Total	193	122		272	203	

J-Jaisalmeri, A-Arab x Bikaneri, K-Kacchhi, B-Bikaneri, S-Sanchori

Table-4.3.2: Copulation time and volume of semen

Camel No.	Copulation Time (Sec.)		Volume of semen (ml)	
	Below 200 Seconds	Above 200 Seconds (percent)	Below 3 ml	Above 3 ml (percent)
J-56	9	28 (75.67)	10	27 (72.97)
A-273	13	15 (53.57)	10	18 (64.28)
J-58	7	27 (79.41)	13	21 (61.76)
J-322	20	4 (21.05)	14	10 (52.63)
S-4	5	25 (83.33)	15	15 (50.0)
K-311	5	13 (72.22)	9	9 (50.0)
364	3	13 (81.25)	9	7 (46.66)
B-346	3	14 (87.5)	10	7 (43.75)
J-54	6	11 (64.70)	10	7 (41.17)
B-335	7	4 (40.0)	7	4 (40.0)
J-321	10	5 (33.33)	10	5 (33.33)
B-418	6	6 (50.0)	8	4 (33.33)
J-315	3	5 (62.5)	8	0
366	4	1 (20)	5	0
Total	101 (37.13)	171 (62.86)	138 (50.73)	134 (49.26)

J-Jaisalmeri, A-Arab x Bikaneri, K-Kacchhi, B-Bikaneri, S-Sanchori

Table-4.3.3: Semen evaluation

Camel No.	Copulation time (s)	Volume(ml)
J-56	250.32±16.72	3.75±0.42
J-58	365.91±36.32	7.07±0.85
J-54	359.82±32.50	3.78±0.47
J-315	246.17±48.35	3.7±1.009
J-321	196.07±26.45	2.607±0.88
J-322	152.94±18.36	4.43±0.74
A-273	354.18±50.69	2.93±0.43
B-335	155±28.71	2.62±0.57
B-346	177.76±23.84	2.67±0.35
B-418	329.88±43.73	5.40±0.71
S-04	327.50±29.42	4.1±0.56
364	225.50±25.67	4.86±0.57
366	173.12±29.25	1.12±0.12

J-Jaisalmeri, A-Arab x Bikaneri, K-Kacchhi, B-Bikaneri, S-Sanchori

Table-4.3.4: Individual sperm motility status of semen samples from 13 camels

Camel No.	No. of semen ejaculate	Individual Sperm Motility (%)							
		0	10	20	30	40	50	60	Above 60
J-56	28	4	4	6	3	2	—	5	4
J-58	19	3	2	1	3	2	2	4	2
J-54	18	3	1	—	1	2	4	4	3
J-315	5	2	1	1	1	—	—	—	—
J-321	6	2	—	—	1	—	—	1	2
J-322	16	4	2	1	—	—	3	3	3
A-273	14	8	2	—	—	1	—	2	1
B-335	6	1	1	1	1	—	—	1	1
B-346	13	5	1	—	1	—	—	3	3
B-418	8	2	1	—	1	—	2	1	1
S-04	10	4	3	—	2	—	—	—	1
364	19	9	2	—	1	1	2	3	1
366	2	1	1	—	—	—	—	—	—
Total	164	48	21	10	15	8	13	27	22

J-Jaisalmeri, A-Arab x Bikaneri, K-Kacchhi, B-Bikaneri, S-Sanchori

Camel semen do not exhibit mass motility as observed in semen samples of other ruminants like cattle, buffalo and sheep. This is thought to be due to viscous nature of semen and relatively low sperm concentration as compared to other species of ruminants. But more rational explanation for lack of mass motility should have been the packing of spermatozoa in fibrous network as revealed by microscopic pictures. This resembles to the semen coagulum in human, where it has been reported that a freshly formed semen coagulum, under scanning electron microscopy presents a dense network of long fibres approximately 0.15 micromillimeters in diameter, separated by spaces too narrow to allow free movement of the enmeshed spermatozoa. Data on motility shows that significant proportion of semen samples either failed to develop motility or had low progressive motility. It appears probable that liquefaction of coagulum, release of spermatozoa from their arrested position in coagulum and acetyl cholinesterase mediated breakdown of ATP appears to be essential prerequisite for sperm motility. It is quite probable that some of these processes might be hindered with current semen handling practices resulting in lack of development of motility. Many workers have reported low motility or no motility in camel semen

Live - dead percent and normal acrosome percent

Live and dead sperm concentration and percent normal acrosome have been presented in Table 4.3.5

Table-4.3.5: Live- dead and normal acrosome in camel semen

Camel No.	Live Sperm (%)	Dead Sperm (%)	Normal acrosome (%)
J-56	72.87 ± 2.84 (16)	27.12 ± 2.84(16)	94 ± 0.66 (10)
J-58	71.50 ± 2.51(13)	28.5 ± 2.51(13)	91.8 ± 1.31(8)
J-54	74.90 ± 2.14(11)	25.09 ± 2.14(11)	90.5 ± 1.57(11)
J-321	79.66 ± 2.40(3)	20.33 ± 2.40(3)	90(1)
J-322	73.11 ± 4.48(9)	26.88 ± 4.48(9)	93.57 ± 0.92(7)
A-273	68.62 ± 3.07(8)	31.37 ± 3.07(8)	92.14 ± 1.49(7)
B-346	78.14 ± 4.14(7)	21.85 ± 4.14(7)	92.5 ± 1.024(6)
B-418	75.5 ± 3.70(6)	24.5 ± 3.70(6)	94 ± 1.00(5)
S-04	73.5 ± 4.5(2)	26.5 ± 4.5(2)	83.33 ± 4.42(3)
J-315	59(1)	41(1)	
364	73.23 ± 3.70(10)	26.77 ± 3.70(10)	92.22 ± 1.21(9)

J-Jaisalmeri, A-Arab x Bikaneri, K-Kacchhi, B-Bikaneri, S-Sanchori

Sperm concentration:

Problems are encountered in determination of sperm concentration of camel semen due to its viscous nature. Many samples do not mix with formol saline (Fig-4.3.2) and in others in which semen apparently appears to be mixed with formol saline, a uniform distribution of spermatozoa cannot be assured because many spermatozoa still remain caught in bunch of coagulum (Fig-4.3.3).

Sperm concentration measurement conducted on limited number of semen samples revealed that sperm rich ejaculates had an average concentration of 300 million spermatozoa while fair grade semen samples had 150 million and poor grade measured 80 million per cubic mm.

Sub project 3. Semen freezing

Data on freezability of camel semen has been presented in Table 4.3.6, which shows that 23/45 (51.11%) semen samples with pre-freeze motility of 50% or above and 4/16 (25%) from low pre-freeze motility group with an overall success of 27/61 (44.26%) were successfully preserved. Data also indicated that there has been a tremendous variation in freezability of semen from different males.

Sub project 4. Artificial insemination:**(i) Induction of ovulation:**

13 female camels in which hCG was administered for a total of 17 times at appropriate stages of folliculogenesis as determined by sonographic examinations of the ovaries (Fig-4.3.4) appears to have definitely induced ovulation in 12 cases as indicated by sonography (Fig-4.3.5)

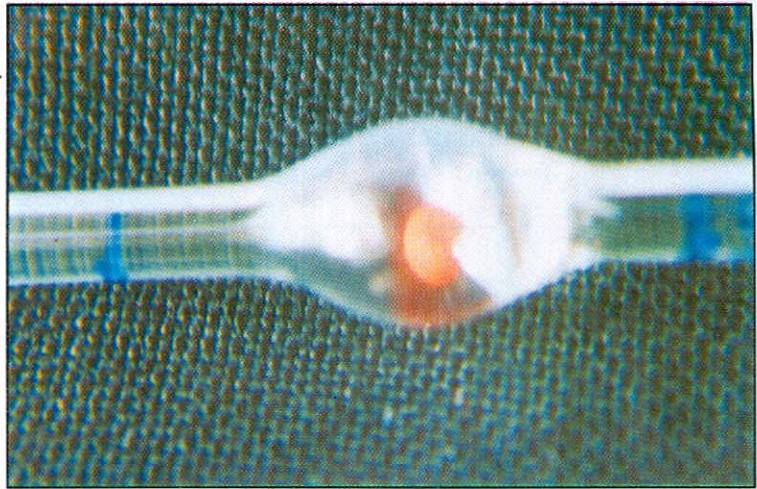


Fig.4.3.2. Semen sample in formol saline

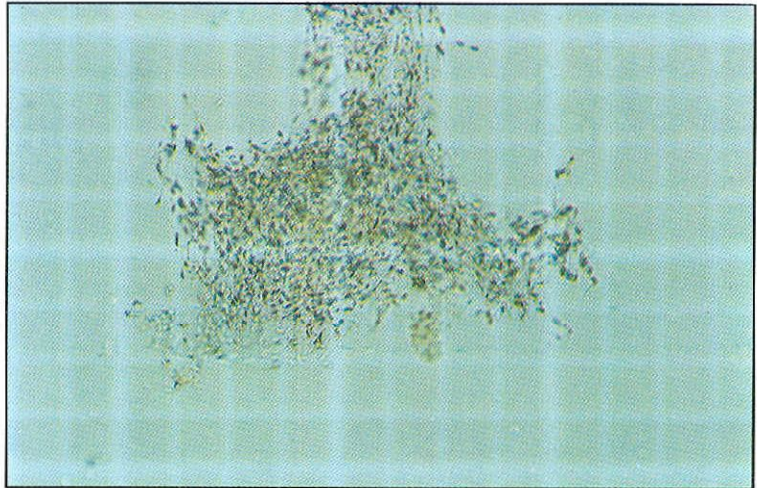


Fig.4.3.3: Spermatozoa caught in bunch of coagulum

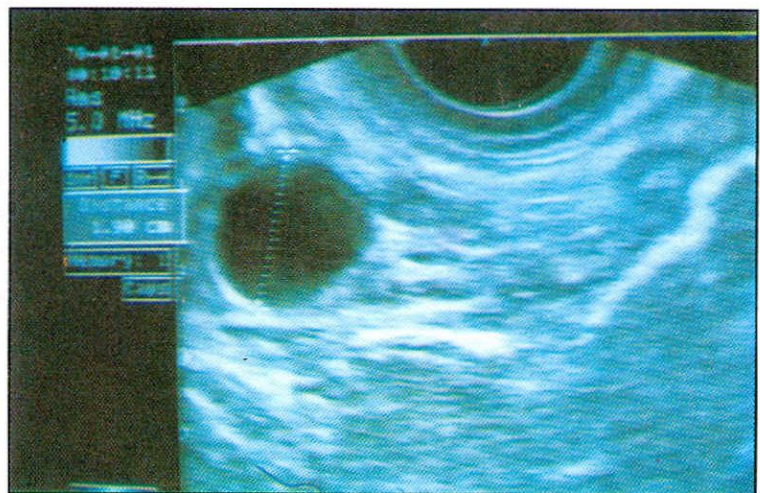


Fig: 4.3.4: Sonographic scan of ovary indicating follicle

Table-4.3.6: Freezability of camel semen

Camel No.	Prefreeze motility 50% & above		Prefreeze Motility < 50 %		Total	
	No. of samples frozen	No. of samples successfully preserved	No. of samples frozen	No. of samples successfully preserved (%)	No. of samples frozen	No. of samples successfully preserved
J-56	6	5 (83.33)	5	0	11	5
J-58	3	3 (100)	3	0	6	3
J-54	8	5 (62.5)	5	4 (80.00)	13	9
J-321	3	2 (66.66)	0	0	3	2
J-322	7	3 (42.85)	0	0	7	3
A-273	3	1 (33.33)	0	0	3	1
B-346	5	1 (20.00)	0	0	5	1
B-418	5	0	1	0	6	0
S-04	1	1 (100)	1	0	2	1
335	1	0	0	0	1	0
364	3	2 (66.66)	1	0	4	2
Total	45	23 (51.11)	16	4 (25)	61	27 (44.26%)

J-Jaisalmeri, A-Arab x Bikaneri, S-Sanchori

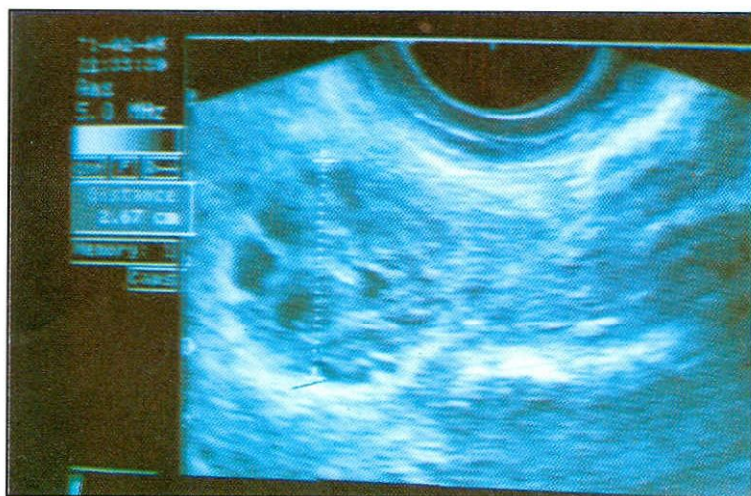


Fig: 4.3.5: Sonography indicating ovulation

(ii) Pregnancy results:

1 out of 13 females inseminated was found pregnant. The poor conception rate might have been due to poor retention of deposited semen under Artificial Insemination in the genital tract of female camel, overuse of xylaxin to restrain camels for repeated examinations and poor fertility of female camels. In natural service the semen is deposited in gel form, spermatozoa surrounded by fine network is expected to be released slowly over long period of time. While in AI it is in liquefied form and it was observed that the deposited semen may drained out through vulva as cervix in camel offers no resistance.

Sub project 5 : Progesterone estimation using commercial Elisa Kits

Progesterone estimation in camel serum/ plasma was conducted using Elisa kits of Biochem Immuno System and Equipar. The results obtained have been either too low too high (Fig-4.3.6). Matrix effect due to protein, salt or other contaminant might have been responsible for disturbed antigen antibody binding.

Fig. 4.3.6 Progesterone profiles of artificially inseminated female camels

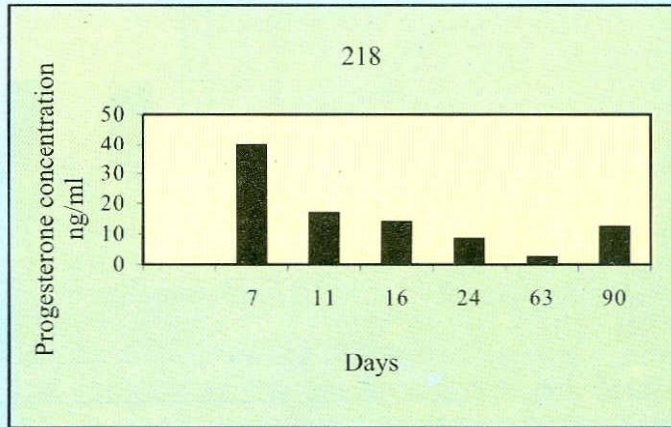
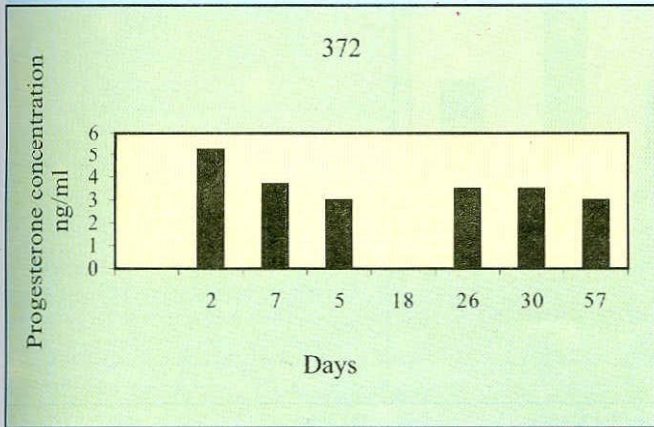
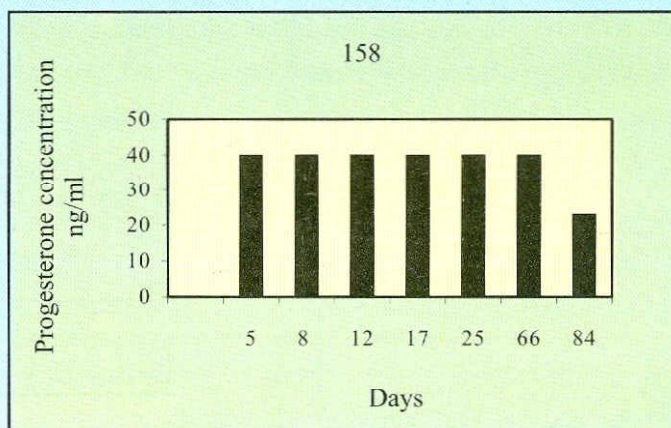
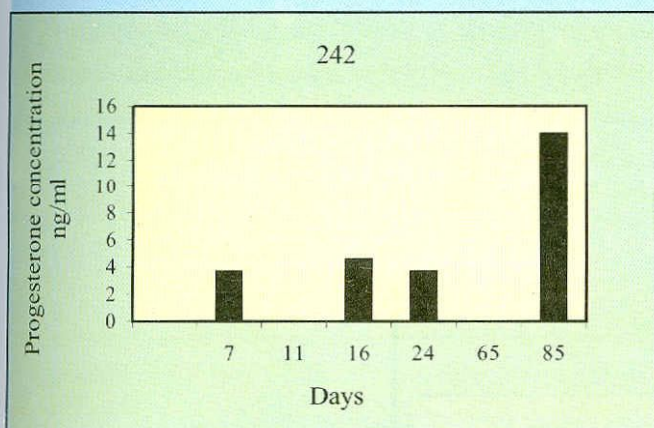
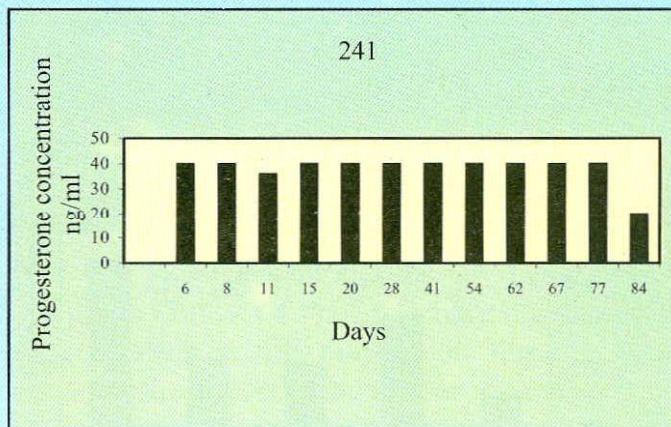
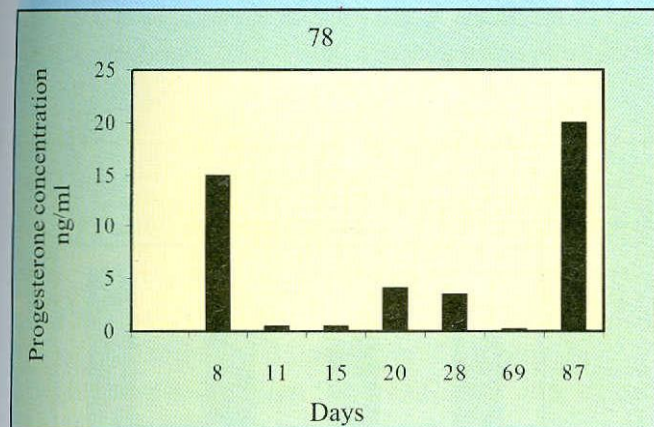
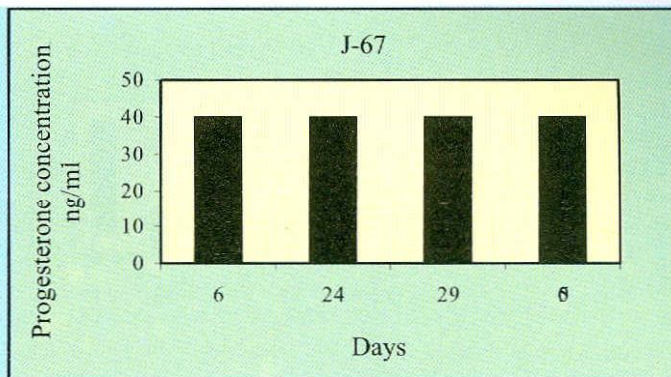
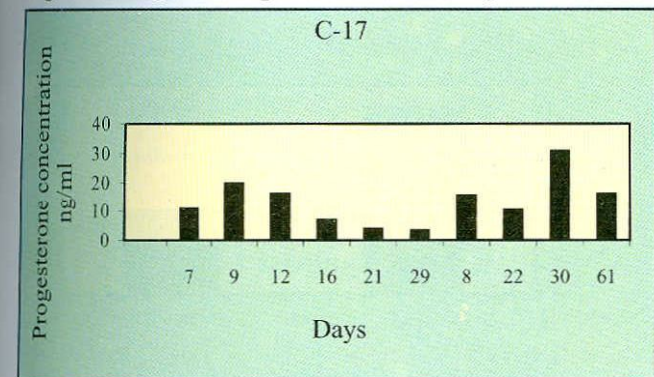
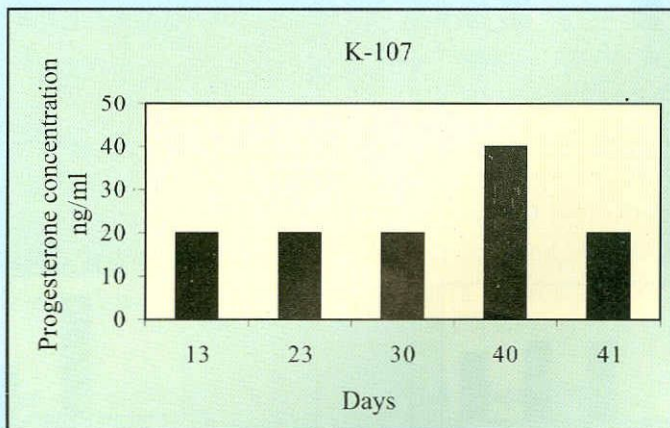
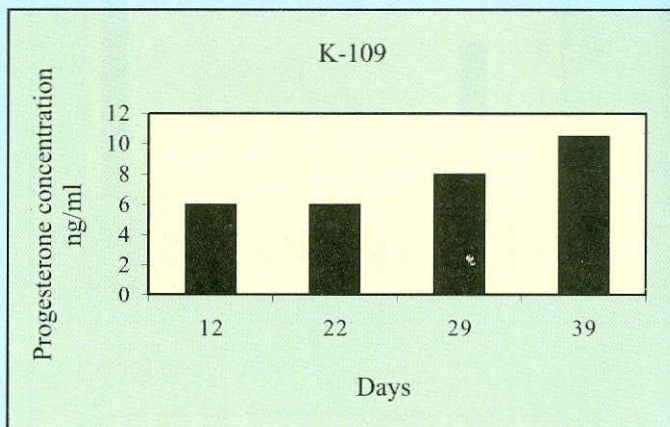
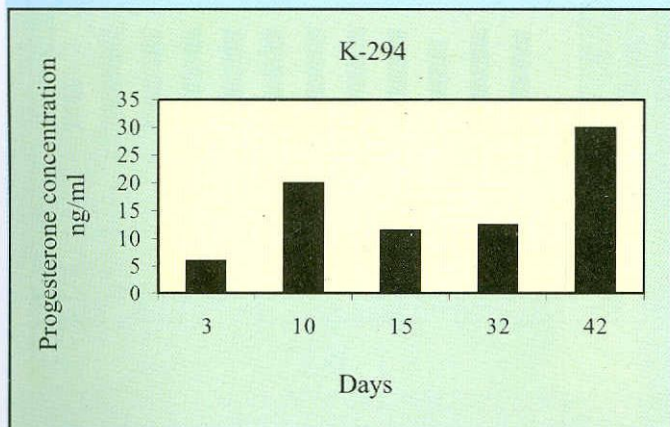
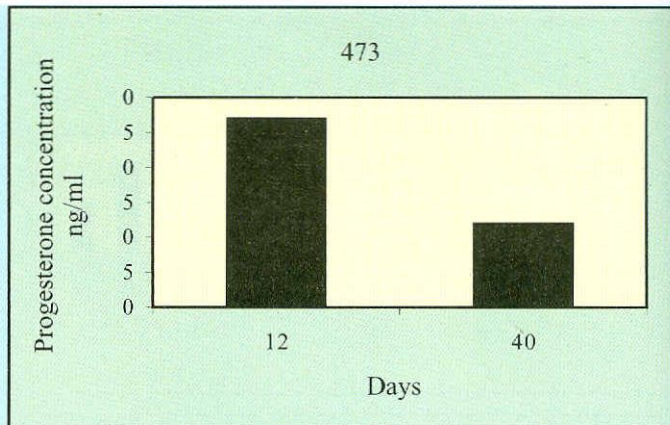
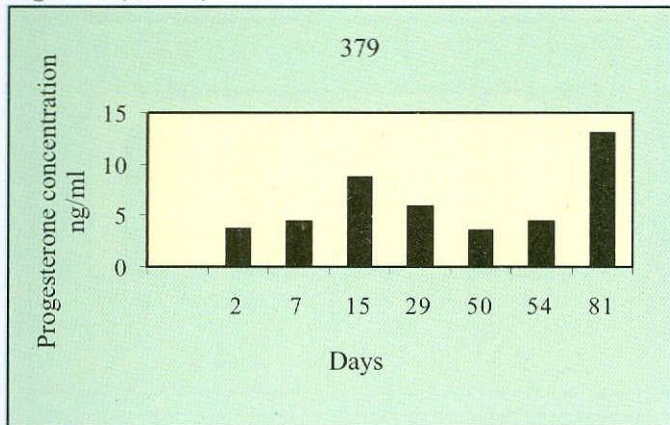


Fig. 4.3.6 (Contd.)



4.4 Studies on feed requirement and feed resource evaluation for optimum production

Project Leader : G. P. Singh

Associates : N. Saini

Sub project 1. Effect of source of nitrogen on the crude protein and fibre digestibility and cost of feeding in camel

A total of 9 camels including 6 female and 3 male (age 3-4 years) were randomly divided into three groups, three in each comprising two female and one male, on the basis of body weight. Camels were fed as

Group-I : Guar chara treated with two percent urea

Group-II : Guar chara supplemented with khejri leaves to provide nitrogen equal to two percent urea.

Group-III : Guar chara as sole ration

Digestibility coefficient of crude fibre and crude protein

The digestibility coefficient of CP were 54.36, 60.13 and 51.10 percent and the CP digestibility was significantly higher ($P < 0.05$) on supplementation of khejri leave (Table 4.4.1). Crude fibre digestibility was significantly ($P < 0.05$) lower in group -III camel fed on guar chara as sole ration. Low fibre digestibility could be due to high lignification of guar stem which was major part in guar chara. However, supplementation of urea and khejri leaves increased the CF digestibility because of catalytic effect of supplements on the ruminal microbial activity due to proper ammonia level in rumen and other factors. On the contrary NDF digestibility of ration was higher in group fed guar chara as sole ration than those observed on supplementation of 2% urea or khejri leaves to guar chara. ADF showed similar trend in respect of digestibility due to supplementation of 2% urea or khejri leaves.

Table-4.4.1: Source of nitrogen and digestibility of CP and fibre

Parameter	Treatment		
	I	II	III
CP*	54.36 ^a	60.13 ^b	51.10 ^b
CF*	52.49 ^a	54.63 ^b	43.91 ^b
NDF*	51.50 ^a	54.54 ^b	60.44 ^b
DDF*	47.46 ^a	53.82 ^b	55.10 ^b

Figure having different superscript in a row differ significantly $< P < 0.05$

Cost of feed and cost of digestive nutrients

The cost of feed per day in three groups were Rs. 13.56, 16.77 and 12.00 respectively on urea supplementation, khejri leaves supplementation and guar chara as sole feed (Table-4.2.2). Cost of per kg DOM in respective groups were Rs. 3.52, 3.73 and 3.38. Cost DOM was lower on urea supplementation

(Rs.3.64) than as khejri leaves feeding (Rs. 4.00) and guar chara as sole feed (Rs.3.96). Although cost of feed was lower on guar chara but the cost available nutrient was cheaper on urea supplementation. Thus urea feeding was economical in terms of nutrient availability which is main index for productivity than a simple DM.

Table-4.4.2: Source of nitrogen and cost of feeding

Parameter	Treatment		
	I	II	III
Cost of feed (Rs/day)	13.56 ^a	16.77 ^{ab}	12.00 ^a
Cost of DDM (Rs/kg)	3.52 ^a	3.73 ^b	3.38 ^a
Cost of DOM (Rs/kg)	3.64 ^a	4.00 ^b	3.96 ^b

Figure having different superscript in a row differ significantly P 0.05

Sub project 2. Effect of weaning of camel calves on growth performance and economics of feeding

14 camel calves were divided in two groups, each comprising seven. Group-I calves were weaned and fed concentrate, guar phalgati, moth chara and groundnut chara while Group-II calves were kept with their mothers. Body weight of these calves were recorded at 15 days intervals.

Dam's milk yield for group number 2 calves was assessed by separating the calves during night hours after their weightment and milking the dam in next day morning.

Dry matter intake

Total dry matter intake in weaned group of calves varied from 2.25 kg/day to 3.90 kg/day with average of 3.16 kg/day. However, dry matter intake as percent of body weight was 1.92. As a natural process, dry matter intake increased with increase of body weight of camel calves (Table-4.4.3).

Milk consumption of camel calves in group-II

The milk yield of camels were found to be varying from 3.0-4.2 kg/day with average of 3.68 kg/day (Table-4.4.3)

Growth of weaned vs suckled calves

Initial average body weight of camel calves were 126.7 and 131.4 kg in Group-I and Group-II, respectively and the final body weight were 200.0 and 198.7 kg in respective groups. Total body weight gain in 137 days were 73.3 kg in group-I and 67.3 kg in Group-II. Average daily body weight gain were 535.03 and 491.24 g/day indicating higher growth rate in weaned camel calves on feeding concentrate, groundnut, guar and moth chara (Table-4.4.4).

Pattern in body weight gain

It is evident from Table-4.4.4 that for the first two fortnight body weight gain was slightly higher in weaned calves. After that, body weight gain was higher in suckled calves upto eighth fortnight. After ward, weaned calves surpassed the suckled calves. The possible explanation could be availability of some green grasses for grazing because of some rains during 2nd week of July.

Table-4.4.3. Fortnightly average dry matter intake of weaned and suckling camel calves.

Fortnight	Group-I (Weaned calves)		Group-II (Suckled) Milk consumption (kg/d) ***
	Total DMI (kg/d)	% of body weight	
I*	2.25	1.68	4.2
II*	2.45	1.66	4.0
III*	2.75	1.83	3.8
IV*	3.35	2.25	4.0
V*	3.15	1.95	4.1
VI**	3.52	2.06	3.7
VII**	3.50	1.97	3.2
VIII**	3.60	1.85	3.0
IX**	3.90	1.95	3.2
	3.16	1.92	3.68

* Diet:- Concentrate + Groundnut chara + Guar chara

** Diet: - Concentrate + Moth chara + Guar chara

*** Based on fortnightly assessment of milk yield

Table-4.4.4: Fortnightly average changes in body weight (kg) in weaned and suckling camel calves.

Fortnight	Group- I (Weaned)	Group-II (Suckled)
Initial body weight	126.70	131.40
I	134.14	131.40
II	147.62	146.42
III	149.64	152.64
IV	148.85	160.00
V	161.21	172.50
VI	170.90	182.20
VII	177.90	187.20
VIII	194.39	196.20
IX	200.00	198.70
Total gain (in 137 day) kg	73.30±5.17	67.30±8.86
Gain (g/day)	535.03±26.72	491.24±30.18
DM per kg gain (kg)	5.91±0.66	—

Feed utilisation efficiency

Requirement of feed per kg body weight gain was 5.91 kg which is quite economical as compared to study conducted last year which was 8.78 kg feed per kg gain in body weight. Concentrate mixture used in this study was of very superior quality (calf starter) having very high crude protein, energy and mineral mixture. Feeding of good quality concentrate, guar chara, groundnut chara and moth chara resulted in very high feed utilisation efficiency.

Digestibility

Digestibility trial in weaned camel calves was conducted and the digestibility of dry matter was 62.3, 54.7, 68.1, 65.3, 66.6, 61.6 and 66.8 percent in seven weaned calves and average DM digestibility was 63.561 1.76.

Sub Project-3: Effect of groundnut chara feeding in combination with guar chara on the intake, digestibility and nitrogen recycling pattern

Six female and three male camels of 4-5 years age were divided into three groups- each comprising 2 female and 1 male. Animals in group-I were fed guar chara as sole feed, group -II were fed 50% guar chara and 50% groundnut chara and group-III were fed the groundnut chara as sole feed. After feeding of 27 days a digestibility trial was conducted.

Chemical composition of feed fed

The chemical composition of guar chara and groundnut chara used in this experiment is given in Table-4.4.5.

Table-4.4.5: Chemical composition of guar chara and groundnut chara

Feed	Percent								
	OM	CP	EE	CF	NFE	TA	NDF	ADF	HC
Guar chara	91.1	6.60	0.64	32.90	51.0	8.86	57.18	43.68	13.50
Groundnut chara	89.1	9.60	1.41	28.89	57.2	10.90	47.65	32.40	15.25

Dry matter intake and changes in body weight

The total dry matter intake in three groups of animals were 6.84, 7.20 and 7.80 kg/day ($P<0.05$), respectively. Similarly, dry matter intake as percent of body weight in respective groups were 1.65, 1.71 and 1.86 ($P<0.05$). Total increase in body weight were 4.50, 7.30 and 10.20 kg in 27 days, respectively in group I, II and III, while, increase in body weight per day basis were 166.67, 270.37 and 377.78 in groups I, II and III, respectively (Table-4.4.6)

Table-4.4.6: Dry matter intake and changes in body weight as affected by level of groundnut chara in ration

Parameters	Group I	Group II	Group III
Body weight (kg)	415 ± 21.72	422 ± 25.27	419 ± 18.08
Metabolic body weight	91.9 ± 5.8	93.1 ± 3.98	92.6 ± 6.75
Dry matter intake			
Kg/day	6.84 ^a ± 0.88	7.20 ^{ab} ± 0.46	7.80 ^b ± 0.59
Kg/100kg body wt.	1.65 ^a ± 0.06	1.71 ^{ab} ± 0.09	1.86 ^b ± 0.09
g/w ^{0.75} kg	74.43 ^a ± 7.28	77.34 ^{ab} ± 10.18	84 ^b ± 2.88
Changes in body weight (in 27 days)			
Total	4.50 ± 0.66	7.30 ± 0.85	10.20 ± 0.57
g/day	166.67 ± 7.5	270.37 ± 8.98	377.78 ± 6.63

Digestibility coefficient and intake of digestible nutrient

Digestible coefficient of rations in three groups is given in Table-4.4.7. Intake of digestible organic matter in groups I, II and III were 3.62, 3.96 and 4.54 kg/day, respectively and CP intake was 240, 327 and 447 g/day indicating significantly higher intake of DOM and DCP due to groundnut chara.

Table-4.4.7: Digestibility coefficient of rations in three groups

Parameters	Group I	Group II	Group III
DM*	56.51 ^a ± 2.18	58.13 ^a ± 1.99	63.37 ^b ± 3.87
OM*	58.08 ^a ± 1.67	61.03 ^a ± 3.90	65.32 ^b ± 2.49
CP*	53.11 ^a ± 4.11	56.11 ^a ± 2.71	59.72 ^b ± 4.81
EF**	27.25 ^a ± 0.87	38.10 ^b ± 1.73	49.23 ^c ± 3.08
CF*	51.73 ^a ± 3.00	41.73 ^b ± 2.18	43.98 ^b ± 3.09
NFE*	63.86 ^a ± 4.41	67.04 ^a ± 5.18	73.02 ^b ± 3.66
NDF*	63.37 ^a ± 2.28	54.33 ^b ± 4.08	50.71 ^b ± 2.66
ADF*	50.71 ^a ± 3.02	53.77 ^{ab} ± 1.88	57.83 ^b ± 3.07
HC*	55.17 ^a ± 1.88	50.23 ^b ± 2.07	50.82 ^b ± 2.18

Nitrogen recycling pattern

In this experiment 56.52, 45.64 and 36.22 % of dietary nitrogen recycled on guar chara, guar chara + groundnut chara and groundnut chara, respectively.

Feed Utilization efficiency

Requirement of feed per kg body weight gains were 41.04, 26.63 and 20.65 in groups I, II and III, respectively. Requirement of feed/kg gain was significantly lower on feeding of guar chara + groundnut chara and groundnut chara as sole feed. Amount of DCP required per kg gain was also significantly lower on groundnut chara (1183 g) as compared to guar chara + groundnut chara (1209 g) and guar chara as sole feed (1440 g). Similarly DOM requirement was 21.72, 14.64 and 12.02 kg/kg gain ($P>0.05$). Thus the feed utilization efficiency was higher on groundnut chara feeding as sole ration (Table-4.4.8).

Cost of feeding

While cost of feeding were Rs. 12.41, 16.23 and 21.03 per day in groups I, II and III, respectively, the cost per kg gain were 74.50, 60.04 and 55.67, respectively on feeding of guar chara, guar chara + groundnut chara and ground nut chara as sole feed. (Table-4.4.8)

Table-4.4.8: Digestibility nutrient intake, nitrogen recycled and cost of feeding as affected by level of groundnut chara in ration

Parameters	Group I	Group II	Group III
DOMI (Kg/day)	3.62 ± 0.08	3.96 ± 0.18	4.54 ± 0.08
DCP (g/day)	240 ± 4.70	327 ± 2.86	447 ± 6.78
DOMI Kg/Kg gain	21.72 ± 0.89	14.64 ± 1.08	12.02 ± 1.17
DCPI g/Kg gain	1440 ± 50.17	1209 ± 58.18	1183 ± 47.38
% N recycled	56.52 ± 2.53	45.64 ± 1.87	36.22 ± 0.88
Cost of feed (Rs/day)	12.4 ± 0.80	16.23 ± 1.92	21.03 ± 2.17
Feed/kg gain	41.04 ± 2.47	36.63 ± 3.85	20.65 ± 1.67
Cost per kg gain (Rs)	74.50 ± 5.98	60.04 ± 3.86	55.67 ± 4.46

Sub project 4: Effect of Supplementation of moth chara to guar chara base of diet on intake, digestibility and nitrogen recycling pattern and nutrient utilization in camel.

Six male and three female camels of 4.5 years of age were divided into three groups three in each (two female and one male) and were fed as:

- Group-I : Guar chara alone
- Group-II : Guar chara + 15% Moth chara
- Group-III : Guar chara + 30% Moth chara

Table-4.4.9: Camels body weight and their feed consumption

Parameters	Group I	Group II	Group III
Body weight (kg)	457.3 ± 17.169	475.7 ± 21.97	437.2 ± 15.22
Metabolic body wt.	98.9 ± 2.86	101.9 ± 5.89	95.6 ± 4.86
Dry matter intake Kg/day*	6.95 ^a ± 0.30	8.63 ^b ± 0.52	8.51 ^b ± 0.23
Kg/100 kg body wt.**	1.52 ^a ± 0.02	1.81 ^b ± 0.06	1.94 ^c ± 0.04
g/w ^{0.75} kg*	70.27 ^a ± 3.82	84.69 ^b ± 5.13	89.02 ^b ± 3.30

Figure having different super script in a row differ significantly * P>0.05 ** P>0.04

Total dry matter intake increased due to supplementation of moth chara. However, there was no significant difference between 15 and 30% supplementation of moth chara. Dry matter intake as percent of body weight also increased due to supplementation and the increase was linear with increase of amount of supplement.

Table-4.4.10: Digestibility of dry matter and nitrogen recycling pattern

Group	DM	% N recycled
I	55.11 ± 3.81	53.5 ± 5.26
II	59.72 ± 4.49	31.2 ± 3.89
III	63.57 ± 3.94	16.97 ± 3.62

4.5. To study the economic of different camel management practices under arid and semi arid ecosystem.

Project Leader : Champak Bhakat
Associate : M. S. Sahani
: N. Sharma

Sub Project 1. Study of economics of camel carting versus bullock carting in hot arid region

A survey of 140 camel-cart and 119 bullock-cart was conducted. Both the categories are using their cart to transport different materials viz: building materials, synthetic yarn, grain bags, bhusa, gas cylinders, fuel wood, water and different fodders. The two wheeled pneumatic tyre wooden cart is popularly used. The mean for various parameters are presented in the Table-4.5.1. The data indicates that although camel cart is costlier than bullock cart, however, camel cart is superior in respect to effective life period of camel, weight carrying capacity, distance covered and total income per day. A detail economics of both type of carting system is analysed by using the linear programming method. The analysis of Fixed cost (FC) and variable cost (VC) is given in Table-4.5.2 and 4.5.3 respectively. The detail Economic Estimate is presented an Table-4.5.4. The total expenditure for both type of carting system do not vary much but total earning

from camel carting is quite high as compared to bullock carting. The similar trend is found in case of profit. The Pay Back Period (PBP) is almost double in case of bullock carting as compared to camel carting where as the Benefit Cost Ratio (BCR) is 3/4th time higher in case of camel carting as compared to bullock carting. This study concludes that due to short pay back period and higher benefit cost ratio camel carting is profitable and advantageous over the bullock carting for poor farmers in the hot arid Thar region.

Table-4.5.1: Comparison of camel v/s bullock carting

Parameter		Camel carting (N = 140)	Bullock carting (N = 119)
Av. working period of animal (Yrs.)		14.50 ± 2.5	10.00 ± 1.6
Life period cart (Yrs.)		10.67 ± 1.7	10.85 ± 1.1
Involved in carting (%)	Self	89.29	90.76
	Hired	10.71	9.24
Av. Cost of Animal (Rs)	Male	9500 ± 279	5672 ± 488
	Female	8860 ± 365	NA
Av. Cost of cart (Rs)		10500 ± 300	8680 ± 450
Sex (%)	Male	96.43	100
	Female	3.5	NA
Av. weight load carrying by cart (per trip) (Quintal)		14.5 ± 4.89 (10 - 20)	8.00 ± 4.11 (4 - 12)
Av. Age of Animal used in Cart (Yr.)		7.50 ± 2.42	5.89 ± 1.74
Working Days/Year		240.57 ± 5.86	236.42 ± 8.78
Working Time Of Cart Animal (hrs/day)	Male	9.2 ± 2.11	8.6 ± 2.50
	Female	8.0 ± 3.00	
Number Of trip / day		3.6 ± 1.25	4.2 ± 1.89
Distance covered / day (Km)		21.4 ± 6.55	14.8 ± 5.50
Total Income Per Day (Rs)		255 ± 35	200 ± 30
Carrying Cost / Grain Bag (Rs)		3.87 ± 1.50	5.22 ± 1.74
Av. number of bag carried / round		18.00 ± 3.50	9.00 ± 2.58

Table-4.5.2: Analysis of fixed cost

Expenditure (Rs)	Camel carting (N = 140)	Bullock carting (N = 119)
Interest on Investment (@ 9 %)	1800	1292
Depreciation of Cart (Rs.)	885	720
Insurance on Animal (@ 5 %)	499	298
Insurance on Cart (Rs.)	147	128
Total FC	331	2438

Table-4.5.3: Analysis of variable cost

Expenditure / year (Rs)	Camel Carting (N = 140)	Bullock Carting (N = 119)
Repair & Maintenance of Cart	1550	1450
Wages of operator (@ Rs. 80 per day)	19245	19714
Maintenance (feeding) of Animal	15330	14965
Shoeing (@ Rs. 50 for 8 plates)	0	800
Total VC	36125	36929

Table-4.5.4: Analysis of economic estimate

Parameter	Camel Carting (N = 140)	Bullock Carting (N = 119)
Total Expenditure (Rs)	39456.0	39367.0
Total Earning (Rs)	61345.0	47284.0
Profit (Rs)	21889.0	7917.0
P.B.P. (Year)	0.91	1.81
BCR	1.55	1.20

4.6. Surveillance, monitoring and control of camel diseases

Project Leader	: S. K. Ghorui
Associates	: Rajender Kumar
	: F. C. Tuteja
	: Gorakh Mal

Subproject 1: Investigation on parasitic diseases of camel

Incidence of parasitic infections around Bikaner & NRCC Farm

Helminths

The field survey of camels was continued in villages around Bikaner for helminthic infection. A total of 386 camels were found positive out of 952 camels screened i.e. 40.55%. Major helminthic infections were *Haemonchus*, *Nematodirella*, *Nematodirus*, *Trichuris* & other strongyles. At NRCC farm a total of 314 camel were found positive out of 936 camels (33.55%) and e.p.g was less than 50 in all the case. Major helminthic infections were *Nematodirella*, *Nematodirus* & *Haemonchus*.

Arthropods

Around Bikaner 952 camels were screened for different arthropod infestations. A total of 147 (15.44%) camel were found positive for Sarcoptes mite on skin *scraping* examination. In ticks *Hyalomma dromedarii*, *H. anatolicum anatolicum* and *Ornithodoros* were major ticks infestation. *Chrysomya* spp fly was found the main causative agent of maggot wound in camel. At farm, *Hyalomma dromedarii* was found as the most common tick infesting the camels.

Protozoa

Around Bikaner in intestine *Balantidium coli* was found as common protozoa infection. Blood samples were found negative for any protozoan infection.

Sub project 2: Studies on mastitis in dromedary camel

The udders of sub-clinical mastitis cases revealed asymmetry and pain on the affected quarter in some cases while in few cases the udder was symmetrical and the animals while milking exhibited pain. Out of 38 lactating camels, 18 were positive for sub-clinical mastitis.

The breed-wise per cent incidence revealed higher incidence of sub-clinical mastitis in Bikaneri (44.44%), followed by Jaisalmeri (38.88%) and Kachchhi (16.66%). The per cent incidence of sub-clinical mastitis in relation to age was significant ($P < 0.05$). The highest per cent incidence was noticed in camels of 13-16 yrs age group indicating this age group as most susceptible for intra mammary infection. The incidence of mastitis increased as lactation number increased up to 5th lactation and highest incidence of sub-clinical mastitis was seen in 5th lactation.

This concludes that 13-16 year age group i.e., 4th and 5th lactation camels are more prone for intra mammary infection.

The pH of the normal milk ranges from 6.5 to 7.0 i.e., from acidic towards neutral side. The pH in sub-clinical and clinical mastitis samples revealed 7.1 to 8.0 and 8.1 to 9.0 respectively towards alkalinity.

The TLC revealed 280000 to 376000, 488000 to 703000 and above 856000 in normal, sub-clinical and clinical mastitis samples respectively. The CMT score '1' indicating no gel/streak formation which reveals normal milk samples and here the pH was up to 7.0. The CMT score '2' and '3' indicated sub-clinical and clinical mastitis, respectively mastitis. (Table 4.6.1)

Table-4.6.1: Relationship between mean pH, CMT and mean TLC

Parameters	Normal	Sub-clinical	Clinical
pH	6.66	7.48	8.48
CMT	1	2	3
TLC	317,000	529,000	857,000

Tetanus in Camel

A female camel of Kachchhi breed, aged 11 years of the Centre's herd suffered with tetanus. The camel had a deep, devitalised and contaminated wound on the left side of udder. It exhibited excitement, prolapse

of third eye lid, lacrimation, trismus, lock jaw, rise in temperature, constipation, stiffness, flaring of the nostrils, foul breathing and shallow & fast respiration.

Sub project 3. To study the keeping quality of camel milk

Keeping quality of camel milk was studied for pure, milk + water (1:1), refrigerated pure milk and refrigerated diluted milk (1:1). The parameters studied were acidity, COBT, alcohol test, alizarin-alcohol test and pH at 2 h intervals. (Table 4.6.2) Pure camel milk can be easily stored for 8h after that there is slight increase in acidity, flake formation and decline in pH was noticed. Diluted camel milk (1:1) can be stored for 10h at room temperature. Refrigerated pure milk can be stored for 20 days, pH and acidity was 6.20 1 0.18, 0.18 1 0.3 % respectively at the end of trial. Diluted camel milk (1:1) under refrigeration can be stored up to 28 days without much changes in pH and acidity.

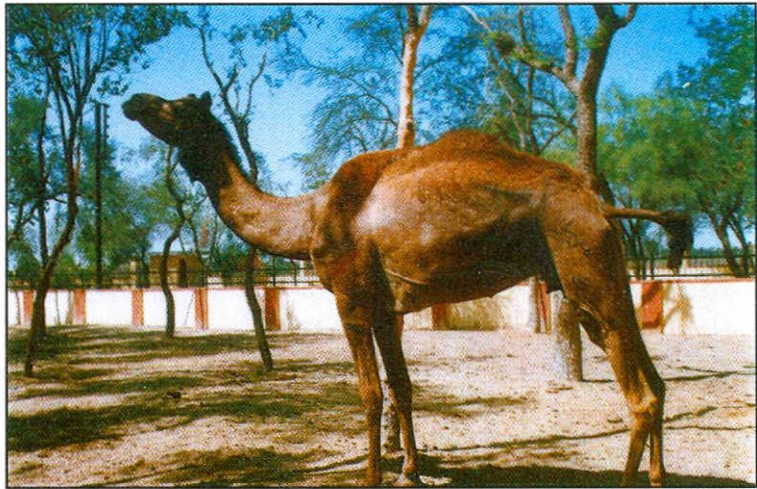


Fig.4.6.1: Tetanus affected camel

Table-4.6.2: Keeping quality of pure camel milk (n=50)

Parameters	0 h	2 h	4 h	6 h	8 h	10 h	12 h	24 h
Acidity	0.12 ± 0.03	0.14 ± 0.02	0.15 ± 0.03	0.16 ± 0.02	0.18 ± 0.02	0.20 ± 0.04	-.28 ± 0.06	0.44 ± 0.08
COBT	-ve	-ve	-ve	-ve	-ve	+ve	+ve	+ve
Alcohol test	-ve	-ve	-ve	-ve	-ve	+ve	+ve	+ve
Alizarin	Brown	Brown	Brown	Brown	Brown	Reddish	Yellowish	Brownish
Alcohol test	Red	Red	Red	Red	Red	Brows	Brown	Yellow
pH	6.42 ± 0.18	6.34 ± 0.15	6.30 ± 0.16	6.25 ± 0.16	6.20 ± 0.19	5.75 ± 0.10	5.69 ± 0.18	5.93 ± 0.25

Sub project 4. Sensory evaluation of camel milk tea/coffee

Camel milk tea was prepared with pure milk, diluted milk in the ratios of 1:1, 1:2, 1:3 and 1:4 and got tasted. The observations were recorded on odour, taste and acceptability. It was observed that tea prepared from camel milk in 1:2 ratio can be taken regularly 85.71% people expressed very good for the odour and 77.50 % for the taste 72% people showed willingness to consume this tea regularly.

Coffee can be used regularly when prepared from the camel milk in 1:1 ratio and its acceptability was 66.67%. The acceptability for cow milk (1:1) coffee was 75.90 %.

Sub project 5. To prepare butter and ghee from the camel milk

Camel milk boiled and then cooled to 40°C and 60°C with starter culture 3-4% in winter and 1-1.5% in summer was used. The curdling time was recorded. Curdling time was 26.7 ± 1.41 hr for 60°C and 22.4

± 1.02 hr for 40°C milk in winter season. While, in summer it was 13.5 ± 1.62 hr for 60°C and 11.5 ± 1.10 hr for 40°C milk. However, the consistency of the curd remain thin as compared to other curd. After churning butter was recovered and ghee could be separated by heating. The recovery of butter and ghee was 3.48 ± 0.25 , $2.25 \pm 0.14\%$ for 40°C milk and it was 3.90 ± 0.36 , $2.57 \pm 0.23 \%$ respectively for 60°C milk. High organoleptic acceptability of butter and ghee was observed. The composition of curd showed that water content varies from 90.0 to 91.0%, pH from 3.9 to 4.8 and acidity from 0.72 to 0.86 %. The moisture content of ghee was $0.66 \pm 13 \%$ and free fatty acid (FFA) was $2.25 \pm 0.15\%$.

4.7. Service project on extension, communication and human resource development

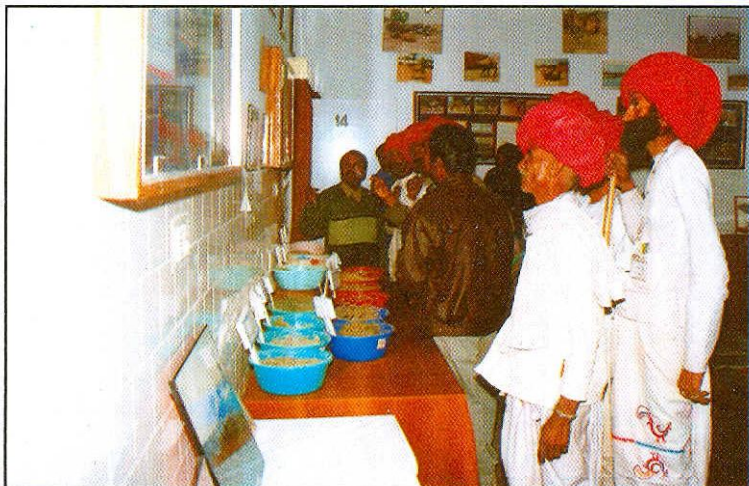


Fig.4.7.1: Demonstration of technology know-how to a group of farmers in an exhibition.

Project Leader : Champak Bhakat
Associates : Poonam Jayant
N. Sharma
B. L. Chirania
M. S. Sahani

I. Exhibition

The centre participated in five different scientific exhibitions organised at centre and state level highlighting camel research and camel husbandry practices and latest technology know-how achieved by the centre. The different scientific exhibitions organised:

1. Indian International Trade fair - From 14 to 27th Nov. 2000 at Pragati Maidan (New Delhi). The theme of exhibition was " Camel hair products and utility of camel".
2. The 88th Indian Science Congress - From 2nd to 8th Jan -2001 at IARI, PUSA, (New Delhi). The theme was " Research achievement on camel".
3. Camel Festival 2001 - From 8th to 12th Jan - 2001. The theme was on " Camel for Mankind".
4. Ramdev Animal Fair - From 31st Jan - 4th Feb- 2001 at Nagore.
5. State Krishi Vigyan Mela - On 4th March - 2001 at RAU, Bikaner.

At this occasion 50 posters/display charts were prepared and sufficient number of handouts and brochures on different aspects of camel management practices and camel research achievements were distributed among the farmers and visitors.

II. Live camel breed exhibition

The centre participated in the live camel breed exhibition at International Agrovision. (88th Indian Science Congress) from 2nd to 8th January - 2001. at IARI , PUSA (New Delhi). To popularise and motivate the people regarding use of camel milk, raw camel milk / Tea and coffee made up of camel milk etc was served (free of cost) among the various national and international visitors /experts / farmers / students etc. during the exhibition.

III. Camel breed competition and other competitions

The centre took part in the camel breed competition which was held in state Krishi Vigyan Mela on 4th march - 2001 at RAU, Bikaner and won prizes.

The centre's camels also participated in various competition like camel race, new born camel calf, camel hair cutting and decorations and camel milking competition etc. organised at the time of Camel Festival - 2001 and won prizes in different events.

IV. Kisan gosthies/ Farmer's day

Three Kisan gosthies / Farmer's day were organised at the centre and in adopted village Gadwala (Bikaner Distt), State Krishi Vigyan Mela RAU, Bikaner. On these occasions the problems under camel management practices and diseases were discussed during the question and answer session by the subject matter specialists. The N. G.O, namely "Lokhit Pashu Palak Sansthan" (A society for indigenous Livestock Research and development) from Sadri, Pali Distt (Raj) along with farmers, youth, farm women participated in Gosthies conducted at campus. The farmers visited the camel farm and were demonstrated about the camel management practices followed at an organised farm and were explained about the functioning of various laboratories. The scientists of centre gathered feedback from farmers about the traditional camel husbandry practices. The farmers were apprised about advance breeding practices, disease prevention and other recent managemental practices.



Fig.4.7.2: A view of Kishan Gosthi conducted at N.R.C.C. Bikaner

V. Animal health camp

During the period the centre organised and conducted animal health camps at adopted village Gadwala (Bikaner district). The farmers attended camp with various animal species comprised mainly of camels and other viz: sheep, goat, cattle and very few buffalo. A substantial number of animals were treated and medicines were distributed free of cost among the poor farmers. The health related problems were solved during these camps. Farmers thoroughly discussed and consulted regarding their animal health problems with scientists/subject matter specialist attended camp.

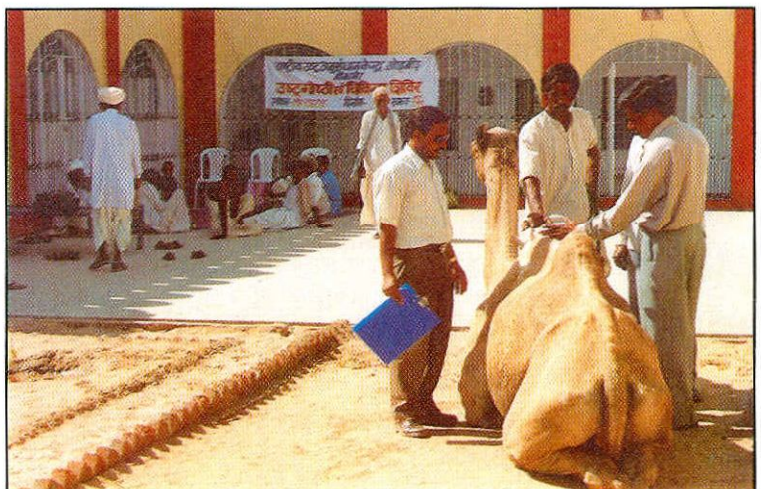


Fig.4.7.3 Animal Health camp at adopted Village (Godwala)

VI. Demonstration of centre's research activity

Various trainees, visitor (National/international) scientists, students, (from veterinary colleges, Medical

Colleges SAUs, schools Universities), livestock owners, administrators, Defence Officers, N.G.Os, Indian and foreign educationists, Journalists, Youth, farmers and farm women etc were demonstrated about on going research activity, camel husbandry practices, and latest technology know-how of the centre during the reporting period.

Radio talk

Different subject matter specialists delivered Radio talk on different subjects, which covered all aspects of camel research.

Centre's revenue generation programme

Centre initiated the revenue generation programme by arranging camel ride, photography etc. for the tourists. The total revenue generated within specific time period was Rs.45,820/-. The headwise revenue generation trend is presented in table 4.7.1

Table-4.7.1: Revenue generated at the Centre

Regular account head	Total (Rs)	Per day (Rs)
Still Photography	12,270	109.55
Camel Riding	6,900	61.60
Over all	19,170	171.16

4.8. Research Schemes

4.8.1. Network collaborative programme on crop based animal production system

Sub project 1. Performance of camel calves kept on silvipastural browsing/grazing management system

Project Leader	:	M.S. Sahani
Associates	:	N. Saini
	:	Ram Kumar
S.R.Fs.	:	Raja Purhoit
	:	Baldev Das Kiradoo

To determine the sustainability of camel under hot arid conditions, 3 male camel of 4 years age were kept on 16.5 ha. silvipasture area with a individual stocking rate of 5.3 ha. The total rainfall recorded during the year was 203 mm, of which monthly highest rainfall of 135.5 mm was recorded during July 2000. The vegetative coverage of area and proximate composition in silvipasture plot in presented in Table 4.8.1.1 and 4.8.1.2 respectively.

The monthly body weight changes of camels reared in silvipasture area indicated that a camel can easily sustain on 5.33 ha. silvipasture area in arid region without any supplementation from outside except for lopping of tree leaves during lean months from the same area. Thus indicating that area around 5.5 ha. per camel is sufficient to sustain camel round the year.

The grazing/browsing behaviour study indicated that during summer camel prefers lopped Jal tree leaves followed by Murali, Tortlis, Pala and Phoag. During rainy season it prefers grasses, creepers found in silvipasture area such as Dudheli, Bakeria, Bhurat, Kanti, Sata, Ganthia. After that it depends on available bushes, and shrubs such as Phoag, Pala, Tortlis, Murali followed by Ker, Bui, Kheemp.

Table-4.8.1.1. The vegetation coverage silvipasture plot (16.5 ha) in farm area

Local name	Botanical Name	Total Plants		
		Above 5 feet	Under 5 feet	
Trees	(a) Jal	<i>Salvadora Oleiodes</i>	270	—
	(b) Kikar	<i>Acacia Tortlis</i>	480	1210
Bushes	(a) Pala	<i>Zizyphus Nummularia</i>	1250	2260
	(b) Phog	<i>Calligonum Pologonoides</i>	—	1540
	(c) Murali Kakani	<i>Lycium Barbarum</i>	—	1184
	(d) Ker	<i>Caparis Decidua</i>	—	361
	(e) Kheemp	<i>Leptadenia Pyrotechnica</i>	—	900
Shrubs	(a) Sinio	<i>Crotolaria Burhia</i>	—	3850
	(b) Bui	<i>Areva Tomentosa</i>	—	3510

Table-4.8.1.2. Percent proximate composition of different vegetation in silvipasture plot

Plants	DM	CP	EE	CF	TA	NFE
Trees Leaves						
Jal (<i>Salvadora oleiodes</i>)	30.20	15.35	2.18	8.46	28.44	45.70
Kikar (<i>Acacia tortlis</i>)	50.10	15.85	6.30	7.45	8.26	62.20
Kheemp (<i>Leptadenia pyrotechnica</i>)	30.00	10.50	—	18.60	21.30	—
Murali Kakni (<i>Lycium barbarum</i>)	29.50	23.00	3.45	9.25	15.75	48.30
Pala (<i>Zizyphus nummularia</i>)	55.10	14.00	3.50	16.70	15.75	47.80
Phoag (<i>Calligonum pologonoides</i>)	26.10	10.70	1.52	22.15	9.30	57.05
Shrubs						
Bui (<i>Areva tomentosa</i>)	29.10	14.40	2.15	16.35	14.70	57.65
Grasses						
Ganthia (<i>Dactyloctenium aegyptium</i>)	29.30	8.30	0.80	36.90	6.50	47.50
Sata (<i>Boerhavia diffusa</i>)	35.20	16.50	2.50	23.10	17.90	40.00
Kanti (<i>Triibulus</i>)	26.50	15.80	1.40	28.50	16.00	38.50
Bakaria (<i>Indigofora cordifolia</i>)	32.10	5.90	2.00	31.40	12.10	48.60
Bhurut (<i>Cenchrus biflorus</i>)	29.90	10.10	2.60	20.25	15.50	51.46

Sub project 2. Effect of supplementation with green grammana grass on growth and milk production of Bikaneri camels.

An experiment on 10 lactating camels of Bikaneri breed belonging to 3-4th parity was conducted to study the effect of green supplementation on milk production. The camels were divided into 2 groups and were allowed to browse daily with guar chara ad lib, while, in addition experimental group was supplemented with green grammana daily.

Supplementation group of camels were offered green fodder @ 314/day/animal. The average daily milk production in supplemented group was 4980.29 ± 30.67 ml/day as compared to 4262.90 ± 30.75 ml/day in control group. The milk production was found to be higher in morning as compared to evening in both the groups. The production was significantly higher (718 ml/day) in supplemented group ($P < 0.01$) at additional cost of Rs.6/- for supplemented grass. Digestibility trial results indicated that total dry matter intake, dry matter intake/100 mg body weight, digestible dry matter intake, DEP, TDN and ME were greater in supplemented group as compared to control.

4.8.2. Evaluation and conservation of double humped camel (*Camelus bactrianus*) in cold desert region

Project Leader	:	M. S. Sahani
Collaborators	:	Gorakh Mal
	:	A. K. Nagpal
	:	Raghvendar Singh
	:	Rajender Kumar
	:	V. K. Joshi (FRL, DET-Partapur, DRDO)
Research Associate	:	Banmali Yadav

Population Structure

According to initial survey during 1996 the population of double humped camel (*Camelus bactrianus*) was 76 confined to the 4-5 villages of the Nobra valley of Ladakh, situated at an altitude of 10,000 to 12,000 ft MSL. The latest survey during November, 2000 indicated population of about 105 (47 males and 58 females) camels (Table-4.8.2.1) indicating an increasing trend in the population and positive impact of the scheme among camel keepers.

Hair quality attributes

Hair is one of the important production traits of bactrian camel, which is extensively used for manufacture of various items like shawls, coats, caps, sweaters and hand gloves etc. in village cottage industry of cold arid region.

A total of 81 hair samples from 3 calves below 6 months and 24 adults (above 4 years) were collected during 2000. The hair samples were collected from 3 major body sites viz. shoulder, mid-side and hump region and analysed for fiber quality attributes viz. staple length, mean fiber diameter and fiber diameter of different types of fiber (Table 4.8.2.2) Breaking load and fiber elongation percent were estimated by 4464 model Instron applying constant load on fiber by holding one end in one jaw and moving upwards

the another end of fiber (holding by another jaw) at a constant speed (Table 4.8.2.3). The load applied, the elongation and the maximum load, breaking load was constantly recorded by computer. The data indicated that staple length was highest in the hump region followed by shoulder and mid-side. Fiber diameter was found to be lowest at the mid-side region. Pure fibers were higher at mid-side region. As regard elongation percent property, it is greater in mid-side-region in calves, at shoulder and hump region in adult camels.

The results indicated that in adult camel also the mid-side region fibers not only possess lowest mean fiber diameter, highest fiber strength but also comparable elongation percent with the fibers of other regions. The fiber quality analysis showed better scope of its utilization in village cottage industry.

Table : 4.8.2.1 Village wise distribution of bactrian camel in Nobra Valley (1999-2000)

Name of village	S.No. of camel owner	Year 1999-2000	
		Male	Female
Hunder	1	1	3
	2	2	4
	3	1	—
	4	2	3
Diskit	1	1	—
	2	2	2
	3	5	1
	4	11	17
	5	3	7
Sumur	1	7	10
	2	2	2
	3	2	3
Trit	1	3	—
	2	5	6
Total number of camel		47	58

Table-4.8.2.2: Age and site-wise hair quality attributes of double humped camel (bactrian camel)

	Body Site	Mean Staple length (cm)	Mean Fiber diameter (μ)	Mean Fiber diameter (μ)			Percentage of Fiber		
				Pure **	Hetero **	Hairy **	Pure **	Hetero **	Hairy NS
Age**	Shoulder	5.26±0.85	21.15±0.60	15.75±0.27	21.89±1.82	39.95±3.42	57.26±1.77	34.00±0.55	8.74±1.66
	Mid-side	4.46±0.18	18.42±0.43	14.69±0.31	20.74±0.40	31.51±1.36	63.5±1.56	28.89±0.78	7.56±2.13
	Hump	16.13±2.39 (9)	25.82±3.57	20.07±2.12 (9)	27.61±3.16 (9)	55.19±4.48 (9)	58.21±2.95 (9)	32.72±0.91 (9)	9.07±2.07 (9)
>4 years **	Shoulder	10.80±1.05	37.56±1.74	27.22±1.41	41.45±1.69	60.54±1.89	46.57±2.08	40.32±1.43	13.11±1.03
	Mid-side	5.00±0.32	6.16±0.96	21.00±0.74	30.31±1.26	58.17±1.67	58.17±1.67	33.04±1.31	8.79±0.90
	Hump	13.33±1.04 (72)	44.34±1.22 (72)	33.59±1.17 (72)	47.04±1.12 (72)	42.01±1.68 (72)	42.01±1.68 (72)	44.40±1.34 (72)	13.59±0.70 (72)

Figures in the parentheses indicate the number of samples in each group. **P, *P

Table-4.8.2.3: Age and site wise mean fiber diameter, breaking load, fiber strength and mean elongation percent of bactrian camel hair

Age	Site	Mean fiber diameter (μ)	Breaking load (gm)	Fiber strength (kg./mm ²)	Elongation (%)
< 6 months	Shoulder (20)	20.86 \pm 0.67	56.30	164.76	18.31
	Mid-side (20)	18.64 \pm 0.70	52.50	192.38	38.23
	Hump (20)	22.05 \pm 0.80	66.90	175.19	15.89
> 4 years	Shoulder (20)	45.84 \pm 0.73	114.70	69.49	35.90
	Mid-side (20)	30.40 \pm 0.78	72.90	100.43	28.76
	Hump (20)	47.04 \pm 1.02	102.90	59.20	61.67

Figures in the parentheses indicate the number of observations in each group

Biometrical observation

Biometrical data recorded from 13 double humped camels covering 16 parameters. Means of various bio-metrical parameters are presented in Table 4.8.2.4 Significant difference in body length ($P < 0.01$), height at wither ($P < 0.01$), tail length ($P < 0.01$), face length ($P < 0.05$), hump size (front) ($P < 0.05$), hump circumference (front) ($P < 0.05$) and leg length ($P < 0.05$) were observed between the sexes. These bio-metrical parameters can be helpful in selection of double humped camel for breeding programmes under cold arid region.

Haematological and mineral profiles

A total of 15 blood samples were collected from 9 females and 6 male adult bactrian camels. Haematological parameters include haemoglobin (Hb) and erythrocyte sedimentation rate (ESR). Mineral studied were sodium (Na), potassium (K), calcium (Ca), magnesium (Mg), zinc (Zn), iron (Fe), copper (Cu), cobalt (Co) and manganese (Mn). The results are presented in Table 4.8.2.5. A significant ($P < 0.05$) higher value of Fe was observed in female camels that may be due to higher concentration of Hb as Fe is required for the synthesis of Hb.

Disease prevalence

During the period a total of 200 faecal and 30 blood samples were examined. All the faecal samples were found negative for any helminth infection. Similarly blood samples examined did not revealed any haemoprotozoan infection. As found in dromedary camels; ectoparasitic and skin diseases are not a major problem in bactrian camels.

Table-4.8.2.4. Least square means of some important bio-metrical parameters (cm) of double humped camel (*Camelus bactrianus*)

Parameters	Mean \pm S.E.			Range
	Male (n=7)	Female (n=6)	Overall (n=13)	
Body length	169.14 \pm 2.60	152 \pm 3.64	161.23 \pm 3.23**	142-180
Heart Girth	219.28 \pm 9.05	218 \pm 10.39	218.69 \pm 6.54	177-258
Height at Withers	170.28 \pm 2.64	156.5 \pm 2.77	164.30 \pm 2.88**	147-178
Neck Length	106.85 \pm 4.31	100.66 \pm 4.22	104.0 \pm 3.03	88-125
Face Length	60.0 \pm 1.97	53.83 \pm 2.37	57.15 \pm 1.70*	45-65
Distance between Eyes	29.28 \pm 0.86	26.0 \pm 0.77	27.76 \pm 0.73	24-32
Distance between Ears	27.85 \pm 0.91	27.16 \pm 0.94	27.53 \pm 0.63	23-31
Hump Size (Front)	42.57 \pm 4.82	37.16 \pm 1.16	40.07 \pm 2.67*	29-60
Hump Size (Rear)	40.57 \pm 3.50	37.33 \pm 2.37	39.07 \pm 2.14	27-50
Hump Circumference(F)	104.71 \pm 7.20	98.16 \pm 4.84	101.69 \pm 4.40*	78-132
Hump Circumference(R)	113.28 \pm 5.35	109.83 \pm 3.34	111.69 \pm 3.18	93-132
Distance between Humps	25.28 \pm 2.46	21.0 \pm 1.23	23.30 \pm 0.58	14-35
Ear Size	13.14 \pm 2.49	11.33 \pm 0.61	12.30 \pm 0.58	10-17
Leg Length (Fore limb)	135.57 \pm 2.49	128.4 \pm 4.78	132.58 \pm 2.56*	112-143
Leg Length (Hind limb)	145.85 \pm 2.18	140.2 \pm 2.1	143.5 \pm 1.71*	135-158
Tail Length	59.57 \pm 2.09	45.5 \pm 2.27	53.07 \pm 2.50**	38-67

**P<0.01, *P<0.05

Table-4.8.2.5. Haematological and minerals profile of bactrian camels

Parameters	Female (n=9)	Range	Male (n=6)	Range
Hb (g/dl)	12.09 \pm 0.68	10.40 - 13.60	11.75 \pm 0.56	10.10 - 13.00
ESR (mm/hr)	2.56 \pm 0.12	2.00 - 3.00	2.50 \pm 0.20	2.00 - 3.00
Sodium (Na) meq/l	130.50 \pm 6.44	92.00 - 156.00	124.0 \pm 3.84	107.00 - 133.00
Potassium (K) meq/dl	7.79 \pm 0.35	6.65 - 9.75	7.42 \pm 0.48	5.90 - 9.20
Calcium (Ca) mg/dl	8.84 \pm 0.34	7.95 - 11.00	7.88 \pm 0.33	6.55 - 9.10
Magnesium (Mg) mg/dl	3.35 \pm 0.19	2.80 - 4.35	3.10 \pm 0.30	2.60 - 4.30
Zinc (Zn) μ g/dl	104.48 \pm 5.65	76.50 - 120.60	92.94 \pm 8.49	65.40 - 126.30
Iron (Fe) μ g/dl	89.50 \pm 7.40 ^a	69.00 - 123.00	65.40 \pm 4.20 ^b	54.00 - 81.00
Copper (Cu) μ g/dl	65.50 \pm 7.56	42.00 - 99.00	56.40 \pm 5.76	30.00 - 69.00
Cobalt (Co) μ g/dl	1.10 \pm 0.32	1.05 - 1.20	1.16 \pm 0.28	1.10 - 1.26
Manganese(Mn) μ g/dl	19.70 \pm 3.28	15.50 - 28.10	18.85 \pm 4.12	16.70 - 24.38

a,b- indicates significance at 5% level

Reproduction

Breeding seasons of double humped camel extends from January to March. Female attains puberty at 3 years while male at the 4 years of age. First calving occur at age of 4 years. Average gestation period is 13 months and calving interval about 2 years. Average birth weight of calves is around 35 \pm 2.04 kg. Lactation length varies from 15-18 months.

Chemical evaluation of feed/fodders utilized by bactrian camels

Chemical composition of commonly available fodders, bushes utilised by camel was carried out during November, 2000 and analysed at NRC on Camel, Bikaner Table 4.8.2.6. The highest crude protein percent was found in Tsermang which is the most popular fodder of the bactrian camel followed by Gyalta, Changna and Alfalfa while crude fibre percent was highest in Umbo followed by Alfalfa and Jantick. Dry matter percent was observed to be highest in Rasukse followed by Gyalta, Alfalfa and Jangser.

Table-4.8.2.6: Chemical composition of various feed/fodder utilized by double humped camel the cold arid region of Ladakh

Name of Plants	DM %	EE %	CP %	CF %	ASH %	NFE %
TSERMANG (<i>Hypophae rhamnoides</i>)	60.24	4.1	12.25	21.2	13.35	48.9
CHANGMA (Dry yellow leaves)	66.60	4.9	8.75	20.06	12.94	53.35
BECHO (Dry yellow leaves)	26.92	4.4	8.05	17.44	20.84	49.27
DRY OLE/Alfalfa (<i>Medicago sativa</i>) stem and leaves	85.44	1.98	8.40	42.20	10.35	37.03
UMBO (<i>Myricaria germanica</i>) Woods	78.16	2.46	8.05	47.78	2.73	38.96
GYALTA (Woods)	95.28	NIL	10.50	26.46	20.0	43.04
JANGTSER(full plant)	75.76	NIL	5.95	23.54	29.74	40.77
JANTICK(<i>Myricaria gallica</i>)	54.36	NIL	6.65	38.22	14.25	48.88
RASUKSE	99.14	1.87	6.65	26.66	18.62	46.20

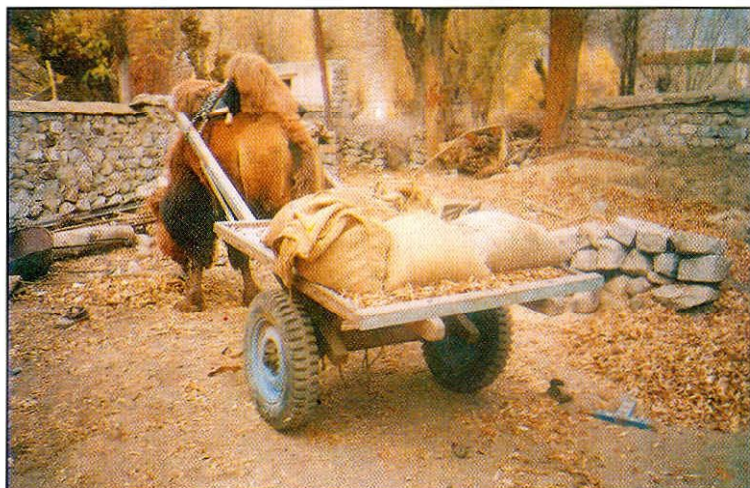


Fig.4.8.2.1 Double humped camel with cart

Draughtability

Bactrian camel carry a load up to 1 quintal as baggage and 4 quintal by camel cart with a speed of 6 km/h. During pre winter season (October-November) adult male camels are being regularly used as baggage animal for transportation of fuel wood, stones bags and manure from agricultural field to village houses and vice versa. In Mongolia and other countries bactrian camels are being used for riding, caravan and carting.

Utility of bactrian camel

1. As baggage animal during summer and pre winter season for transporting agricultural and other items.
2. A camel cart was sent to Partapur (Ladakh) to explore its short distance (5 km.) transport utility. The cart can carry 4-5 qtls. of load easily.

3. Fibre quality data of bactrian calves and adult camels indicated good prospects of its utility for preparing various items (caps, shawls, coats, durries etc.) not only in the form of pure camel hairs but as blends with other fibres in village cottage industry.
4. Use of these camels for agricultural operations in small fields using camel drawn implements (seed drill, plough tiller, bund maker etc.) can be helpful in further creating its utility in cold arid region of Nobra valley Ladakh.
5. In the recent past, due to heavy influx of tourist in the valley of Ladakh district, scope has been observed for utility in camel safari.

4.9. NATP Projects

4.9.1. Improving the shelf life of milk and milk products of camel and goat

Project leader	: Raghvendar Singh
Co-PI	: Poonam Jayant
R.A.	: Sanjay Shukla

Camel milk

Milk samples from ten lactating camels of Bikaneri breed of Parity 3rd and 4th in late lactation period were collected for the study. The animals were divided into two groups (Group I & II), 5 camels in each group on the basis of initial body weight. The animal of both the groups were managed under semi-intensive system. They were allowed to graze and browse daily and guar chara was offered ad lib. Additionally Group-2 camels were supplemented with green fodder (Blue panic) @ 3kg/animal/day while Group 1 remained unsupplemented.

Physico-chemical and gross chemical composition

The camel milk is opaque white in colour with normal odour and salty-sweet in taste. Milk samples were analysed for protein, fat, lactose, SNF, ash, moisture and vitamin C and data are given in Table-4.9.1.1. Data on physico-chemical properties of camel milk such as pH, acidity, specific gravity, viscosity were determined and given in Table-4.9.1.2.

Shelf-life evaluation of camel milk

Camel milk samples were analysed for acidity, pH at 0, 2, 4, 6 and 8 hours at 37°C and 0, 1, 2, 3, 4, 5, 6, 7 and 8 days at refrigeration temperature in both the groups. The acidity increased from 0.17 ± 0.002 to 0.197 ± 0.009 in group I and 0.168 ± 0.006 to 0.187 ± 0.013 in group II while pH decreased from 6.42 ± 0.195 to 6.13 ± 0.045 in group I and 6.42 ± 0.34 to 6.19 ± 0.084 in group II at 37°C. At refrigerated temperature, acidity and pH ranged from 0.169 ± 0.002 to 0.176 ± 0.003 , 6.44 ± 0.01 to 6.38 ± 0.02 and 0.167 ± 0.003 to 0.176 ± 0.003 , 6.45 ± 0.00 to 6.39 ± 0.02 in group I and II respectively. Data given in Table-4.9.1.3 and 4.9.1.4.

Camel milk may be used for processing and consumption even after eight hour at 37°C and eight days at referigerated temperature.

Table-4.9.1.1: Gross chemical composition of camel milk (Late lactation)

Parameters	Group I	Group II
Moisture %	90.05 ± 0.655	90.30 ± 0.649
Total solids %	9.78 ± 0.598	9.70 ± 0.649
Protein %	2.76 ± 0.107	2.76 ± 0.145
Fat %	3.12 ± 0.416	3.25 ± 0.194
Lactose %	3.15 ± 0.314	2.84 ± 0.738
Ash %	0.85 ± 0.028	0.85 ± 0.05
SNF %	6.84 ± 0.370	6.45 ± 0.750
Vitamin C (mg/100ml)	3.55 ± 0.42	3.56 ± 0.37

Table-4.9.1.2: Physico-chemical properties of camel milk (Late lactation)

Parameters	Group I	Group II
Colour	White	White
Odour	Normal	Normal
Taste	Saltiest sweet	Saltiest sweet
Acidity (%Lactic acid)	0.171 ± 0.002	0.171 ± 0.002
PH	6.41 ± 0.03	6.42 ± 0.03
Specific gravity	1.029 ± 0.00	1.029 ± 0.008
Viscosity (centipoise at 20°C)	1.655 ± 0.12	1.537 ± 0.04

Table-4.9.1.3: Transition in acidity and pH of camel milk at 37°C

Time (hrs)	Group I		Group II	
	Acidity (%LA)	pH	Acidity (%LA)	pH
0	0.171 ± 0.002	6.42 ± 0.19	0.168 ± 0.006	6.42 ± 0.03
1	0.171 ± 0.002	6.38 ± 0.02	0.168 ± 0.006	6.39 ± 0.03
2	0.172 ± 0.002	6.35 ± 0.02	0.168 ± 0.006	6.37 ± 0.03
3	0.176 ± 0.002	6.31 ± 0.01	0.171 ± 0.006	6.34 ± 0.03
4	0.177 ± 0.001	6.30 ± 0.01	0.171 ± 0.006	6.33 ± 0.03
6	0.184 ± 0.003	6.19 ± 0.02	0.177 ± 0.007	6.24 ± 0.05
8	0.197 ± 0.009	6.13 ± 0.04	0.187 ± 0.013	6.19 ± 0.08

LA= Lactic Acid

Table-4.9.1.4: Transition in acidity and pH of camel milk at refrigerated temperature

Time (hrs)	Group I		Group II	
	Acidity (%LA)	pH	Acidity (%LA)	pH
0	0.169 ± 0.002	6.44 ± 0.01	0.167 ± 0.003	6.45 ± 0.00
1	0.176 ± 0.003	6.49 ± 0.00	0.171 ± 0.006	6.51 ± 0.05
2	0.176 ± 0.003	6.48 ± 0.00	0.171 ± 0.006	6.44 ± 0.03
3	0.176 ± 0.003	6.47 ± 0.00	0.171 ± 0.006	6.46 ± 0.05
4	0.176 ± 0.003	6.45 ± 0.00	0.171 ± 0.006	6.45 ± 0.03
5	0.176 ± 0.003	6.44 ± 0.00	0.171 ± 0.006	6.44 ± 0.03
6	0.176 ± 0.003	6.38 ± 0.01	0.171 ± 0.006	6.40 ± 0.07
7	0.176 ± 0.003	6.37 ± 0.02	0.176 ± 0.003	6.39 ± 0.06
8	0.176 ± 0.003	6.38 ± 0.02	0.176 ± 0.003	6.39 ± 0.06

LA=Lactic Acid

Post partum changes in gross chemical composition of camel colostrum/milk

Samples of colostrum/milk from five female camels after calving at 0, 1, 2, 3, 4, 5, 13, 20 and 27 days were analysed for acidity, pH, crude protein, fat, SNF, total solid and moisture to study post partum periodical variation in composition of camel milk. Data are presented in Table 4.9.1.5. The acidity and pH ranged from 0.29 ± 0.01 to 0.13 ± 0.02 and 6.35 ± 0.12 to 6.61 ± 0.12 , respectively. Fat percent increased from 0.1 ± 0.00 to 3.78 ± 0.40 while protein percent decreased from 17.62 ± 0.55 to 2.66 ± 0.14 . The increase in pH and decrease in acidity with time of calving was observed.

Camel milk tend to normal in respect of acidity pH, fat protein and SNF after 2-3 week of post partum.

Table-4.9.1.5: Post partum changes in gross composition of camel milk

Time (days)	Acidity	pH	Moisture	Total Solid	Crude Protein	Fat	SNF
0	0.29 ± 0.01	6.35 ± 0.12	76.92 ± 0.87	23.28 ± 0.77	17.62 ± 0.55	0.1 ± 0.00	23.18 ± 0.77
1	0.22 ± 0.02	6.38 ± 0.03	82.33 ± 0.83	17.67 ± 0.83	8.05 ± 0.91	0.6 ± 0.08	16.63 ± 1.12
2	0.22 ± 0.02	6.37 ± 0.03	84.19 ± 0.92	15.81 ± 0.92	5.73 ± 0.63	1.4 ± 0.30	14.41 ± 1.08
3	0.21 ± 0.02	6.39 ± 0.05	87.83 ± 0.82	12.17 ± 0.82	4.77 ± 0.33	1.46 ± 0.16	10.71 ± 0.88
4	0.20 ± 0.01	6.38 ± 0.06	88.33 ± 0.84	11.67 ± 0.84	4.61 ± 0.30	2.28 ± 0.48	9.39 ± 1.14
5	0.17 ± 0.02	6.49 ± 0.08	87.93 ± 0.35	12.07 ± 0.35	4.37 ± 0.21	3.00 ± 0.39	9.87 ± 0.12
13	0.15 ± 0.01	6.52 ± 0.03	88.26 ± 0.73	11.74 ± 0.73	3.47 ± 0.33	3.02 ± 0.58	9.18 ± 0.36
20	0.15 ± 0.00	6.54 ± 0.03	87.80 ± 0.96	12.20 ± 0.96	3.07 ± 0.09	3.28 ± 0.58	8.94 ± 0.54
27	0.13 ± 0.02	6.61 ± 0.12	87.70 ± 0.58	12.30 ± 0.58	2.66 ± 0.14	3.78 ± 0.4	8.74 ± 0.50

4.9.2. Characterisation and conservation of Jaisalmeri camel

CCPI	:	S.C. Mehta
Co-CCPIs	:	Rajender Kumar
	:	Narendra Sharma
JRFs	:	Salag Ram Punia
	:	Ranjeet Singh Rathore

Survey of the breeding tract for availability of pure Jaisalmeri camels was done. The whole breeding tract of the breed was divided into 12 strata. The Jaisalmer and Barmer districts were divided in to four stratum where as the Jodhpur and Bikaner districts were divided into two strata. The proforma for recording of information from the camel owners of breeding tract of Jaisalmeri breed was developed. Seven enumerators were selected in the Jaisalmer & Barmer districts. They were given sufficient training for recording of the information. They were also told the objective of the project. The importance of conservation of the Jaisalmeri breed was also explained to them. At present they are working in the following villages:

Jaisalmer district - Badoragaon, Chhor, Chandan,

Barmer district - Bavari Kalla, Poshal, Binjrad, Harvecha

So far biometry of 248 camels belonging to the above villages has been done. The sex wise & age wise mean and results of analysis variance of the biometry data are presented in Table 4.9.2.1, 4.9.2.2 and 4.9.2.3. Purchased 10 Jaisalmeri elite males from the breeding tract. Their body measurements for 17 traits have been recorded.

Table-4.9.2.1: Leastsquares mean of body measurements of Jaisalmeri camel

(in cm)

Traits/ Effects	Body length	Heart girth	Height at withers	Neck length	Leg length (Front)	Leg length (Hind)
Sex**	135.99 ± 0.75 (248)	188.05 ± 0.95 (248)	182.90 ± 0.78 (248)	98.85 ± 0.70 (248)	138.24 ± 0.57 (248)	144.12 ± 0.56 (248)
Male	137.91 ± 0.99 (127)	190.47 ± 1.25 (127)	185.52 ± 1.04 (127)	100.10 ± 0.93 (127)	139.70 ± 0.75 (127)	145.73 ± 0.74 (127)
Female	134.07 ± 1.00 (121)	185.63 ± 1.27 (121)	180.28 ± 1.05 (121)	97.60 ± 0.94 (121)	136.77 ± 0.76 (121)	142.52 ± 0.75 (121)
Age** (Years)	135.99 ± 0.75 (248)	188.05 ± 0.95 (248)	182.90 ± 0.70 (248)	98.85 ± 0.70 (248)	138.24 ± 0.57 (248)	144.12 ± 0.56 (248)
<1	68.67 ± 2.07 (14)	93.38 ± 3.42 (14)	110.75 ± 2.83 (14)	53.57 ± 2.53 (14)	93.44 ± 2.05 (14)	97.76 ± 2.02 (14)
1	104.11 ± 2.37 (18)	145.28 ± 3.00 (18)	160.61 ± 2.49 (18)	88.39 ± 2.23 (18)	129.17 ± 1.80 (18)	134.56 ± 1.78 (18)
2	122.34 ± 3.58 (8)	175.83 ± 4.53 (8)	181.43 ± 3.75 (8)	97.25 ± 3.36 (8)	138.60 ± 2.71 (8)	144.55 ± 2.68 (8)
3	138.18 ± 2.61 (15)	189.42 ± 3.30 (15)	185.26 ± 2.73 (15)	99.72 ± 2.44 (15)	144.49 ± 1.98 (15)	149.92 ± 1.95 (15)
4	143.70 ± 2.03 (25)	197.92 ± 2.56 (25)	192.89 ± 2.12 (25)	105.55 ± 1.99 (25)	146.57 ± 1.53 (25)	152.41 ± 1.51 (25)
5	148.88 ± 2.45 (17)	201.02 ± 3.10 (17)	192.51 ± 2.57 (17)	99.19 ± 2.29 (17)	142.03 ± 1.85 (17)	148.21 ± 1.83 (17)
6	150.09 ± 2.46 (17)	210.18 ± 3.11 (17)	197.80 ± 2.58 (17)	108.01 ± 2.30 (17)	141.87 ± 1.86 (17)	148.57 ± 1.84 (17)
7	150.02 ± 2.61 (15)	210.58 ± 3.30 (15)	197.48 ± 2.73 (15)	107.42 ± 2.44 (15)	143.71 ± 1.98 (15)	149.94 ± 1.95 (15)
8	155.69 ± 2.32 (19)	212.98 ± 2.93 (19)	194.44 ± 2.43 (19)	107.67 ± 2.17 (19)	146.29 ± 1.75 (19)	152.76 ± 1.73 (19)
9	157.27 ± 2.53 (16)	215.52 ± 3.20 (16)	199.59 ± 2.65 (16)	108.94 ± 2.37 (16)	147.70 ± 1.91 (16)	153.66 ± 1.89 (16)
≥ 10	156.93 ± 1.10 (84)	216.42 ± 1.39 (84)	199.14 ± 1.10 (84)	111.64 ± 1.03 (84)	146.74 ± 0.83 (84)	153.02 ± 0.82 (84)

** (P<0.01)

Table-4.9.2.2: Leastsquares mean of body measurements of Jaisalmeri camel

(in cm)

Traits/ Effects	Foot pad length (F)	Foot pad width (F)	Foot pad length (H)	Foot pad width (H)	Hump circum. (H)	Hump circum. (V)
Sex	** 17.10 ± 0.10 (248)	** 16.27 ± 0.09 (248)	NS 15.46 ± 0.10 (248)	* 14.52 ± 0.10 (248)	** 78.03 ± 1.55 (248)	** 30.27 ± 0.79 (248)
Male	17.33 ± 0.12 (127)	16.46 ± 0.12 (127)	15.59 ± 0.19 (127)	14.66 ± 0.13 (127)	82.58 ± 2.04 (127)	32.27 ± 1.04 (127)
Female	16.87 ± 0.12 (121)	16.08 ± 0.12 (121)	15.34 ± 0.13 (121)	14.38 ± 0.13 (121)	73.84 ± 2.07 (121)	28.27 ± 1.05 (121)
Age** (Years)	17.10 ± 0.10 (248)	16.27 ± 0.09 (248)	15.46 ± 0.10 (248)	14.52 ± 0.10 (248)	78.03 ± 1.55 (248)	30.47 ± 0.79 (248)
<1	9.50 ± 0.33 (14)	9.02 ± 0.32 (14)	8.61 ± 0.35 (14)	7.96 ± 0.35 (14)	24.49 ± 5.57 (14)	9.21 ± 2.83 (14)
1	13.17 ± 0.29 (18)	12.39 ± 0.28 (18)	11.39 ± 0.28 (18)	10.78 ± 0.31 (18)	58.83 ± 4.90 (18)	19.83 ± 2.49 (18)
2	15.99 ± 0.44 (8)	15.09 ± 0.42 (8)	14.06 ± 0.47 (8)	13.07 ± 0.46 (8)	59.90 ± 7.38 (8)	22.75 ± .75 (8)
3	16.51 ± 0.32 (15)	15.77 ± 0.31 (15)	15.15 ± 0.34 (15)	14.23 ± 0.34 (15)	69.24 ± 0.34 (15)	24.07 ± 2.73 (15)
4	17.90 ± 0.25 (25)	16.93 ± 0.24 (25)	16.11 ± 0.26 (25)	15.16 ± 0.26 (25)	80.39 ± 4.17 (25)	28.80 ± 2.12 (25)
5	17.95 ± 0.30 (17)	17.07 ± 0.29 (17)	16.54 ± 0.32 (17)	15.54 ± 0.31 (17)	97.09 ± 5.04 (17)	37.41 ± 2.56 (17)
6	19.08 ± 0.30 (17)	18.16 ± 0.29 (17)	17.01 ± 0.32 (17)	16.12 ± 0.32 (17)	89.95 ± 5.07 (17)	36.59 ± 2.58 (17)
7	19.22 ± 0.32 (15)	18.49 ± 0.31 (15)	17.17 ± 0.34 (15)	16.10 ± 0.34 (15)	89.16 ± 5.38 (15)	34.13 ± 2.73 (15)
8	19.46 ± 0.29 (19)	18.57 ± 0.27 (19)	17.67 ± 0.30 (19)	16.68 ± 0.30 (19)	96.92 ± 4.77 (19)	38.84 ± 2.43 (19)
9	19.57 ± 0.31 (16)	18.70 ± 0.30 (16)	18.03 ± 0.33 (16)	17.09 ± 0.32 (16)	88.36 ± 5.21 (16)	38.62 ± 2.65 (16)
≥ 10 Years	19.70 ± 0.13 (84)	18.78 ± 0.13 (84)	18.02 ± 0.14 (84)	17.03 ± 0.14 (84)	103.98 ± 2.27 (84)	42.71 ± 1.15 (84)

NS - Non significant, *(P<0.05) and **(P<0.01) F - Front H - Hind

Table-4.9.2.3: Leastsquares means of body measurements of Jaisalmeri camel

(in cms)

Traits/ Effects	Face length	Distance between eyes	Distance between ears	Ear length	Tail length
Sex	NS 49.1 ± 0.37 (248)	* 20.28 ± 0.12 (248)	* 16.86 ± 0.18 (248)	NS 11.30 ± 0.07 (248)	* 49.10 ± 0.31 (248)
Male	49.29 ± 0.49 (127)	20.10 ± 0.16 (127)	17.27 ± 0.24 (127)	11.34 ± 0.10 (127)	50.58 ± 0.41 (127)
Female	49.08 ± 0.49 (121)	20.06 ± 0.16 (121)	16.46 ± 0.24 (121)	11.25 ± 0.10 (121)	49.41 ± 0.42 (121)
Age** (Years)	49.19 ± 0.37 (248)	20.28 ± 0.12 (248)	16.86 ± 0.18 (248)	11.30 ± 0.07 (248)	49.10 ± 0.31 (248)
<1	27.83 ± 1.33 (14)	12.94 ± 0.44 (14)	11.67 ± 0.66 (14)	7.35 ± 0.25 (14)	27.62 ± 1.13 (14)
1	40.89 ± 1.67 (18)	16.11 ± 0.39 (18)	13.00 ± 0.58 (18)	9.67 ± 0.22 (18)	44.44 ± 0.99 (18)
2	48.05 ± 1.76 (8)	18.23 ± 0.59 (8)	15.08 ± 0.87 (8)	10.02 ± 0.33 (8)	48.29 ± 1.49 (8)
3	50.62 ± 1.28 (15)	20.31 ± 0.43 (15)	16.61 ± 0.63 (15)	10.87 ± 0.24 (15)	51.38 ± 1.09 (15)
4	51.03 ± 0.10 (25)	20.98 ± 0.33 (25)	16.63 ± 0.49 (25)	11.77 ± 0.19 (25)	51.90 ± 0.84 (25)
5	54.48 ± 1.20 (17)	22.13 ± 0.40 (17)	18.02 ± 0.59 (17)	12.18 ± 0.23 (17)	51.97 ± 1.01 (17)
6	52.72 ± 1.21 (17)	22.02 ± 0.40 (17)	18.66 ± 0.60 (17)	12.34 ± 0.23 (17)	54.64 ± 1.02 (17)
7	50.86 ± 1.28 (15)	21.89 ± 0.43 (15)	18.31 ± 0.63 (15)	12.52 ± 0.24 (15)	54.94 ± 1.09 (15)
8	54.36 ± 1.14 (19)	22.62 ± 0.38 (19)	18.66 ± 0.56 (19)	12.57 ± 0.21 (19)	53.71 ± 0.96 (19)
9	55.04 ± 1.24 (16)	23.07 ± 0.42 (16)	19.71 ± 0.61 (16)	12.68 ± 0.23 (16)	56.60 ± 1.05 (16)
≥ 10	55.21 ± 0.54 (84)	22.74 ± 0.18 (84)	19.12 ± 0.26 (84)	12.30 ± 0.10 (84)	54.56 ± 0.46 (84)

NS – Non-significant, *(P<0.05) and **(P<0.01)

4.9.3: Evaluation of locally available feed and fodder to improve quality and formulate economic rations with high roughage diet

CCPI	:	A. K. Nagpal
Co-CCPI	:	A. K. Roy
SRF	:	Mrs. Manju Arora

Sub project 1: Studies on nutrient intake and utilization of guar phalgati based complete diet to camel calves

Seven camel calves of 1.5 - 2 years age were randomly divided into 2 groups of 3 (group I) and 4 (group II). The group I was fed only guar phalgati and group II was given complete feed, the chemical composition of which is shown in Table-4.9.3.1. At the end of feeding trial a digestibility trial of 6 days period was conducted. Water intake was also measured and blood samples were drawn for checking the metabolic profile.

Table-4.9.3.1: Chemical composition of experimental feeds (on % DMB)

Parameters	Guar phalgati	Complete feed
Crude protein	7.13	8.28
Ether extract	0.98	1.14
Crude fibre	35.21	27.03
Total ash	10.28	13.25
NFE	46.40	50.30
NDF	49.67	42.17
ADF	36.46	30.83

The results indicated that not only the DMI was higher but the digestibility coefficients of all proximate parameters except crude fibre were higher in camel group given complete diet (Table-4.9.3.2). This is also supported by the blood profile information given in Table 4.9.3.3.

Sub project 2: Utilization of guar phalgati in combinations with groundnut chara for preparation of complete feed and feeding to camel calves

The camel calves of around 2 years age were randomly allotted to 3 groups and were fed 3 different diets based on guar phalgati. The chemical composition of which is given in Table-4.9.3.4. After preliminary feeding a digestibility trial of 6 days duration was conducted in January 2001 to assess the nutrient utilization by camel calves from 3 different diets. Water intake of camel calves was also recorded during the digestibility trial. The results indicated that nutrient digestibility and intake were better in Group II and III than in Group-I (Table-4.9.3.5).

Table-4.9.3.2: Nutrient digestibility and intake in camel calves given guar phalagati and complete feed

Parameters	Group I	Group II
No. of calves	3	4
Feed cost (Rs/ q.)	319.00	399.8
Body Wt. kg	282.0 ± 14.47	275.5 ± 4.72
DMI kg/d.	6.19 ± 0.42	7.21 ± 0.28
DMI kg/ 100 kg B.Wt*.	2.03 ± 0.04	2.32 ± 0.09
Water intake l/d	18.58 ± 2.58	13.14 ± 1.43
Nutrient Digestibility %		
DM*	61.99 ± 0.71	68.31 ± 1.50
OM**	65.35 ± 0.33	71.65 ± 1.40
CP*	51.09 ± 0.39	57.65 ± 2.62
EF	30.70 ± 3.17	49.68 ± 8.88
CF	68.13 ± 3.18	64.11 ± 4.49
NEF**	65.84 ± 2.38	78.57 ± 1.98
Nutrient Intake		
DCP g/d	209.33 ± 1.30	305.30 ± 18.54
TDN kg/d	3.386 ± 0.22	4.027 ± 0.14
DM* g/kg W ^{0.75}	83.42 ± 2.57	94.64 ± 3.67
DCP** g/kg W ^{0.75}	3.04 ± 0.08	4.52 ± 0.31
TDN* g/kg W ^{0.75}	49.14 ± 1.29	59.62 ± 2.49
H2O l/kg DM*	3.21 ± 0.31	2.05 ± 0.19

Significant ** (P<0.01) and * (P<0.05)

Table-4.9.3.3: Serum biochemical profile of camel calves.

Parameters	Group I	Group II
Glucose (mg/dl)	72.26 ± 4.53	71.25 ± 4.98
Total protein (mg/dl)	4.49 ± 0.12	4.55 ± 0.13
Urea (mg/dl)	20.82 ± 0.88	26.55 ± 3.81
Calcium (mg/dl)	12.45 ± 0.83	13.39 ± 1.15
Phosphorus (mg/dl)*	5.32 ± 0.12	6.75 ± 0.14

Significant * (P<0.05)

Table-4.9.3.4: Chemical composition of experimental feeds of different groups (on % DMB)

Parameters	Group I	Group II	Group III
Crude protein	7.44	8.40	9.41
Ether extract	1.72	1.71	1.79
Crude fibre	30.95	29.02	23.86
Total ash	10.86	12.39	14.74
NEF	49.03	48.48	50.20
NDF	45.97	43.09	40.99
ADF	32.21	30.48	26.58

Table-4.9.3.5: Nutrient intake, digestibility and water intake of camel calves

Parameters	Group I	Group II	Group III
No. of calves	4	3	3
Body weights. kg.	292.0 ± 12.19	301.3 ± 8.41	292.7 ± 19.91
DMI kg/d.	5.93 ± 0.14	6.59 ± 0.29	5.97 ± 0.32
DMI kg/ 100 kg B.Wt*.	2.03 ^B ± 0.05	2.18 ^{Ab} ± 0.09	2.05 ^{Aa} ± 0.05
Water intake l/d	16.25 ± 1.77	15.54 ± 1.63	13.70 ± 0.86
Water intake l/kg DMI	2.78 ± 0.41	2.35 ± 0.17	2.30 ± 0.07
Nutrient Digestibility %			
DM*	58.47 ± 0.44	60.66 ± 0.50	60.25 ± 0.88
OM**	62.45 ^A ± 0.34	68.65 ^B ± 0.76	68.09 ^B ± 0.51
CP*	49.73 ± 2.32	53.57 ± 0.54	57.17 ± 3.04
EF	39.57 ± 7.82	50.86 ± 4.38	39.26 ± 2.52
CF**	57.84 ^a ± 1.53	68.34 ^b ± 2.37	60.32 ^a ± 2.22
NEF**	68.49 ^A ± 1.12	72.07 ^{AB} ± 0.26	75.06 ^B ± 1.27
Nutrient Intake			
DCP g/d	218.00 ± 9.71	296.33 ± 12.20	322.67 ± 32.83
TDN kg/d	3.376 ± 0.22	4.038 ± 0.20	3.519 ± 0.16
DM g/kg W ^{0.75}	84.07 ± 3.04	91.01 ± 2.41	84.45 ± 1.36
DCP g/kg W ^{0.75}	3.09 ^A ± 0.10	4.10 ^A ± 0.09	4.55 ^B ± 0.30
TDN* g/kg W ^{0.75}	47.67 ^A ± 1.62	55.79 ^B ± 1.96	49.82 ^A ± 0.92

Significant * (P<0.05) and ** (P<0.01)

4.9.4. Environmental stress and its amelioration through shelter management.

Sub Project-1: Studies on Camel Marketing System and its impact

C.C.P.I : Champk Bhagat
 Associates : Raghvendar Singh
 : N. Sharma
 SRF : D. Chaturvedi

A benchmark survey was conducted at Ramdev Animal Fair, Nagour district (Rajasthan). A total of 104 camel keepers were randomly interviewed and 32 complete transaction cases were recorded. Majority of the camel keepers interviewed were farmers (91%). Nevertheless 9% also claimed to be camel businessman/middleman. Most of the farmers present at the fair were from Rajasthan (90%). Ten different categories of camel keepers were identified. Maximum farmers belonged to Jat community (45%). A total of 9171 camel were registered at the fair, out of which 719 camels were sold involving a transaction of more than Rs.30 lakhs.

The camel distribution among the farmers

Maximum camel transacted by famers were Male (52%) as compared to female (48%). Camels above

7 year age group was the most representative followed by 4-7 year and less than 3 year age group. The distribution of camels among the various farmers was not uniform. It ranged from 0 to 12 camel 8 per farmer. More than half (54%) of them brought only one camel followed by two (11%) and 3 camels (10%). Bikaneri breed was predominant (90%) followed by Jaisalmeri breed (10 %). About 81 % of farmers usually participate in one animal fair where as 8 % attend more than one fair and only 1 % attend all fair.

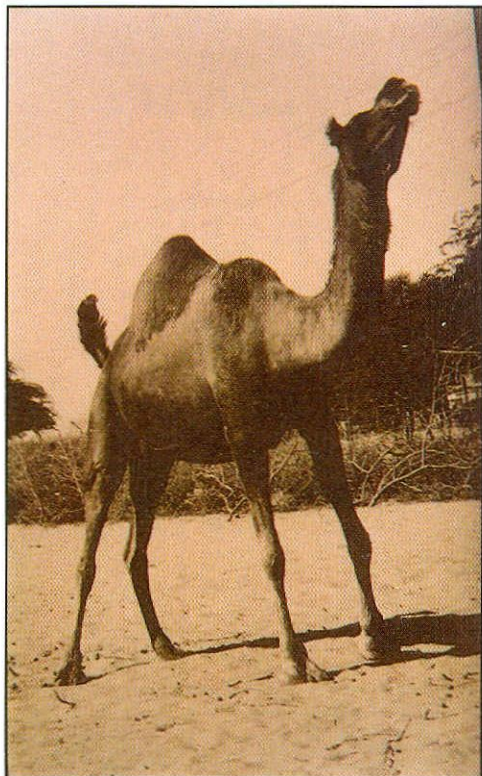


Fig. 4.9.4.1 : A parturient camel showing sign of parturition

The trend of camel farming

The camel keeping at household level varied in a wide proportion ranging from 1 to 80 camels per farmer. About 70% of farmers owned only one camel, 20% owned 2-3 camels, 4% owned 4-10 camels, 3 % owned more than 10 camels, only 1% owned 80 camels where as 2% owned no camel. The average number of camel owned per farmer at the village/house level was 4.90 ± 2.67 out of which 3.50 ± 1.22 were male and 1.40 ± 0.50 were female. The average number of camel brought for sale was 2.54 ± 1.11 .

The average cost of camel varied according to age and sex. Among 32 transaction cases, the average expected cost prior to sale was Rs. 9654 ± 287 where as the average actual cost of the transaction was Rs. 8768 ± 165 . The sale cost was 90% of the expected cost which shows that farmers achieved cost quite near to their expectation.

Sub Project 2. Studies on parturition behavior and neonatal behaviour of camel



Fig. 4.9.4.2 : Dam with neonatal calf just after delivery

A total of 10 parturient camels were observed from at least one week before the expected date of calving. The parturient behaviour and neonatal behaviour of camel in loose housing system is shown in fig. 4.9.4.1 to 4.9.4.7. The parturient camels wants to remain alone and separate from the main herd is very common and prominent sign showing two grooves on either side of the root of tail. Concavity between the site of pin bone (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 and welling of udder

and teat were very common sign which indicates that parturition process is likely to start very soon. Where as some other sign viz. looking to the flank and aggressiveness is not so common. In maximum

cases (80%) allanto-chorion (A-C) bag expelled out only after rupturing where as there were very few cases (20%) where A-C bag expelled out as such and ruptured outside and subsequently released straw colour fluid.



Fig. 4.9.4.3 : Placenta of camel (Diffuse type)

The average time (min.) gap between appearance and expulsion of A-C bag was 3.50 ± 1.00 and it ranged from 2 to 5 min. The average time (min.) gap between expulsion of A-C bag and appearance of foetus was 5.25 ± 1.66 where as the range value was 3 to 7 min. Almost 100% cases showed normal presentation (out stretched foreleg with chin of the calf resting on it). The posture of dam at the time of expulsion of foetus was on sternal recumbancy (100%). The average time (min.) gap between appearance and expulsion of foetus was 6.23 ± 2.44 (assisted labour case) and 42.50 ± 6.50 (unassisted labour case). Assisted labour case means where manual assistance (slight pulling outward by holding head and leg of foetus). The post partum average time (min.) taken for expulsion of placenta was 55.86 ± 10.00 where as it ranged from 30 min to 120 min. The

dam stands up as soon as the calf was expelled out and noising and

smelling the calf was very common feature. In normal and natural delivery process the placenta was not eaten by dam (100%). After parturition maximum dam (80%) adapt their calf very quickly (with in 5 to 10 min) but there were few cases (20%) where dam took more time for this adaptation process. In maximum cases (90%) dams were extremely protective of young and not readily allow any one to handle the calf but few dam (10%) were reluctant to this behaviour.

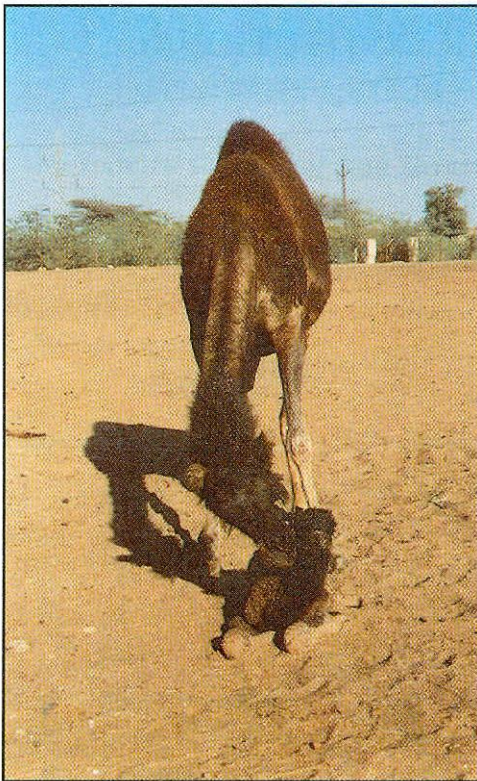


Fig. 4.9.4.4 : Nosing & smelling of neonatal calf

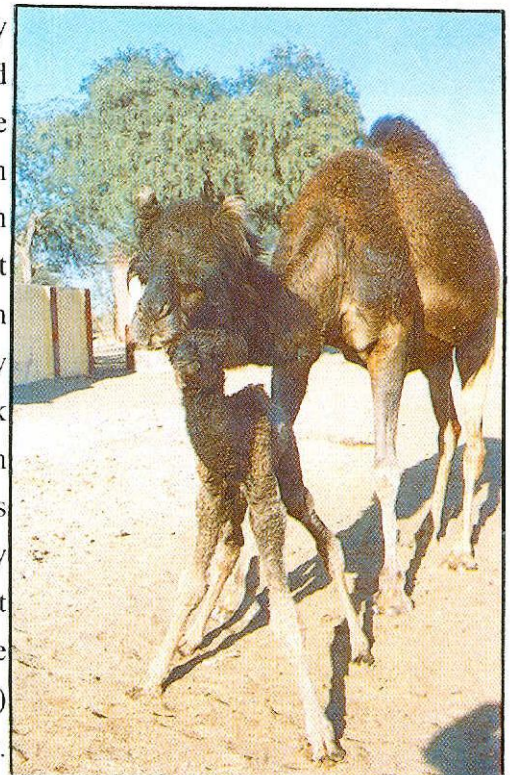


Fig. 4.9.4.5: First standing attempt by neonatal calf.

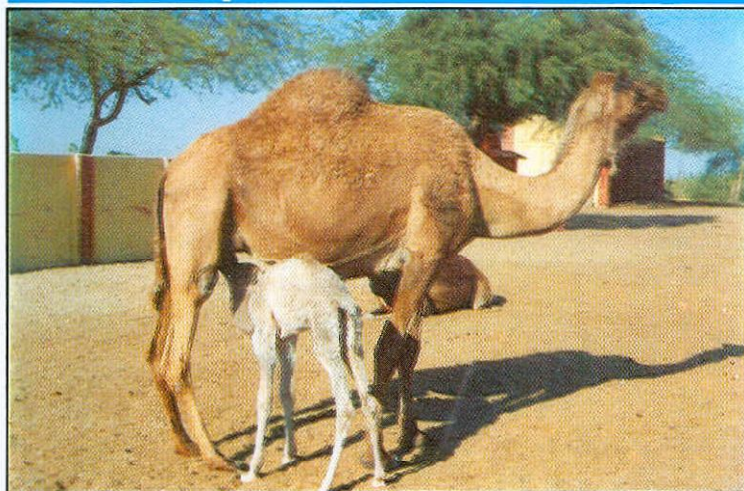


Fig. 4.9.4.6: First milk suckling attempt by neonatal calf.

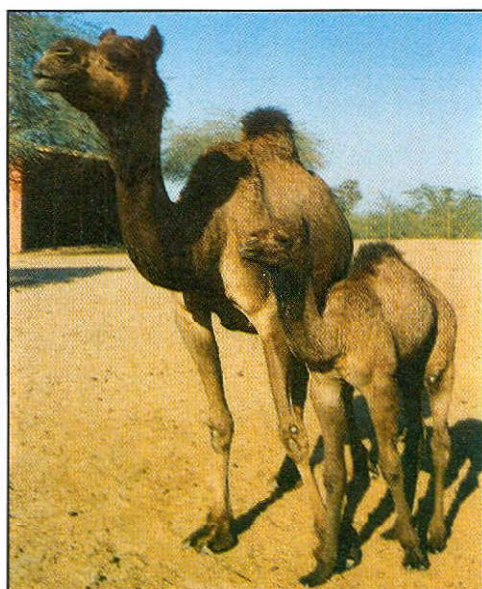


Fig. 4.9.4.7 : Dam with seven days old calf.

The average time (min.) taken for the calf to stand on leg was 56.23 ± 10.44 whereas the range was 25 to 90 min. The average time (min.) taken for 1st suckling attempt was 80.26 ± 8.53 where as the time interval for suckling varied from 1 to 3 hr. The average (min.) time taken for excretion of muconium was 32.00 ± 5.64 . But the average time (min.) taken for 1st urination was 61.50 ± 2.11 . The average rectal temperature ($^{\circ}\text{C}$), pulse rate (time/min) and respiration rate were 36.58 ± 1.29 , 122.00 ± 8.54 and 35.50 ± 2.66 , respectively. In maximum cases (90%) the locomotory movement of newly born calf was normal within 12 to 24 hr after parturition but some calves (10%) took more time to normalise their locomotory movement. On the other hand maximum calf (90%) could properly walk after 6 to 7 days of parturition even though there were few cases (10%) where calves could walk properly before 6 - 7 days.

4.10. INTER INSTITUTIONAL COLLABORATIONS

4.10.1. Structural and molecular studies on Camel

Ph. D. Scholar : J. A. Khan
 Major Advisor : T. P. Singh, Deptt. of Biophysics, AIIMS, New Delhi

Co-advisor : Raghvendar Singh

Camel lactoferrin is the first protein from the transferrin super family, which has been found to display the characteristic functions of iron binding and release of both lactoferrin as well as transferrin simultaneously. It was remarkable to observe a wide pH 6.5 and the remaining 50% iron is released only at pH 4.0 and 2.0. Furthermore, proteolytically generated N- and C-lobes of camel lactoferrin showed that C-lobe lost

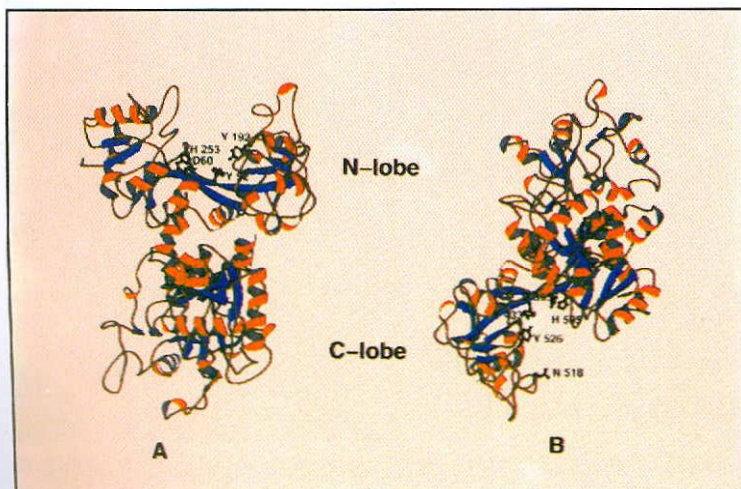


Fig. 4.10.1.1: Three dimensional folding of camel lactoferrin molecule

iron at pH 6.5, while N-lobe lost it only at pH less than 4.0.

These observations suggest that the N-lobe of camel apo-lactoferrin is structurally very similar to the N-lobe of human apo-lactoferrin. On the other hand, the structure of the C-lobe of camel apo-lactoferrin matches closely with that of the hen and duck apo-ovotransferrin. This implies that the iron binding and releasing behaviour of N-lobe of camel lactoferrin is similar to that of the N-lobe of human lactoferrin whereas that of the C-lobe resembles with those of the C-lobes of duck apo-ovotransferrin and hen apo-ovotransferrin.

Hence, it correlates with the observation of N-lobe of camel lactoferrin losing iron at a low pH (4.0-2.0) as in other lactoferrins whereas the C-lobe of camel lactoferrin loses iron at higher pH (7.0- 6.0) like transferrins suggesting its functional similarity with that of the C-lobes of transferrins. (Fig. 4.10.1.2)

The isolation of poly A mRNA from mammary gland of lactating camel and c-DNA synthesis was performed. The PCR was performed with Taq polymerase and the nucleotide sequencing was performed on cloned double stranded DNA using automatic sequencer. The camel lactoferrin c-DNA is 2307 base pair in length.

The overall structure of camel apo-lactoferrin folds into four distinct domains.

4.10.2. Studies on the physical and biochemical characteristics of donkey (*Equus asinus*) semen

Ph. D. Scholar : A. K. Roy
Major Advisor : O. P. S. Sengar
Co-advisor : M.P. Yadav

Physical characteristics of semen

The seminal characteristics were observed in 10 ejaculates each from 5 donkeys in 3 seasons during one year. The freshly ejaculated semen appeared off white to creamish in colour. The gel was observed in only two samples. The mean gel free volume was maximum in autumn which is more ($P < 0.05$) as compared to that of summer and winter. There was not much variation in the mean gel free volume between individuals in the same season. The mean of mass motility score (1-5) was highest in the autumn which is more ($p < 0.01$) than that of other seasons. The maximum mean value of pH (7.38) was observed in the summer season. The mean pH during winter season was 7.35 vs 7.23 in autumn, which differs (p) from each other. The mean concentration of spermatozoa ($\times 10^6$) was 329.88 during summer which was more ($P < 0.05$) than that of autumn (300.8) and winter (308.0). Total number of spermatozoa per ejaculate ($\times 10^9$) were highest during autumn (14.44) followed by summer (13.95) and winter (13.18). The mean length of spermatozoa (5m) was 57.7, 56.92 and 57.54 in summer, autumn and winter, respectively. The mean of live sperm percentage was 84.28, 85.33 and 85.46 during summer, autumn and winter seasons, respectively. There were no significant variations in live sperm percentage between the seasons. The mean of abnormal sperm

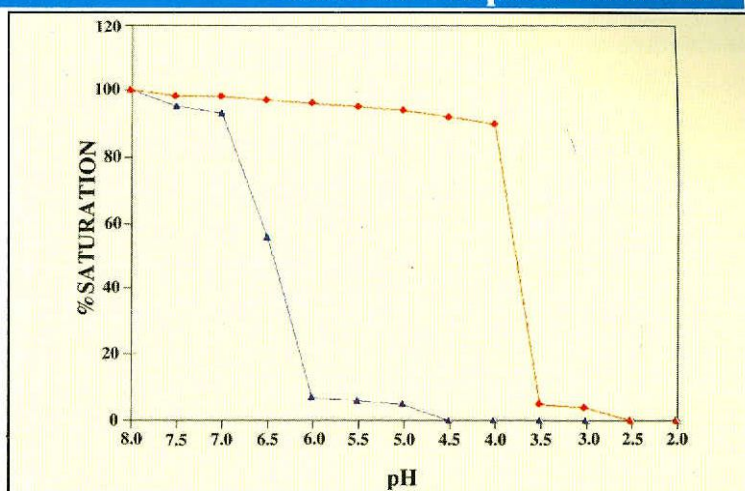


Fig. 4.10.1.2: Comparative study of iron desaturation for the N-(red) and C-lobes (blue) of camel lactoferrin.

percentage was significantly different ($P < 0.01$) in three seasons. It was highest in summer (5.78) followed by winter (4.74) and autumn (3.03). The mean of acrosomal damage(%) was different (P) in three seasons. It was highest in summer (3.91) followed by winter (2.92) and autumn (2.33). Effect of season on biochemical composition of donkey semen is given in table 4.10.2.1.

Table-4.10.2.1: Effects of season on the biochemical composition of donkey semen*

Biochemical Parameters	Seasons		
	Autumn	Winter	Summer
Glucose (mg/dl)	11.41 ^b	10.25 ^b	6.13 ^a
Cholesterol (mg/dl)	16.04 ^b	14.69	13.31 ^a
Protein (g/dl)	4.43	3.92	4.20
Albumin (g/dl)	0.793	0.707	0.755
Acid phosphatase (I.U./L)	17.889 ^b	18.083 ^b	16.085 ^a
Alkaline phosphatase (I. U./L)	50.30 ^b	63.69 ^c	39.65 ^a
Aspartate amino transeferase (I. U./L)	456.40	498.36 ^b	387.52 ^a
Alanine amino transferase (I. U./L)	26.30 ^a	34.77 ^b	22.72 ^a
Lactate dehydrogenase	3344.52 ^b	2322.31 ^c	2916.28 ^a
Calcium (mg/dl)	7.05	7.37	6.33
Phosphorus (mg/dl)	5.088 ^A	4.022 ^B	4.482
Sodium(m Eq/l)	102.90 ^b	107.28 ^a	111.0 ^a
Potassium (m Eq/l)	24.42	29.01	26.95
Magnesium (m Eq/l)	8.755 ^b	8.549 ^b	6.156 ^a

a, b ($P < 0.01$) A, B ($P < 0.05$)

4.10.3. Molecular markers for genetic characterisation of *Camelus dromedarius*

Research Scholar : Sharat Chandra Mehta
 Major Advisor : R.S. Gahlot
 Co-Advisor : B.P.Mishra

The repetitive DNA analysis & PCR-RAPD technique was employed to investigate the genetic variation in Bikaneri, Jaisalmeri & Kachchhi breeds of camel and other livestock species. Restriction enzyme digestion of camel genomic DNA with Hind III, Pst I & Pvu II resolved 10, 6 & 2 repetitive DNA bands, respectively. It was observed that probably camel has higher equimolar concentration of repetitive DNA in its genome with internal periodicity of about 100-200 bp. Restriction enzymes Hind III, Pst I and Pvu II resolved respectively 3, 4 and 4 DNA bands in cattle and 3, 5 and 4 bands in buffalo. The molecular size range of the fragments in two species was similar in three enzymes used but the bands were observed to be species specific. In sheep and goat a single band of 3.02 kb was resolved with Hind III digestion. It was observed that there exists organisational similarity of repetitive DNA in the genome of the two species, which probably possess relatively less repetitive DNA. The restriction digestion of donkey genomic DNA resolved 7, 1 and 5 repetitive DNA bands with Hind III, Pst I and Pvu II, respectively. It was observed that donkey genome probably has higher concentration of repetitive DNA with internal periodicities. In horse 3 repetitive DNA bands were resolved with Pvu II, but the bands were observed to be species specific as none of them coincided with that of donkey.

PCR-Random Amplification of Polymorphic DNA was carried out using six random oligonucleotide

primers. Reproducible polymorphic bands with varying frequencies among the three breeds of camel were obtained with five primers (GT-10, GC-10, G-2, OP-08 and G-1). A total of 75 bands were amplified, of which 27 (36%) were polymorphic. The 0.5 kb band in GT-10, 0.48 kb band in G-2 and 1.08 kb band in OP-08 were observed to exhibit probable specificity for Jaisalmeri breeds whereas the 0.67 kb band in GT-10, 1.07 kb band in G-2 and 0.57 kb band in G-1, were observed to be of use in distinguishing the camel breeds. The band frequency estimates were superior to band sharing estimates in measuring the genetic relationship among camel breeds. The maximum genetic variability was found in Bikaneri ($W^f = 0.80 \pm 0.05$) followed by Kachchhi ($W^f = 0.84 \pm 0.06$) and Jaisalmeri ($W^f = 0.87 \pm 0.05$) breeds, which was observed to be mainly due to the differences in the herd size and population base of the breeds in the breeding tracts. Close genetic relationship between Bikaneri & Kachchhi ($D^f = 0.075$) followed by Jaisalmeri & Kachchhi ($D^f = 0.106$) and Bikaneri & Jaisalmeri ($D^f = 0.132$) was observed.

The five random primers used for generating polymorphic RAPD patterns in camel were found effective in priming the amplification reaction in other livestock species studied. The primer OP-08 amplified polymorphic DNA bands in all livestock species. It was therefore indicated that PCR-RAPD can be used to envisage the between and within species genetic variations. The data obtained in the present study along with the sizable number of samples from the breeding tract will be of great use in characterising and documenting the indigenous camel breeds

Specific amplification of the sequences spanning NCAM gene in camel and other livestock species was obtained. In camel two bands of 237 & 288 bp were amplified whereas in species belonging to bovidae and equidae a single band of 255 bp & 226 bp were observed, indicating conservation of the microsatellite at 3' untranslated end of NCAM gene in the livestock species studied.

4.10.4 The research work of following staff members of the Centre, doing Ph.D from Rajasthan Agriculture University, Bikaner is under progress

1. Research Scholar : U.K. Bissa
 Major Advisor : S.B.S. Yadav
 Co-Advisor : M.S. Sahani
 Title : Selectivity, productivity and longevity in Indian camels
 (*Camelus dromedarius*)
2. Research Scholar : Sumant Vyas
 Major Advisor : P.K. Pareek
 Title : Ultrasound scanning and serum progesterone profile for studying effect of photoperiodic control on female reproduction in *Camelus dromedarius*

4.11. Camel health management

Clinical cases

During the period 169 clinical cases of different ailments were treated, among them 30 were of digestive disorders, 61 of surgical affections, 48 skin affections and remaining 30 includes pyrexia, heat stroke, debility and mastitis etc. Age, sex and breed wise morbidity are presented in Table 4.11.1.

Prophylactic measures

1. Control of Trypanosomiasis

For prevention and control of trypanosomiasis quinapyramin sulphate and chloride were injected twice a year during the month of August–September and in February–March. No case of surra was recorded during the year 2000-2001.

2. Control of external parasites

The camels were sprayed with insecticides for prevention and control of ectoparasites after clipping of hair in the March–April and in the month of September–October.

Table -4.11.1. Age, sex and breed wise morbidity (2000-2001)

Name of disease/diagnosis	Sex		Breed				Age group			Total
	M	F	B	J	K	AxB	0-3 months	3-36 months	Adult	
Digestive System										
Simple indigestion/dyspepsia	3	5	2	1	4	1	—	1	7	8
Diarrhoea	6	10	6	9	1	—	5	-2	9	16
Impaction	1	4	-1	2	2	—	—	—	5	5
Tympany	1	—	—	1	—	—	—	—	1	1
Surgical Affections										
Wounds & injuries	45	8	20	20	7	4	5	2	46	53
Lameness	4	3	4	1	—	—	—	—	7	7
Naval ill	—	1	1	—	—	—	1	—	1	1
Skin Infection										
Mange	29	19	24	12	8	4	2	6	40	48
Others										
Conjunctivitis	1	1	1	1	—	—	1	—	1	2
Heat stroke	1	—	—	—	—	1	1	—	—	1
Debility	1	2	2	1	—	—	—	—	3	3
Pyrexia	8	5	3	6	2	2	2	2	9	13
Agalactia	—	1	1	—	—	—	—	—	1	1
Mastitis	—	3	1	1	1	—	—	—	3	3
Tetanus	—	1	—	—	1	—	—	—	1	1
Respiratory System										
Pneumonia	1	—	—	1	—	—	1	—	—	1
Reproductive System										
Retention after birth	—	5	2	2	—	1	—	—	5	5
Total	101	68	68	59	29	13	18	13	138	169

3. Control of internal parasites

The camels were given broad spectrum anthelmintic twice a year in the month of September–October and March–April.

Mortality

The specific death rate (SDR%) at the NRC on camel, was 7.79% during the year. The breed wise mortality in Bikaneri, Kachchhi, Jaisalmeri and Cross bred (Arab x Bikaneri) was 3.59% 12.26%, 7.90% and 17.63% respectively. Age, sex and breed wise mortality per thousand camel days per day are presented in Table-4.11.2 and 4.11.3.

Table 4.11.2. Age and Sex mortality during 2000-2001

Age group	Sex	Camel days	No. of animal died	Mortality per 1000 camel days/day
0-3 months	M	2444	06	2.4549
	F	2145	03	1.3986
	Pooled	4589	09	1.9612
3 month-3year	M	13546	03	0.2214
	F	10955	—	0.0000
	Pooled	24501	02	0.2214
Above 3 years	M	19457	02	0.1027
	F	45983	07	0.1522
	Pooled	65440	09	0.1375
Overall	M	35447	11	0.3103
	F	59083	10	0.1692
	Pooled	94530	21	0.2221

Table 4.11.3. Breed wise mortality during 2000-2001

Breeds	Camel days	No. of animals died	Mortality per 1000 camel days/day	SDR%
Bikaneri	40627	04	0.0984	3.59
Kachchhi	12679	06	0.4732	12.26
Jaisalmeri	34872	08	0.2294	7.90
Arab x Bikaneri	6352	03	0.4722	17.63
Pooled	94530	21	0.2221	7.79



Fig : 4.12.1 Modified tree guard

4.12. Rangeland Management

The land resources of the centre is spread over in an area of 824 hectares. The land form is undulated alluvial with interdunal plains, sand dunes of varying size. The soil is predominantly sandy, light textured, calcareous, loose/ weak structured as well as sandy loam and clay-patches are also present. The regional elevation of the farm area above mean sea level is about 234.9 m.

Farm area has been fenced in phases comprising of five big blocks. About 20,000 live trees and shrubs are present. The tree species primarily *Salvadora oleoides*, *Azadirachta indica*, *Prosopis cinerarea* and shrubs like *Zizyphus nummularia* are present. About 20 hectares pasture comprising of perennial grasses like *Lasuirus indicus* and *Panicum antidotale* were maintained.

During the year under range land/farm resource development programme tree plantation of 7000 plants suitable to arid condition comprising of *Acacia tortalis*, *Prosopis cineraria* and 3000 ornamental and other plants was taken up in Block No.1 and office complex in collaboration in Rajasthan

State Forest Department, Bikaner for future sustainability. One plant nursery was also raised near tube well No.2 in farm area.

One small block in campus area was sown with lucerne crop for supplementary feeding to small animals. About 6 hectares area was sown with guar as a rainfed crop.

Other general works of maintenance of vegetational flora in farm area as well campus were carried out along with road gradation of farm area.

The Centre has designed and fabricated a new type of tree-guard, (Fig. 4.12.1) which is quite light in weight and found to be ideal for range-land arid condition in order to protect new plants from various animals viz; Camels, Cattle, buffaloes, blue bulls and deer etc. The tree-guard is triangular in shape with one-inch wide wire mesh. The height above the ground level is 11 feet and width 2 feet. One side of tree-guard is detachable, so it becomes easy in shifting and transportation. If required the bottom i.e. ground side can be shifted upwards and the height can be further increased by tying sticks etc. so that plants can easily achieve height up to 12 to 14 feet.

5. TECHNOLOGY ASSESSED & TRANSFERRED

1. Camel semen collection and its cryo preservation has been successfully attempted.
2. Immunomodulatory effect of camel milk against multiple drug resistance in Tuberculosis patient was assessed.
3. Reproductive efficiency of farm camel herd improved significantly in terms of percent conception through adoption of modified research technology.

6. EDUCATION AND TRAINING

SCIENTISTS			
Name and Designation	Training/Seminar/Symposium	Place	Date
Dr. Aminu Deen (Sr. Scientist)	Windows-98 and MS-Office sponsored by NIIT and Siemens National Training programme on advances in cellular and molecular techniques for livestock improvement	NRC on Camel, Bikaner Centre for Advanced studies, Dairy Cattle Breeding Division, NDRI, Karnal	July 31-August 2, 2000 September 19- October 17, 2000
Dr. S. K. Ghorui (Sr. Scientist)	Orientation programme on "Vigilance mechanism for vigilance and non-vigilance functionaries" organized by Institute of Socio-economics Research and Action, New Delhi.	Bangalore	December 13-15, 2000
Dr. A. K. Roy Scientist (Sr. Scale)	Veterinary Ethology	IVRI, Izatnagar	December 18, Jan.8, 2001
Dr. Raghvendar Singh (Scientist)	Training course on RIA-IRMA techniques and their clinical applications	Bhabha Atomic Research Centre, Mumbai	March 8-30, 2001
Sh. Gorakh Mal (Scientist)	Short course on "Advances in cellular immune effector system of farm animals in response to intracellular pathogens"	IVRI, Izatnagar	October 11-20, 2000
Dr. Rajender Kumar (Scientist)	Agricultural Research Prioritization techniques	NAARM, Hyderabad	August 21-26, 2000.
Ms. Poonam Jayant (Scientist)	Winter school CWS 2000 "Recent techniques in gene cloning, sequencing and DNA profiling"	CIMAP, Lucknow	November, 20-29, 2000
Dr. C. Bhakat (Scientist)	"Training Methods"	E.E.I,GAU, Anand, Gujrat.	August 3-10, 2000.
Dr.(Mrs.) Nirmala Saini, (Scientist)	Advance course on feed microbiology	IVRI, Izatnagar	November 23- December 22, 2000

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TECHNICAL STAFF			
Name and Designation	Training/Seminar/Symposium	Place	Date
Dr. B.L. Chirania (Veterinary Officer)	Upgradation of Managerial skills	EEl, Anand, Gujrat.	August, 16-25, 2000
	Computer training	IASRI, New Delhi	March, 25-31, 2000
Sh. Ram Dayal Raiger, Technical Officer (Library)	Joint Workshop on Digital Libraries: Managing Convergence, continuity & change Convergence,continuity& change	University of Mysore, Mysore.	March 12-16, 2001
Sh. Dinesh Munjal, (Computer Programmer)	Web programming and Internet technologies	IASRI, New Delhi	October 9-21, 2000
ADMINISTRATIVE STAFF			
Sh. Ram Kumar (P.A. to Director)	Windows-98 and MS-office	NRC on Camel, Bikaner	July 31-August 2, 2000.
	Improving Secretarial performance efficiency and effectiveness	Institute of Technology and management system, New Delhi.	August 9-12, 2000.
Sh. Harpal Singh Kaundal, (Jr.Steno)	Increasing effectiveness of private Secretaries/ Personal Assistants/ Personal Staff	Centre for Research, Planning and Action, New Delhi.	October 9-11, 2000.
Sh. Nemi Chand Barasa, (Hindi Translator)	Personal contact programme on Hindi Typewriting	Central Hindi Training Institute, Jaipur	June 20-22, 2000
Sh. Anil Jajoria (Sr. Clerk)	Windows-98 and MS-office	NRC on Camel, Bikaner	July 31-August 2, 2000.
Sh. V.K.Soni (Jr. Clerk)	Computer Awareness Programme	NARRM, Hyderabad	September 18-23, 2000.

7. AWARDS AND RECOGNITIONS

7.1. **Sh. Gorakhmal**, Scientist bio-chemistry received ISHEER award-2000 by Indian Society of Health Environment Education and Research, Bikaner in recognition of significant contribution in the field of veterinary and animal science for the work on 'Role of camel milk as an adjuvant nutritioned supplement in human tubercublosis patients"

8. LINKAGES AND COLLABORATIONS

8.1. National Level

- AIIMS, New Delhi : Milk protein especially lactoferrin
- RAU, Bikaner : Research work of M.V.Sc and Ph.D. students
- CCSHAU, Hissar (Haryana) : Research work of M.V.Sc and Ph. D. students
- NDRI, Karnal (Haryana) : Camel milk analysis
- CSWRI, Avikanagar (Raj.) : Camel hair processing
- CIAE, Bhopal (M.P.) : Camel drawn implements
- S. P. Medical College, Bikaner : Camel milk as nutritional adjuvant in treatment of Tuberculosis
- DRDO, Ministry of Defence : Evaluation and conservation of double Humped camel

8.2. International level

- CIRAD-EMVT, France : Research and training

9. AICRP/COORDINATION UNIT/NATIONAL CENTRES

All India Coordination Research Project

Centre is collaborating with Department of Farm Machinery and Power Engineering, College of Technology of Agricultural Engineering, Maharana Pratap University of Agriculture and Technology, Udaipur, for their AICRP on "Increased system of Animal Energy with enhanced system efficiency". The objectives of this programme are-

1. ORP trials on improved implements for camels.
2. Standardization of two- wheeled/four-wheeled camel cart.

3. Evaluation of camel based agro-processing complex including irrigation, thrasing, cleaning, and chap-cutting operation.
4. Effect of diets of varying energy-protein ratio on performance of draught animals.

This centre is also recognised by the council as one of the collaborating units for AICRP on "Blood Protista" with CVAS, RAU, Bikaner. To fulfil the broad objective of the project as control of haemoprotozoan parasites of domestic livestock, we have been assigned the work to develop PCR-based diagnosis against *Trypanosoma evansi* in camel.

GENERAL/MISCELLANEOUS

10. LIST OF PUBLICATIONS

Articles published

- 10.1 Vyas, S. and Sahani, M.S. (2000) : Real-time ultrasonography of ovaries and breeding of the one-humped camel (*Camelus dromedarius*) during the early postpartum period. *Animal Reproduction Science* 59 (2000) 179-184.
- 10.2 Jayant, P. and Singh, G. P. (2001): "Camel milk and its unique properties". *Indian Dairyman*, 53, 37-45.
- 10.3 Aminu Deen and Sahani, M. S. (2000): Preliminary attempts to collect and cryopreserve camel semen. *Journal of camel Practice and Research* 7 (2): 181-86.
- 10.4 Saini, N., Singh, G. P. and Nagpal, A. K. (2000): Kal kitana upayogi hooga oont. *Khati*, 5-6.
- 10.5 Nagpal, A. K., Sahani, M. S. and Roy, A. K. (2000): Effect of grazing sewan (*Lasiurus sindicus*) pasture in female camels in arid ecosystem. *Indian Journal of Animai Science* 70 (9) 968-971.
- 10.6 Nagpal, A. K., Saini, N. and Sahani, M. S. (2000): Effect of type of supplementation on nutrient utilization and serum profile of camels in rut. *Indian Journal of Animai Science* 70 (12) 1263-1265..
- 10.7 Nagpal, A. K., Roy, A. K., Kiradoo, B. D., Purohit, R. and Sahani, M. S. (2000): Voluntry feed intake and nitrient utilization of adult female racing camels (*Camelus dromedarius*) during exercise and at rest. *Journal of Camel Practice and Research*. 7 (2) 205-208.
- 10.8 Bhakat, C. and Sahani, M. S. (2000): Camel Carting: A subsidiary source of in come of camel keepers in the hot arid Bikaner district of Rajasthan. *Indian Journal of Animal Production and Management*, 16 (1&2), 7-9.
- 10.9 Bhakat, C., Tandon, S. N. and Sahani, M. S. (2000): Camel management practices in the hot arid Bikaner district of Rajasthan. *Indian Farming*: 50 (6), 32-34.
- 10.10 Bhakat, C. and Sahani, M. S. (2000): The comprehensive study of camel production system in north -west coastal zone of Egypt. *Livestock - International*. 4(10), 4-7.
- 10.11 Bhakat, C. and Sahani, M. S. (2001): Impact of camel production system on the sustainability of marginal farmers in hot arid villages of Thar desert, *Indian Journal of Animal Research* 35 (1): 10-14.
- 10.12 Gorakh Mal., Sena, S., Jain, V. K., Singhvi, N. M. and Sahani, M. S. (2000): Role of camel milk as an adjuvant nutritional supplement in tuberculosis patients. *Livestock International*.4 (4): 7-14.

- 10.13 Gorakh Mal (2000): Chemical composition and Vitamin C content of milk in Indian camels managed under farm conditions. *Indian Veterinary Journal*. 77(8): 695-96.
- 10.14 Raghvendar, S; Bhakat, C. and Sahani, M. S. (2000): "Work potential of camel under arid ecosystem and it's management." *Natural Resource of Indian Desert*. 145-151.
- 10.15 Raghvendar, S; Tandon, S. N. and Sahani, M. S. (2001): Milk enzymes in different breeds of Indian camel. *Interiational Journal Animai Science*; 16(1), 85-87
- 10.16 Raghvendar, S., Tandon, S. N. and Sahani, M. S. (2001): Work potential of camel under arid ecosystem and its management. In book: *Natural resources of Indian desert*. 145-151.
- 10.17 Kasturi, N., Raghvendar, S., Tandon, S. N., Raisinghani, G and Khanna, N. D. (2000): Study on haemolytic complement activity of camel through alternate pathways. *Intrantial Journal Animai Science* 15 (2), 179-183
- 10.18 Banmali yadav ; Raghvendar, S. and Sahani, M. S. (2001): Kahi lupt na ho jaya do kubad ushra. *Kheti*, 3, 9-10. (In hindi)
- 10.19 Kataria, N; Kataria, A. K.; Agarwal, V. K.; Garg, S. L.; Sahani, M. S. and Raghvendar, S. (2000): Effect of water restriction on serum aldosterone and cortisol in dromedary camel during winter and summer. *Journal of Camel Practice and Research*, 7(1), 1-7
- 10.20 Bissa, U. K.; Yadav, S. B. S.; Khanna, N. D. and Pant, K.P.(1998): Growth curves of body weight from birth to four years in Bikaneri breed of Indian camels (*Camelus dromedarius*). Proceedings of the 3rd Annual meeting for Animal Production under Arid conditions, Vol. 2: pp 15-24. Organized by faculty of Agricultural Sciences, United Arab Emirates University, Al-Ain, 2-3 May 1998
- 10.21 Yadav, S. B. S. and Bissa, U. K. (1998): Factors affecting some blood constituents in camels, A review. Proceedings of the 3rd Annual meeting for Animal Production under Arid conditions, Vol. 2: pp 32-48. Organized by faculty of Agricultural Sciences, United Arab Emirates University, Al-Ain, 2-3 May 1998
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11. LIST OF APPROVED ON GOING PROJECTS (IXth PLAN)

- 11.1 Improvement of the working efficiency of camel under arid and semi arid conditions.
- 11.2 Genetic characterization, evaluation and conservation of indigenous camel breed.
- 11.3 Improvement of reproductive efficiency and to study the causes of reproductive failure in camels.
- 11.4 Studies on feed requirement and feed resources evaluation in camel for optimum production.
- 11.5 To study the economics of different camel management practices under arid and semi arid eco-system.
- 11.6 Surveillance, monitoring and control of camel diseases.

12. RAC, MANAGEMENT COMMITTEE, SRC, QRT MEETINGS

12.1. Management Committee Meeting

Meeting of management committee was held under the chairmanship of Dr. M. S. Sahani, Director, on 20-10-2000. The following members participated the meeting.

1. Dr. Arun Verma, ADG (AN&P), ICAR, New Delhi
2. Dr. G. R. Purohit, Dean, CVAS, Bikaner
3. Dr. Narendra Mohan Singh, Dy. Director, Deptt. Animal Husbandry, Govt. Rajasthan, Bikaner.
4. Dr. G. P. Singh, Principal Scientist, (Animal Nutrition) NRCC, Bikaner
5. Dr. Raghavendar Singh, Scientist, (Bio-Chemistry), NRCC, Bikaner
6. Sh. Ashok Mallick, AAO, (Member Secretary) NRCC, Bikaner

Committee approved the various proposal of urgent priority:

1. Construction of approach road from campus area to Block No.2.
2. Proposal of additional garage space for mini bus, staff car, Jeep and cycle-scooter stand at campus.
3. Proposal for construction of separate fodder store of experimental camels of Nutrition Unit.
4. Proposal for extension of metabolic shed to accommodate at least 16 camels at a time and false ceiling of Nutrition laboratories.
5. Proposal of PVC flooring of RIA laboratory.
6. Proposal of grill-gates at office, laboratory building and nutrition laboratory.
7. Laying of overhead electric line extending from Tube Well No. 2 to Tube Well No. 3 in Block No.2 of farm area.
8. Proposal of purchase electric lawnmoer.
9. Proposal for preparation of 50 tree guard of 10' height in farm campus area.
10. Write off proposal for old submersible pump & motor and weighing machine.
11. Purchase proposal of two new submersible pump against replacement of old one.

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12. Proposal of auction of old tractor (MF 1035)
13. Write off proposal of coulter counter ZF; 6 in physiology unit.
14. Proposal for raising annual ceiling of security contract from 3 Lacs to 10 Lacs as per the requirement of centre.
15. Proposal of fixing of cabinet board in conference hall and dual board in different laboratories.
16. Proposal of approach road from farm campus to Agriculture farm office in Block No.1 in farm area.
17. Proposal for purchase of all the remaining research equipments approved under the IXth Plan.

12.2. SRC meeting

During the year 2000-2001, Annual and half yearly Scientific Research Council meeting were held under the chairmanship of Director of the Centre. The annual meeting for the year 1999-2000 was held on 15th May, 2000. Experts from different disciplines viz., Dr. Arun Varma, ADG (AN&P), ICAR, in addition to Dr. G.R. Purohit, Dean, CVAS, Bikaner, Dr. P. K. Pareek, CVAS, Bikaner and Dr. R.S. Gahlot, CVAS, Bikaner attended the meeting along with Scientific and Technical Staff.

The half yearly SRC meeting for 2000-2001 was held on February 5, 2001. The progress of various research projects were presented and future plan of work were discussed.

12.3. RAC meeting

The new research advisory committee is under constitution.

13. PARTICIPATION OF SCIENTISTS IN CONFERENCE, MEETINGS, WORKSHOPS AND SYMPOSIA

Name of Scientist	Workshops/Symposia/ Seminar/Conferences	Venue	Period
Dr. S. K. Ghorui (Sr. Scientist)	Workshop on patent awareness	D.S.T. Govt. of Rajasthan, Bikaner	Feb. 19, 2001
Dr. A. K. Nagpal (Sr. Scientist)	Annual workshop of NATP	College of Veterinary and Animal Science, Bikaner.	March 23-24 2001
Dr. Raghvendar Singh (Scientist)	i) Workshop on project monitoring and management information system	Central Arid Zone Research Institute, Jodhpur	September 21-22 , 2000
	ii) Workshop on official language	NAARM, Hyderabad	November 29-30, 2000
	iii) Nagar Rajbhasa karyanvayan Samiti meeting	DRM office, Bikaner	December 22, 2000
	iv) Workshop on patent awareness	D.S.T. Govt. of Rajasthan, Bikaner	Feb. 19, 2001

14. WORKSHOPS, SEMINARS, SUMMER INSTITUTE, FARMERS DAY ETC. ORGANISED AT THE INSTITUTE

The Centre organized a training programme of 2 months duration from Jan 1-Feb. 28, 2001 on Camel Reproduction for International Atomic Energy Agency, Vienna sponsored candidate Mr. D. Badamdorz of Mongolia in special context to camel semen collection, evaluation, cryopreservation and artificial insemination, embryo transfer technology, sonographic examination of genitalia and ELISA techniques for measurement of peripheral steroid hormones.

15. DISTINGUISHED VISITOR

Visit of Union State Agriculture Minister, New Delhi

Central Minister of State for Agriculture, Govt. of India, Dr. Debendra Pradhan, visited the Centre on 23rd August 2000 and expressed his happiness over the research work and progress of the institute. He expressed that research efforts made by the centre will help poor people of Rajasthan.

Chairman, ASRB, New Delhi

Dr. A.G. Sawant, Ex-chairman, ASRB visited different laboratories of Centre on 6th November 2000 and took keen interest in the research programmes of the centre and expressed happiness.

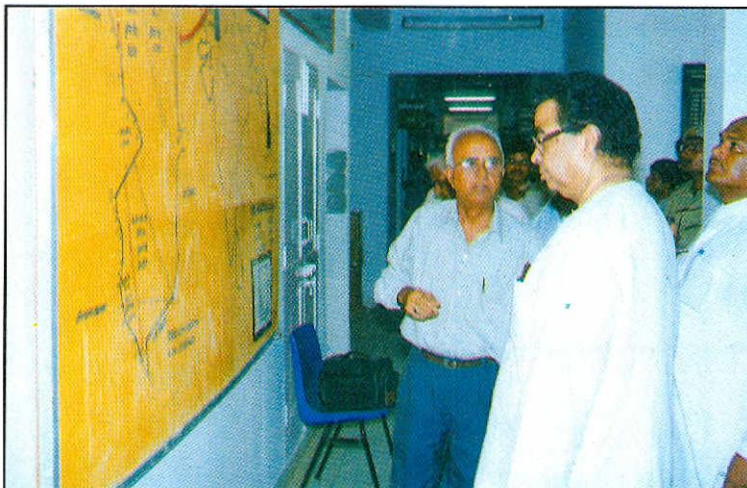


Fig : 15.1 Visit of Union State Agricultural Minister

Mrs. and Mr. Narang from National Research Council of Canada Visited NRCC

Saran and Sandy Narang from National Research Council of Canada visited Centre on 13th Dec, 2000. Mr. S. Narang delivered a seminar on "Generation of specific Camelid Antibodies by Phage Display Technology" and was of the opinion that learning of immune system of camel will lead to the understanding and development of new antibodies for the treatment of cancer.

QRT team of CAZRI Visited NRCC

QRT team of CAZRI visited this Centre on 16th March 2001 and Dr. G.S. Sekhon, chairman of QRT expressed the possibilities of purposeful collaborative work between NRC on Camel and CAZRI, Jodhpur for silvi pasture farm development programme.

16. PERSONNEL

Name of staff members (2000-2001)

Director	:	Dr. M. S. Sahani <i>PhD</i>
Scientific		
Principal Scientist (Animal Nutrition)	:	Dr. G.P. Singh <i>PhD</i>
Sr. Scientist (Animal Reproduction)	:	Dr. Aminu Deen <i>---</i>
Sr. Scientist (Animal Nutrition)	:	Dr. A.K. Nagpal <i>---</i>
Sr. Scientist (Veterinary Parasitology)	:	Dr. S. K. Ghorui <i>---</i>
Scientist Sr Scale (Animal Physiology)	:	Dr. A.K. Roy <i>---</i>
Scientist Sr Scale (Animal Reproduction)	:	Dr. Sumant Vyas (on study leave) <i>---</i>
Scientist Sr Scale (Animal Biochemistry)	:	Dr. Raghvendar Singh <i>---</i>
Scientist (Animal Biochemistry)	:	Sh. Gorakh Mal <i>*</i>
Scientist (Veterinary Parasitology)	:	Dr. Rajender Kumar <i>*</i>
Scientist (Animal Genetics & Breeding)	:	Dr. S. C. Mehta <i>---</i> (Transferred from CSWRI, ARC, Bikaner, joined NRCC on 01.01.2001)
Scientist (Veterinary Medicine)	:	Dr. F. C. Tuteja <i>---</i> (Transferred from IGFRI, Jhansi, joined NRCC on 29.01.2001)
Scientist (Animal Biochemistry)	:	Ms. Poonam Jayant <i>*</i>
Scientist (Livestock Production Mgmt.)	:	Dr. Champak Bhakat <i>PhD</i>
Scientist (Veterinary Medicine)	:	Dr. D. Suchitra Sena <i>MSc</i> (On Study Leave from 08.09.2000)
Scientist (Animal Nutrition)	:	Dr. Nirmala Saini <i>MSc</i>
Technical		
Senior Veterinary Officer, T-8	:	Dr. U.K. Bissa <i>PhD</i> (joined from study leave on 30.12.2000)
Livestock Farm Superintendent, T-7	:	Dr. N. Sharma <i>MSc</i>
Farm Manager, T-7	:	Sh. Ram Kumar <i>BSc</i>
Veterinary Officer, T-6	:	Dr. B.L. Chirania <i>BSc</i>
Technical Officer, T-5 (Library)	:	Sh. Ram Dayal
Computer Programmer, T-4	:	Sh. Dinesh Munjal <i>MSc</i>

Agricultural Assistant, T-II-3	:	Sh. M.K. Rao	<i>BSc</i>
Laboratory Assistant, T-II-3	:	Sh. Anand Kumar Bhati	<i>MSc</i>
Hindi Assistant, T-II-3	:	Sh. Nemi Chand	<i>B.A.</i>
Junior Engineer, T-II-3	:	Sh. Manjit Singh	<i>Diploma</i>
Livestock Assistant, T-II-3	:	Sh. Mohan Singh	<i>Diploma</i>
Livestock Assistant, T-I-3	:	Sh. Ram Chander	<i>Diploma</i>
Laboratory Technician, T-2	:	Sh. Nand Kishore	<i>B.A.</i>
Livestock Assistant, T-2	:	Sh. Radha Kishan	<i>Diploma</i>
Laboratory Technician, T-1	:	Sh. Rameshwar Vyas	<i>BSc</i>
Drivers (T-1)	:	Sh. Shivji Ram	
	:	Sh. Prabhu Dayal	
	:	Sh. Mahboob Hussain	
	:	Sh. Rafiq Alam	
	:	Sh. Mani Lal	
Tube well operator	:	Sh. Satnam Singh	
	:	Sh. Suraj Bhan Singh	

Administration

Asstt. Admin. Officer	:	Sh. A.K. Mallick
Asstt. Fin. & Accounts Officer	:	Sh. N.D. Sharma (on deputation)
Assistant	:	Sh. Kanwar Pal
Stenographer	:	Sh. Ram Kumar
Jr. Stenographer	:	Sh. Harpal Singh
Sr. Clerk	:	Sh. Ashok Yadav
Sr. Clerk	:	Sh. Jamil Ahmed
Sr. Clerk	:	Sh. Anil Kumar
Jr. Clerk	:	Sh. Vishnu Soni
Jr. Clerk	:	Sh. Krishan Kumar

Supporting : 21

Casual workers with temporary status : 21

17. INFRASTRUCTURAL DEVELOPMENT

The various developmental works taken up are :

- Construction of agricultural farm office in Block No. 1 of farm area was completed.
- Street light work along the main road from campus to agriculture farm office in Block No.1 was completed and work on new electric panel board for proper load distribution in lab cum administration building.
- Laying of LT line from tube well No.2 to agricultural farm office in Block NO.1 and from Tube well no. 3 to newly constructed dispensary in Block No.2.
- Construction of post mortom pit/room in farm area Block NO.1 was completed.
- Paddock fencing of 4 km distance in Block No.1 of farm area.
- Construction of two new ground water tanks each of 2 lakhs litre capacity in Block No.1 of farm area was completed for irrigation purpose and to meet the water supply of campus.
- Approach road approved under IXth Plan has been taken up in farm area Block No.1 up to agriculture farm office.
- Renovation of Nutrition and RIA research laboratories and fitting of Grill gates at the main entry of laboratory building and nutrition laboratory.

18. सारांश

कार्यकारी सारांश

कर्मचारी वर्ग

वर्ष 2000-2001 के दौरान अलग-अलग वर्गों के अन्तर्गत स्वीकृत पदों की संख्या 76 थी। जिनमें निदेशक, 15 वैज्ञानिक, 22 तकनीकी, 10 प्रशासकीय तथा 22 सहायक कर्मचारीगण सहित कुल 70 कर्मचारी कार्यरत रहे।

बजट

वित्तीय वर्ष 2000-2001 में योजनामद में 126 लाख व गैर-योजनामद में 116.88 लाख रुपये की धनराशि स्वीकृत की गई; जिनमें क्रमशः 126 लाख व 111.88 लाख रुपये व्यय हुए।

वर्ष के आरम्भ में ऊँटों के समूह की कुल संख्या 260 व अन्त में 272 रहीं। देशी नस्ल के ऊँटों के समूहों में मुख्यतया बीकानेरी, जैसलमेरी, कच्छी तथा संकर नस्ल (अरब X बीकानेरी) के ऊँट थे। ऊँटों में प्रथम बार भिन्न-भिन्न अनुसंधान पहलुओं पर डाटाबेस विकसित किए गए।

अवसंरचनात्मक विकास के अन्तर्गत केन्द्र के पुस्तकालय अनुभाग को पठनीय सामग्री के परिप्रेक्ष्य से और अधिक सम्पन्न बनाया गया। वर्तमान में केन्द्र के पुस्तकालय में विभिन्न विषयों की कुल 1506 अध्ययन हेतु सामग्री उपलब्ध है, जिनमें 260 पुस्तकें हिन्दी भाषा की भी सम्मिलित हैं। वर्ष 2000-2001 के दौरान कुल 145 पुस्तकों की खरीद हुई जिनमें नौ हिन्दी पुस्तकें सम्मिलित हैं।

केन्द्र में ऊँटों के विभिन्न पहलुओं पर अनुसंधान, केन्द्र की स्वयं अनुसंधान परियोजनाएं, कृषि-उत्पादन राजस्व की तदर्थ अनुसंधान योजना एवम् सहयोगिक अनुसंधान कार्यक्रम केन्द्र की कार्यसूची के अन्तर्गत जारी रहे।

शोध कार्य

देशी नस्ल की 4-5 वर्ष तक की मादा ऊँटों का 12 किलोमीटर की दूरी तक दौड़ क्षमता का तुलनात्मक मूल्यांकन करने पर ज्ञात हुआ कि जैसलमेरी मादा की औसत दौड़ गति 18 ± 1.4 कि.मी./घंटा बीकानेर मादा 16 ± 1.7 कि.मी. प्रति घंटा/ की अपेक्षा अधिक है। दौड़-दबाव के फलस्वरूप इनके रूधिर पीओ₂, पीसीओ₂, ग्लूकोज, कोरटीसॉल व लैक्टेट के आधार-स्तर प्रतिशत में वृद्धि, जैसलमेरी मादा में क्रमशः 65, 72, 72, 84, 187 व 285 तथा बीकानेरी मादा में 90, 60, 62, 234 व 287 रहीं। दौड़ के पश्चात् जैव रसायनिक की पुनःग्रहणता जैसलमेरी मादा में बीकानेरी मादा की अपेक्षा अधिक तीव्र रहीं।

ऊँटों के मध्य कृत्रिम योनि द्वारा वीर्य एकत्रण हेतु संगमन प्रतिक्रिया व वीर्य के स्खलन में बहुत अधिक भिन्नता देखी गई। इसके अन्तर्गत कुछ ऊँटों में कार्य निष्पादन क्षमता समान रूप में अच्छी, जबकि कुछ द्वारा यह औसतन रही तथा अन्यो में इस ओर अत्यन्त शिथिलता देखी गई। इसके अन्तर्गत कुल 14 ऊँटों को परीक्षण हेतु रखा गया, जिसमें 6 ऊँटों में कार्य निष्पादन अच्छा, एक में सामान्य स्तर का, 4 में निम्न तथा तीन में अत्यन्त निम्न स्तर का रहा। लगातार दो वर्ष तक छह ऊँटों में कार्य निष्पादन क्षमता का तुलनात्मक अध्ययन किया गया। इसके उपरान्त दो ऊँटों में अपेक्षित सुधार, एक में स्थिर तथा तीन में कमी आंकी गई। नर ऊँटों में स्वाभाविक संगमन मैथुनक्रिया करने की छूट की अपेक्षा कृत्रिम योनि में संगमन क्रिया के निष्पादन में कमी देखी गई। ऊँटों में वीर्य का जैल बनना एक विशेष क्रिया विधि है जिसके द्वारा वीर्य, गर्भाशय की भित्ति से चिपक जाता है ताकि बहाव के कारण

वीर्य की होने वाली क्षति से बचते हुए योनि व योनि द्वार में वीर्य की रक्षा की जा सके। इसके अतिरिक्त जैल बनने से एक गहरा रेशेनुमा जाल बन जाता है जिसमें शुक्राणु इस प्रकार घिरे रहते हैं कि वे शुक्र गति नहीं कर सकते। इससे शुक्राणु की ऊर्जा संरक्षित रहती है। इस प्रकार एक शुक्राणु बैंक बन जाता है जिसमें से निषेचन हेतु लम्बे समय तक शुक्राणु उपलब्ध करवाये जा सकते हैं। इस प्रकार जनन क्षमता में वृद्धि होती है। शुक्राणु की गति वीर्य के द्रवीकरण के बाद विकसित होती है। नर ऊँटों के वीर्य के हिमीकरण परिणाम में भिन्नता पायी गई। शुक्र गति परीक्षण के आरम्भिक आधार पर वीर्य हिमीकरण की समग्र सफलता की दर 44.26 प्रतिशत आंकी गई।

कृत्रिम गर्भाधान प्रयोग में एच. सी. जी. उपचार मादा ऊँटों में अण्ड-स्फूर्तन में प्रभावी पाया गया लेकिन कृत्रिम गर्भाधान से गर्भधारण-दर कम आंकी गई। इसे अभी भी मानकीकृत करने व अन्वेषण किए जाने की आवश्यकता है।

ऊँटों में मुख्य कृमि संक्रमण हेमॉक्स, नेमेटोडिरेला, नेमेटोडाइरस तथा ट्राइचूरिस के कारण होता है। अन्य सारकोप्टिज़ माइट, हाइलोमा ड्रोमेडरी, हाइलोमा एनोलिकम, ऑरनिथोडोरोस चिचड़ (टीक्स) तथा क्रिसोम्या प्रजाति की मक्खियों के कारण ऊँटों में मुख्य सन्धिपाद संक्रमण पाया गया। सामान्य प्रोटोजोआ संक्रमण मुख्यतः बैलेन्टिडियम के कारण पाया गया।

आर्थिक दृष्टिकोण को ध्यान में रखते हुए शुष्क क्षेत्रों में ऊँट गाड़ा व बैल गाड़ी का तुलनात्मक विश्लेषण किया गया। विश्लेषण करने पर यह पता चला है कि ऊँट गाड़ा, बैल गाड़ी की अपेक्षा यद्यपि थोड़ा-सा मंहगा रहता है, फिर भी यदि इसे ऊँट के लम्बे जीवनकाल, मालदुलाई क्षमता, तय दूरी, प्रतिदिन कुल आय, कम खर्च शीघ्र मुनाफा तथा उच्च दाम के बावजूद लाभ अनुपात अधिक इत्यादि के परिप्रेक्ष्य में देखें तो यह बैलगाड़ी से अति उत्तम रहेगा।

चारे की पाचनता/पाच्यता की गुणात्मकता के अन्तर्गत खेजड़ी की पत्तियों में अपरिष्कृत प्रोटीन व अपक्व रेशे अधिक अनुपात में देखे गये तथा 2 प्रतिशत यूरिया अनूपूरित ग्वार चारा, केवल ग्वार चारों की तुलना में अधिक लाभदायक हैं। यद्यपि ग्वार चारे पर आने वाला व्यय निम्न था परन्तु यदि हम अनूपूरित यूरिया चारे को पौष्टिकता की दृष्टि से देखें तो यह सस्ता प्रतीत होता है। ऊँट के बच्चे (टोरडा/टोरडी) अपनी माँ के स्तन-त्याजन करने के पश्चात् सफलतापूर्वक ग्वार/मोठ या मूँगफली चारा तन्मय होकर चरते हैं। बच्चों को दिए जाने वाले उपरोक्त चारे पर आने वाली लागत एक स्तन पान करने वाले बच्चे द्वारा अपनी माँ का दूध पीने की अपेक्षा कम आयेगी। सामान्यतया लगने वाले फलीदार सूखे चारे के अन्तर्गत मूँगफली चारे की मिश्रित खुराक ऊँटों के लिए प्रति किलोग्राम शारीरिक भार प्राप्ति हेतु ग्वार चारे की अपेक्षा अधिक श्रेष्ठ पायी गई। उसी प्रकार से ऊँटों को जब ग्वार चारा, मोठ चारे के साथ अनूपूरित कर खिलाया गया तो उनमें शुष्क मान बहुत अधिक देखा गया। जबकि दूसरी ओर केवल ग्वार चारा खिलाने पर शुष्क मान वैसा नहीं रहा जैसा अनूपूरित मोठ चारे के दिए जाने पर प्राप्त किया गया।

केन्द्र में उपलब्ध ऊँटों की तीन देशी नस्लों के शारीरिक भार के अनुसार बीकानेरी नस्ल के ऊँटों का शारीरिक भार (527.09±4.95) जैसलमेरी नस्ल के ऊँटों के शारीरिक भार (484.18±7.90 किग्रा) व कच्छी नस्ल के ऊँटों के शारीरिक भार (473.72±7.86 किग्रा) की अपेक्षा अधिक देखा गया। इस अवस्था में ऊँटों के शारीरिक भार पर पड़ने वाले मद का प्रभाव असार्थक रूप में रहा। लेकिन जब मद में मिथःक्रिया/परस्पर क्रिया व आयु को लिया गया तब आयु के साथ मद का प्रभाव अधिक सार्थक रूप में अवलोकित किया गया। जैसलमेरी नस्ल के ऊँटों के समूह में (76 प्रतिशत) बीकानेरी (68.57 प्रतिशत) व कच्छी नस्ल (52.94 प्रतिशत) के ऊँटों की तुलना में औसतन समूह गर्भ-ग्रहण

दर (67.53 प्रतिशत) रही। औसतन प्रथम वत्स-जनन आयु (2026.02 + 95.41 दिन) कच्छी नस्ल में (1971.33+200.59 दिन) बीकानेरी (2017.93+87.65 दिन) व जैसलमेरी (2088.79+170.78 दिन) नस्ल के ऊँटों की तुलना में निम्नतम रही। इनमें औसतन गर्भावधि 388.30+0.68 दिन रही। कच्छी नस्ल के मादा ऊँटों में गर्भावधि काल (385.17+1.53 दिन) बीकानेरी (390.2+ 0.93 दिन) व जैसलमेरी (398.52+0.98 दिन) मादा ऊँटों के गर्भावधि काल की तुलना में सार्थक रूप से कम रहा।

प्राइमर के एकल सेट के साथ जीनोमिक डी.एन.ए. का विस्तार यह प्रकट करता है कि दो कुब्बड़ वाले ऊँट में 237 बीपी का एकल बैंड का विस्तार होता है जबकि एक कुब्बड़ वाले ऊँट में 237 बीपी व 288 बीपी के 2 बैंडों का विस्तार हुआ। तंत्रिक कोशाणु आसंजन (Neural cell adhesion) अणु माइक्रोसैटेलाइट- भैंस, भेड़, बकरी, गधों तथा घोड़ों आदि पशुओं में विस्तारित हुआ।

यद्यपि ऊँटों का बालों के दृष्टिकोण से महत्व, भले ही द्वितीय स्तर का होता है तथापि इनका ग्रामीण कुटीर उद्योगों तथा अन्य सम्बन्धित उद्योगों के मिश्रण के रूप में भावी आसार को ध्यान में रखते हुए ऊँटों में वार्षिक-बाल उत्पादन कुल 763.50 ± 12.72 ग्राम आंका गया। बीकानेरी नस्ल के ऊँटों द्वारा अधिकतम वार्षिक बाल उत्पाद (933.85 ± 17.19 ग्राम) ऊँटों की अन्य नस्लों- जैसलमेरी व कच्छी की तुलना में, अधिक रहा। दूसरी ओर नर ऊँटों का बाल उत्पादन (717.24 ± 16.45 ग्राम) मादा ऊँटों (809.77 ± 18.20) की अपेक्षा ज्यादा था। बाल उत्पादन का आयु के आधार पर आकलन करने पर यह देखा गया कि इस हेतु प्रयुक्त 2 वर्ष, 4-6 वर्ष 1 वर्ष व 6 वर्ष की आयु से अधिक समूह की तुलना में तीन वर्ष की आयु के समूह में बाल-उत्पादन अधिकतम देखा गया।

गरम शुष्क क्षेत्रों में भारवाहन क्षमता के अध्ययन के अन्तर्गत ऊँटों को सिलवी पाश्चर क्षेत्रों में चरने हेतु छोड़ा गया। अध्ययन से यह पता चला है कि एक ऊँट को संतोषजनक चरने हेतु 5.33 हैक्टेयर का क्षेत्र आवश्यक है। अध्ययन से यह पता चला है कि ऊँट ग्रीष्मऋतु में मुराली, टोरटलिस्, पाला तथा फोग की अपेक्षा जाल की शाखाओं की पतियों को खाना अधिक पसन्द करता है। वर्षाऋतु में यह घास, क्रेपरस जैसे, दूधेली, बेकरिया, भुरट, कांटी, साटा व गंठियां आदि खाना पसन्द करता है जबकि सर्दियों में यह मुख्यतः उपलब्ध झाड़ियों जैसे- फोग, पाला, टोरटलिस्, मुराली आदि पर केर, बुई तथा खीप की अपेक्षा अधिक निर्भर रहता है। दूधारू मादा ऊँटों को हरी ग्रामना घास का अनुपूरण करने पर प्राप्त परिणाम में कुल गृहीत शुष्क मान, डी.सी.पी., टी.डी.एन., एम.ई. तथा समग्र दूध-उत्पादन गैर अनुपूरित समूहों की तुलना में बहुत अधिक रहा।

सिलवी पाश्चर विकास कार्यक्रम के अन्तर्गत भू-क्षेत्र में नवीन वृक्षारोपण कार्यक्रम को वन विभाग, राजस्थान सरकार, बीकानेर के साथ सहयोगिक तौर पर शुरू किया गया जिसमें खेजड़ी (प्रोसपिक्स् सिनेरिया), जारबेरी (जिजिपस् न्यूम्यूलरी), नीम, अरडू तथा ईजरायली बबूल के साथ-साथ एक पौधशाला लगाई गई।

चारा खाने वाले उष्ट्र-बच्चों को ग्वार फलगटी मिश्रित खुराक गुड़ (8.5 प्रतिशत), गेंहूं भूसी (5 प्रतिशत), ग्वार चुरी (5 प्रतिशत), खनिज मिश्रण (0.5 प्रतिशत) तथा सामान्य नमक (1 प्रतिशत) के साथ अनुपूरित करके खिलाया गया। परिणामों से यह ज्ञात हुआ है कि केवल ग्वार फलगटी खिलाये जाने की अपेक्षा उपरोक्त खुराक के अन्तर्गत केवल डीएमआई ही उच्च नहीं रहा अपितु इसके पाचनता की अनुपात मात्रा अवशेष तन्तु को छोड़कर सभी समीपस्थ परिमाणों में बहुत अधिक रही।

बीकानेरी ऊँटों में देर तक की अवस्था के दूध नमूनों का विश्लेषण किया गया। विश्लेषण से इस अवस्था में ठोस/घन, एसएनएफ, वसा, प्रोटीन, दूध, शर्करा तथा राख क्रमशः 9.70, 6.45, 3.25, 2.76, 2.84 तथा 0.85 प्रतिशत पाया गया। अम्लता एवं पीएच में परिवर्तन पर आधारित रहते हुए उष्ट्र-दूध को 37 डिग्री तापमान व 4 डिग्री

तापमान पर रखा गया। दूध की स्व:प्राणता 37 डिग्री तापमान (8 घंटा) पर रखने की तुलना में 4 डिग्री तापमान (8 दिन) पर रखने पर अधिक लम्बी पाई गई। प्रसव के पश्चात् नवस्तन्य व दूध नमूनों का 4 सप्ताह तक विश्लेषण करने पर यह ज्ञात हुआ है कि आरम्भिक अवस्था में नवस्तन्य/पीयूष प्रोटीन में प्रबल (17.6 प्रतिशत), वसा (0.1 प्रतिशत) में निम्न तथा अम्लता में उच्च रहता है। जैसे-जैसे समय निकलता है दूध के प्रोटीन अंश 2.66 प्रतिशत तक कम हो जाते हैं जबकि वसा अंश की बढ़ोतरी 3.78 प्रतिशत रहती है।

उष्ट लैक्टोफेरीन का अभिलक्षण-फलन प्रदर्श लोह-बन्धन तथा लैक्टोफेरीन व ट्रांसफेरीन दोनों को एक साथ मुक्त करते हुए देखा गया। सी व एन शिराओ से लोह का निस्तार भिन्न-भिन्न पीएच मान पर निष्पादन क्रमशः 6.5 व 4.0 ± 2.0 रहा।

एनएटीपी परियोजनाओं के अन्तर्गत केन्द्र में वर्ष 1999-2000 की एक एनएटीपी की परियोजना " भैंस, भेड़, बकरी व ऊँट आदि पशुओं की प्रजनन क्षमता में सुधार " आरम्भ हुई।

विस्तार कार्यक्रम:-

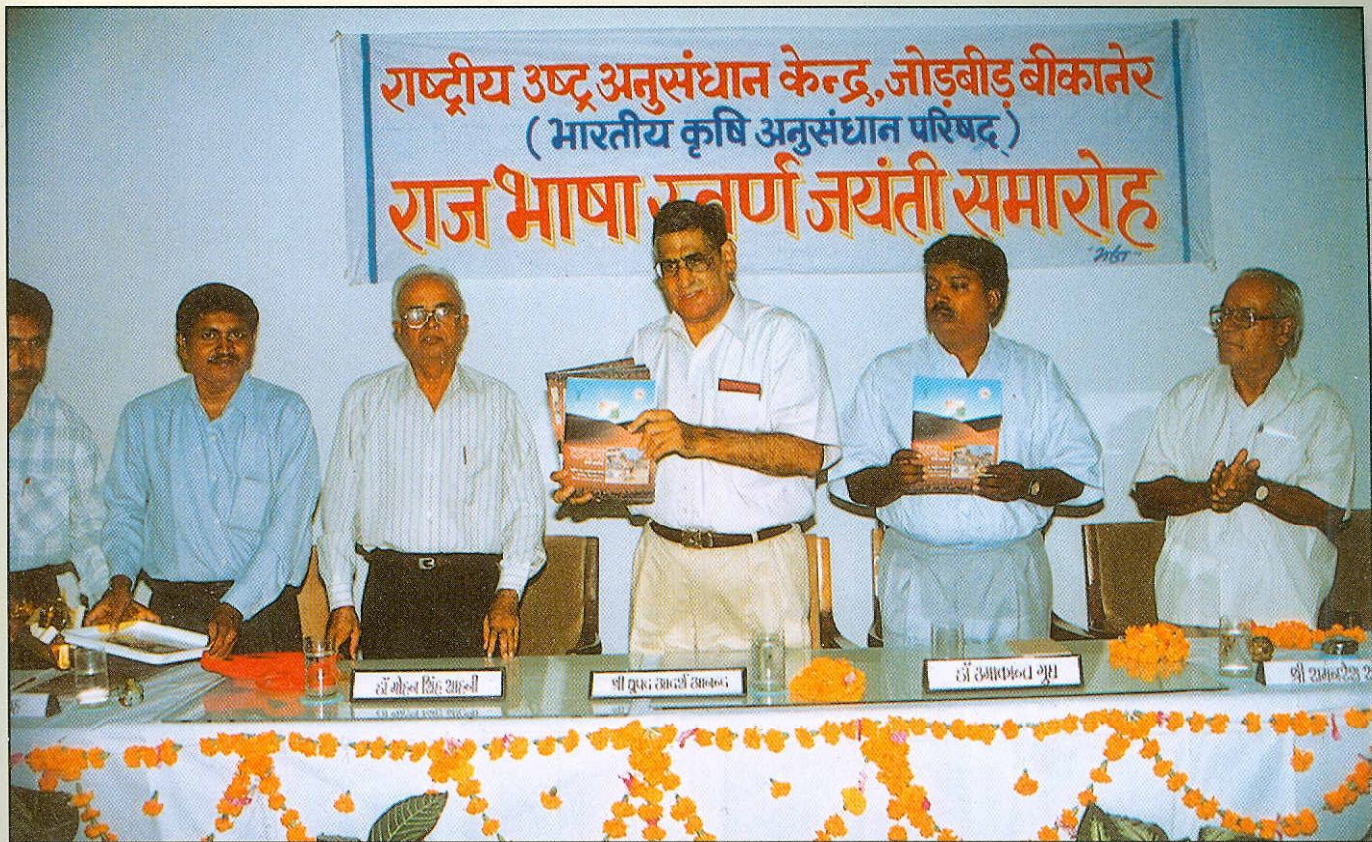
वर्ष के प्रजनन काल के दौरान आस-पास के ग्रामीण उष्ट्र पालकों की लगभग 200 मादा ऊँटनियों को उत्तम गुणवत्ता वाले बीकानेरी ऊँटों द्वारा नि:शुल्क सर्विस उपलब्ध करवाई गई।

राष्ट्रीय उष्ट्र अनुसंधान केन्द्र द्वारा पशु स्वास्थ्य शिविर अंगीकृत गांवों में लगाये गए। इन शिविरों के माध्यम से स्वास्थ्य सम्बन्धी समस्याओं का निराकरण किया गया। इसके अतिरिक्त तीन किसान गोष्ठी भी आयोजित की गई। किसानों द्वारा केन्द्र का भ्रमण किया गया तथा उन्हें ऊँटों के विभिन्न पहलुओं से सम्बन्धित जानकारी दी गयी। केन्द्र के विशेषज्ञों की उष्ट्र पालन के सन्दर्भ में अलग-अलग विषयों पर रेडियो वार्ता प्रसारित हुई। केन्द्र ने उष्ट्र-नस्ल की राष्ट्रीय स्तर की प्रतियोगिता में भाग लेते हुए कई ईनाम जीते। उष्ट्र पशु पालन विधियां और आधुनिक तकनीकी, केन्द्र की प्रगति-कैसें शीर्षक से, राष्ट्रीय-अन्तर्राष्ट्रीय व्यापार मेला, नई दिल्ली, 88 वीं भारतीय विज्ञान कांग्रेस, नई दिल्ली, उष्ट्र-उत्सव, 2001, रामदेव पशु मेला, नागौर, कृषि विज्ञान मेला, बीकानेर आदि आयोजित किए व भाग लिया।

राजभाषा स्वर्ण जयन्ती कार्यक्रमों के अन्तर्गत केन्द्र में नगर स्थित कार्यालयों के स्तर पर 'इस सदन की राय में हिन्दी को ही महत्व मिलना चाहिए' विषयक वाद-विवाद प्रतियोगिता का आयोजन रखा गया। स्वर्ण जयन्ती कार्यक्रमों के अन्तर्गत ही हिन्दी स्मारिका 'करभ' का प्रकाशन, हिन्दी निबन्ध प्रतियोगिता, सांस्कृतिक कार्यक्रम इत्यादि कार्यक्रम रखे गये।

अवसंरचना

केन्द्र में विकास कार्यों के अन्तर्गत उष्ट्र पोषण प्रयोगशाला में पीवीसी फर्श, विद्युत ओवरहैड लाईन तथा विद्युत पेनल बोर्ड बनाया गया। 4 किलोमीटर तक चारा भूमि में कांटेदार तार लगाई गई। नये शव परीक्षा स्थल का निर्माण, फार्म कैम्पस से फार्म कार्यालय तक रोड़ लाईट लगाई गई। सुरक्षा की दृष्टि से लोहे की ग्रील व द्वार लगाये गये। उष्ट्र संग्रहालय में डिस्पले बोर्ड लगाया गया। आवासीय कॉलोनी और कृषि भूमि को अलग-अलग करने के लिए पाईप लाईन लगाई गई।



करभ हिन्दी स्मारिका का विमोचन



Participation of NRCC in IITF - 2000

