



ANNUAL REPORT 1991-92



NATIONAL RESEARCH CENTRE ON CAMEL
BIKANER

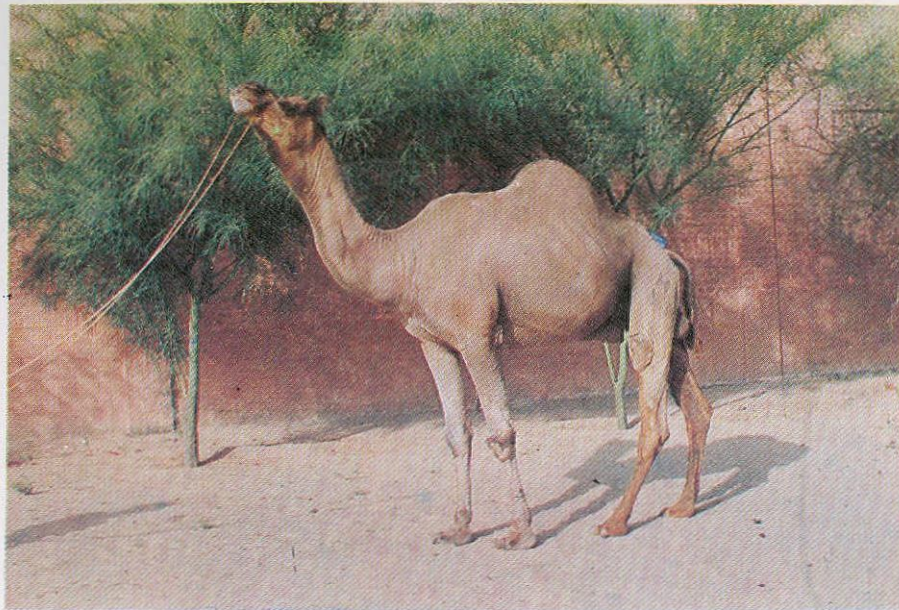


Fig. 6.2.1. Bikaneri Camel

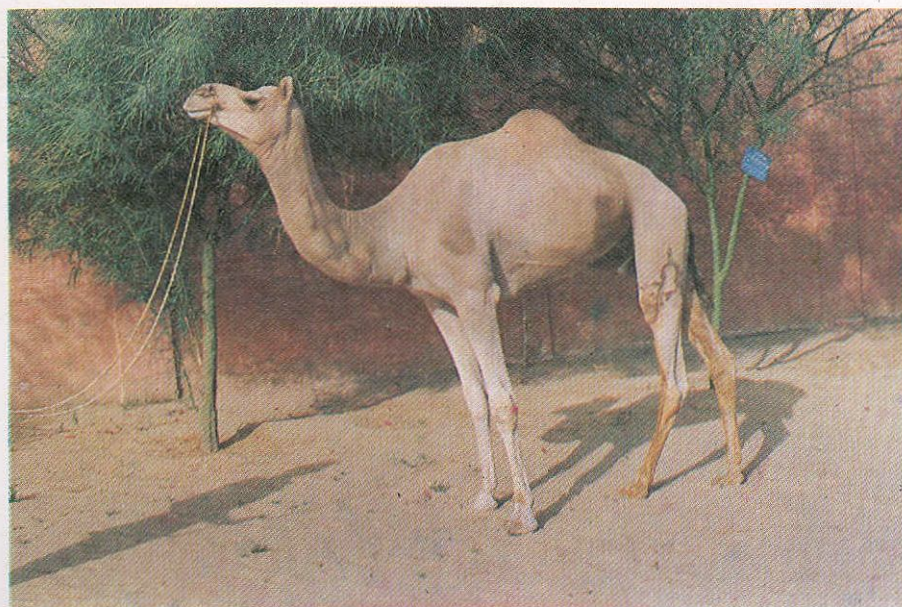


Fig. 6.2.2. Jaisalmeri Camel



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(Estd. 5th July, 1984)

PROJECT DIRECTOR : DR. N.D. KHANNA

NATIONAL RESEARCH CENTRE ON CAMEL
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PREFATORY REMARKS

The National Research Centre on Camel (NRCC) was established on 5th July, 1984 under the auspices of Indian Council of Agricultural Research, Ministry of Agriculture, New Delhi. This centre is located in the Jorbeer area at a distance of about 10 km from Bikaner city.

1.1 Rationale

Distribution of dromedary camels in India is presently confined to the dry lands of North-Western India. The majority of 0.32 m sq km hot arid zone is spread out in parts of Rajasthan, Gujarat, Haryana where camel is an important domestic animal. India has 1.45 m camels (base 1990) which is about 7.45% of the global camel population (19.45 m) and ranks third highest in the world after Somalia and Sudan.

Seventy percent of Indian camel population is concentrated in the state of Rajasthan. The highest camel density, 3.06 per sq km and 4.78 per 100 persons were observed in the eleven arid districts of Rajasthan having 208751 sq Km area. Camels in this part constitute almost 10% of the total domestic herbivore livestock biomass. There are over-whelming supporting evidences from archaeology, literature, arts, numismatics as well as religious and social aspects which reflected the presence and importance of camel in India from proto-historic period (c 3000-1800 BC) to the present time.

Due to restrictive resource endowment, livestock farming has an economic edge in the Indian dry lands. Camels constitute an influencing component of the desert eco-system and dry lands livestock production system. Presently, camel keeping forms an important vocation of the rural people in the dry lands. In the dry lands economy, camel plays many roles including transport, both wheeled and riding as a provider for agricultural

power, source for water carrying and subsistence in the rural system. Camel milk, hair, bone and hide are also utilised. A report from the National Bank for Agriculture and Rural Development has revealed that almost 70-80 % of loans were distributed in the arid region of Rajasthan for the purchase of camels and camel carts.

The credit flow was high in this sector and was predicted to increase to in years to come. Distribution of camel energetic in the western Rajasthan during 1961 to 1983 revealed 32% increase. The need of augmenting research for camel improvement is, therefore, beneficial to the people, particularly small and marginal rural farmers living in the arid zone.

1.2 Facilities and thrust

- The present sanctioned strength of scientist, technical and other staff is sixty. However, during next few years, it is proposed to increased upto 100.
- NRCC has modern laboratories and has very good infrastructural facilities. It has already generated large body of scientific data on the Indian camels.
- The centre has camel herd consisting of more than 250 animals belonging to four genetic groups namely Bikaneri, Jaisalmeri, Kachchhi and crossbreds between Arbi X Bikaneri.
- The centre has about 825 ha of range-land and very good progress had been made in improvement of pastures for browsing, grazing and camel fodder.
- Improvement in controlling mortality in camels has been achieved through developing packages of practices for management.
- Significant progress has been made in studies on draughtability on camels and work rest cycle. Studies are being conducted on physical, biochemical and haematological factors during stress of draught and riding at different terrains.
- Base line data on production and reproduction traits are being collected. Very useful data on camel genetics and breeding, cytogenetics, haematology, physiology, nutrition, hormone estimations during breeding and non-breeding season and reproduction has been collected.
- Significant improvement in breeding efficiency of herd has been achieved. The age at first service which was 1390 days in 1961-85 has been improved to 118 days in 1989-90, age at first calving from 1882 days to 1489 days and calving intervals from 770 days to 713 days. Studies

- were also conducted on birth weight, growth rate, herd dynamics and biometrical measurements in different camel breeds.
- The centre has provided research facilities for postgraduate and doctoral candidates of Universities and interinstitutional collaboration with different research organisations interested on camel research.
 - Research for utilisation of camel hair and milk has been initiated. Trials are undergoing to utilise the camel hair and its blend.
 - The centre provides free of charge services of genetically improved sires to female camels brought by the villagers in large numbers during breeding season.
 - In addition to this, the centre is also distributing the studs to the rural areas for breed improvement through state Animal Husbandry department.
 - Studies are under progress to study traditional camel management as practised in the field.
 - The centre has conducted one National Seminar and one Summer Institute on Camel Management and Health Control to provide specialised knowledge on camels to the field technical and research workers. The NRCC has basic facilities to impart training on various camel disciplines.
 - The National Research Centre on Camel, Bikaner has active collaboration with several other sister research institutions in the country.

1.3 Priorities

The priorities and thrust of the National Research Centre on Camel, Bikaner during 8th plan period will be :-

1. Camel genetic resource evaluation.
2. Camel genetic improvement.
3. Studies on camel draught and its improvement.
4. Investigations on nutritional requirements of camel, feed resource determination and evaluation.
5. Improvement of camel reproductive efficiency.
6. Improvement of camel health and research on major camel diseases, monitoring and surveillance and control.
7. Studies on traditional camel management, its improvement and socio-economic impact of camel keeping.
8. Camel products (milk and fibre) evaluation and utilisation.

N D KHANNA

PROJECT DIRECTOR

2.

STAFF POSITION

At the time of establishment of the NRCC, 23 positions were sanctioned during 1984. Subsequently additional 36 positions were added during 7 th plan period. Year-wise staff position is given in Table 2.1.

Table 2.1
Staff Position

Staff categories	Sanctioned posts			Positions filled (Year-wise)				
	VI	VII	Total	87-88	88-89	89-90	90-91	91-92
R.M.P.	1	-	1	1	1	1	1	1
Scientific	1	7	8	3	2	4	5	6
Technical								
Category I	2	1	3	3	3	3	3	3
Category II	-	3	3	1	3	3	3	3
Category III	2	2	4	3	3	3	3	4
Administrative	4	7	11	7	8	10	10	11
Auxiliary	2	3	5	3	5	5	5	5
Supporting	11	13	24	22	22	23	24	24

The name of the members in position during 1991-92 are given below:-

Project Director : Dr. N D Khanna

Scientific

Principal Scientist (Animal Physiology) : Dr. A. K. Rai

Senior Scientist (Animal Gen. & Breeding) : Dr. M. S. Sahni

Senior Scientist (Animal nutrition)	:	Dr. R.C. Jakhmola
Senior Scientist (Animal Gen. & Breeding)	:	Dr. S. N. Tandon
Senior Scientist (Animal Reproduction)	:	Vacant
Scientist (Animal Nutrition)	:	Dr. A. K. Nagpal
Scientist (Animal Physiology)	:	Sh. A.K. Roy
Scientist (Animal Biochemistry)	:	Vacant

Technical

Animal Health Officer, T-7	:	Dr. U.K. Bissa
Vety. Officer, T-6 (Livestock farm Supdt.)	:	Dr. Narendra Sharma
Farm Manager (Agri.), T-6	:	Sh. Ram Kumar
Vety. Officer, T-6	:	Dr. K.L. Mehrara
Agril. Asstt., T-II-3	:	Sh. J.C. Joshi
Library Asstt. T-II-3	:	Sh. Ram Dayal
Computer Opt., T-II-3	:	Sh. Dinesh Munjal
Livestock Asstt., T-I-3	:	Sh. Mohan Singh
Livestock Asstt., T-2	:	Sh. Ram Chandra Bheel
Lab. Tech., T-2	:	Sh. Nand Kishore

Administrative

Asstt. Adm. Officer	:	Sh. Santokh Singh
Asstt. Accounts Off.	:	Sh. N.D. Sharma
Supdt.	:	Sh. Ashok Malik
Stenographer	:	Sh. P.K. Nair
Junior Stenographer	:	Sh. Ram Kumar
Senior Clerk	:	Sh. Kanwar Pal
Senior Clerk	:	Sh. A.K. Yadav
Junior Clerk	:	Sh. Jamil Ahmed
Junior Clerk	:	Sh. Anil Kumar
Junior Clerk	:	Sh. Vishnu Kumar
Junior Clerk	:	Sh. K.K. Yadav

Auxiliary

Driver	:	Sh. Shivaji Ram
	:	Sh. Prabhu Dayal
	:	Sh. Mehboob Hussain
	:	Sh. Rafiq Alam
	:	Sh. Mani Lal

Supporting

SSG I to IV	:	24
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3.

FINANCIAL STATEMENT

During the year 1991-92, Rs. 65.00 lakhs were sanctioned under 'Plan' and Rs. 31.00 lakhs were sanctioned under 'Non Plan'. The expenditure during the year under 'Plan' was 43.66 lakhs and under 'Non Plan' was 28.89 lakhs. The details was provided in the table 3.1.

Table 3.1
Statement of expenditure

(Rs. in lakhs)

S.No.	Head of Account	1990-91				1991-92			
		Plan		Non Plan		Plan		Non Plan	
		B.E.	Exp.	B.E.	Exp.	B.E.	Exp.	B.E.	Exp.
1.	Estt. Charges	12.00	-	14.60	16.79	18.00	-	17.20	19.34
2.	T.A.	1.00	0.20	0.50	0.45	1.00	-	0.50	0.40
3.	Other Charges	21.00	16.02	11.80	10.55	23.00	30.75	12.50	7.38
4.	Equipment	-	4.13	-	0.77	-	5.38	-	0.80
5.	Works	16.00	15.51	1.50	-	23.00	7.53	0.80	0.97
Total		50.00	35.86	28.40	28.56	65.00	43.66	31.00	28.89

BE = Budget Estimate

4.

CAMEL HEALTH MANAGEMENT

4.1 Clinical Cases :

Cases of different ailments (209) were treated (table 4.1) out of these the highest morbidity (24.3%) was due to skin affections followed by wounds (23.0%), infectious diseases (10.9%) and digestive disorders (10.5%). The morbidity was maximum in Kachchhi breed followed by Bikaneri & Jaisalmeri.

4.2 Prophylactic measures :

(i) Animals and sheds were sprayed regularly with malathion insecticide (0.5%) twice a year for prevention and control of ectoparasites.

(ii) For controlling internal parasites broad spectrum anthelmintics were administered to the animal twice a year in the month of June and November.

(iii) Prophylaxis against trypanosomiasis consisted of administering quinapyramine sulphate and chloride twice a year (June & November). No positive case of trypanosomiasis was observed during the year.

(iv) Pregnant females, new born calves and breeding males were given Vit. A.

4.3 Mortality :

Breed wise standard death rate (SDR%) in Bikaneri, Kachchhi, Jaisalmeri and crossbred (Arab X Bikaneri) was 5.12, 9.81, 1.51 and 6.29% respectively. (Table 4.2). The age and sex wise mortality per 1000 camel days per day indicated highest in younger groups (0-3 months) followed by adults (Above 3 Years) (Table 4.3). In different age groups the mortality was slightly higher in males as compared to females.

Table 4.1
Age, sex and breed wise morbidity during year 1991-92

		Sex		Age			Breed				Total	Percent morbidity
		Male	Female	0-3 months	3-36 months	Above 3 yrs	Bikaneri	Kachchhi	Jaisalmeri	Cross bred		
1.	Diarrhoea	8	9	12	3	2	10	3	2	2	17	8.13
2.	Impaction	-	3	-	-	3	1	2	-	-	3	1.43
3.	Dyspepsia	-	2	-	1	1	-	2	-	-	2	0.95
4.	Bronchitis	1	1	-	-	2	1	1	-	-	2	0.95
5.	Pericarditis	-	1	-	-	1	-	1	-	-	1	0.47
6.	Lymphadenitis	6	6	-	12	-	7	2	2	1	12	5.74
7.	Metritis	-	1	-	-	1	-	1	-	-	1	0.47
8.	Retention after birth	-	2	-	-	2	2	-	-	-	2	0.95
9.	Hypovitaminosis A	13	-	-	-	13	10	2	1	-	13	6.22
10.	Thiamine deficiency	2	2	3	-	1	3	-	1	-	4	1.91
11.	Allergic dermatitis	8	9	-	9	8	12	2	3	-	17	8.13
12.	Fungal infection	8	9	-	17	-	7	5	5	-	17	8.13
13.	Mange	1	3	-	2	2	4	-	-	-	4	1.91
14.	Ticks infestation	4	9	-	11	2	8	4	1	-	13	6.22
15.	Wounds	27	21	-	3	45	31	10	6	1	48	22.96
16.	Lameness	2	2	-	-	4	4	-	-	-	4	1.91
17.	Polyarthritis	-	1	1	-	-	1	-	-	-	1	0.47
18.	Internal parasitic infestation	1	10	-	4	7	6	4	1	-	11	5.26
19.	Suspected for rabies	-	1	-	-	1	-	1	-	-	1	0.47
20.	Camel pox like lesions	10	12	-	22	-	12	5	4	1	22	10.52
21.	Unspecific and others	4	10	-	4	10	6	7	1	-	14	6.69
		95	114	16	88	105	125	52	27	5	209	

Table 4.2
Breed wise mortality during 1991-92

Breeds	Camel days	No. of animal died	Mortality per 1000 camel days/day	SDR%
Bikaneri	43665	7	0.1603	5.12
Kachchhi	20965	6	0.2819	9.81
Jaisalmeri	19035	1	0.0525	1.51
Arab cross	4775	1	0.2094	6.29
Pooled	88440	15	0.1696	5.36

Table 4.3
Age and sex wise mortality during 91-92

Age groups	Sex	Camel days	No. of animals died	Mortality per 1000 camel days/day
0-3 months	Male	1559	2	1.2828
	Female	2615	3	1.1472
	Pooled	4175	5	1.1978
3 months to 3 years	Male	11623	2	0.1720
	Female	17738	-	-
	Pooled	29361	2	0.0681
Above 3 years	Male	16206	4	0.2468
	Female	39285	4	0.1018
	Pooled	55491	8	0.1441
Over all	Male	29388	8	0.2722
	Female	59638	7	0.1173
	Pooled	89026	15	0.1684

5.

RANGE LAND MANAGEMENT

Range resource of the centre is 824 ha. The area is being fenced in phases and developmental activities are mainly confined to the fenced area.

About 24 ha grass pasture of Sewan (*Lasiurus indicus*) and Blue panic (*Panicum antidotale*) was maintained, out of which, 12 ha was added during the current year. About 4 ha was sown with rabi crop (*Oat & Chinese cabbage*). Farm produce supported about 17000 camel days grazing during the year. About 40,000 plants were maintained which included about 12000 new plantation of fodder trees. The main species were Bordi (*Ziziphus nummularia*), Khejri (*Prosopis cineraria*), Vilayati babool (*Prosopis juliflora*), Israeli Babool (*Acacia tortilis*), Siris (*Albizia lebbek*). Sand-dunes were levelled and planted with rootslips of grasses and trees.

6.

RESEARCH HIGHLIGHTS

6.1 To study work standards in camel and to associate work standards with physical, physiological and biochemical parameters

Project Code : P.I. 86/1-ICN/1-50/5220

Project Leader : A.K. Rai

Associates : N.D. Khanna

: A.K. Roy

6.1.1 Performance of camels at fixed draught in a loading car

The draught performance of 7 adult camels was assessed at 10, 15 and 20 percent of body weight as fixed draught in a loading car.

The endurance period observed was 1.12, 0.81 and 0.64 hrs and speed 3.54, 3.07 and 2.76 kmph under 10, 15 and 20 percent draught respectively (Table 6.1.1). The maximum tractive force was 113.2 ± 3.46 kgf and the horse power generated was 1.15 ± 0.075 at 20 percent draught. Significant differences were observed for these attributes.

The loss in body weight during the course of work performance could not be accounted for the loss on weight due to work passage of urine and defecation during period of working. Irrespective of the quantum of draught the animals lost body weight ranging from 5-7 kg which was approx. 1% of their body weight.

Increase in respiration rate was 7 to 24 per min (248%), pulse rate 41 to 60 per min (46%) and rectal temperature 36.5 to 38.7°C (6%). The increase in physiological responses due to different draught did not exhibit significant

differences.

Experiments on the effect of different watering schedule on the draught performance is under progress.

6.1.2 Comparative study on speed and strides of male and female camels at different gaits

The speed and strides of male and female camels were compared at walk, trot and gallop. The observations were recorded after a warming distance of about 3 to 4 km (Table 6.1.2). The speed of female was higher than males at all the three gaits.

The length of stride of male camels was more than the females at walk but during trot and gallop the differences were not significant. The percent increase in length of strides was higher in males from trot to gallop (52.5%), whereas, in females it increased by 37.9%, thus there was no significant difference in speed of male and female camels at gallop.

Different body measurements of camels were correlated with the length of stride and speed at all the three gaits. The neck length, leg length and height at withers were found to be positively correlated with the length of stride. The leg length and neck length showed a positive correlation with speed during trot and gallop.

6.1.3 Excretory and digestibility pattern during dehydration in summer

The study was conducted on 6 adult Bikaneri camels in June 1991. During the pre-experimental period of 4 months the animals were maintained on twice weekly schedule of watering. The animals were divided into 2 groups of 3 each. They were housed in shed open from 3 sides with facility for individual feeding and watering. The animals were fastened with urine and faecal collection bags. Both the groups were offered water *ad-lib* on day 1 of the experiment. No water was allowed to group I there after, whereas, group II continued to be on twice weekly schedule of watering and served as control.

The body weight, feed intake, urine and faecal matter voided were recorded daily. A record of water consumption of control camels was also maintained.

The dehydration continued upto 10 days and *ad-lib* water was offered to dehydrated camels on 11th day.

During the period of dehydration and rehydration the meteorological observations were as under :

Fig 6.1.1 Body weight changes during
dehydration & rehydration in summer

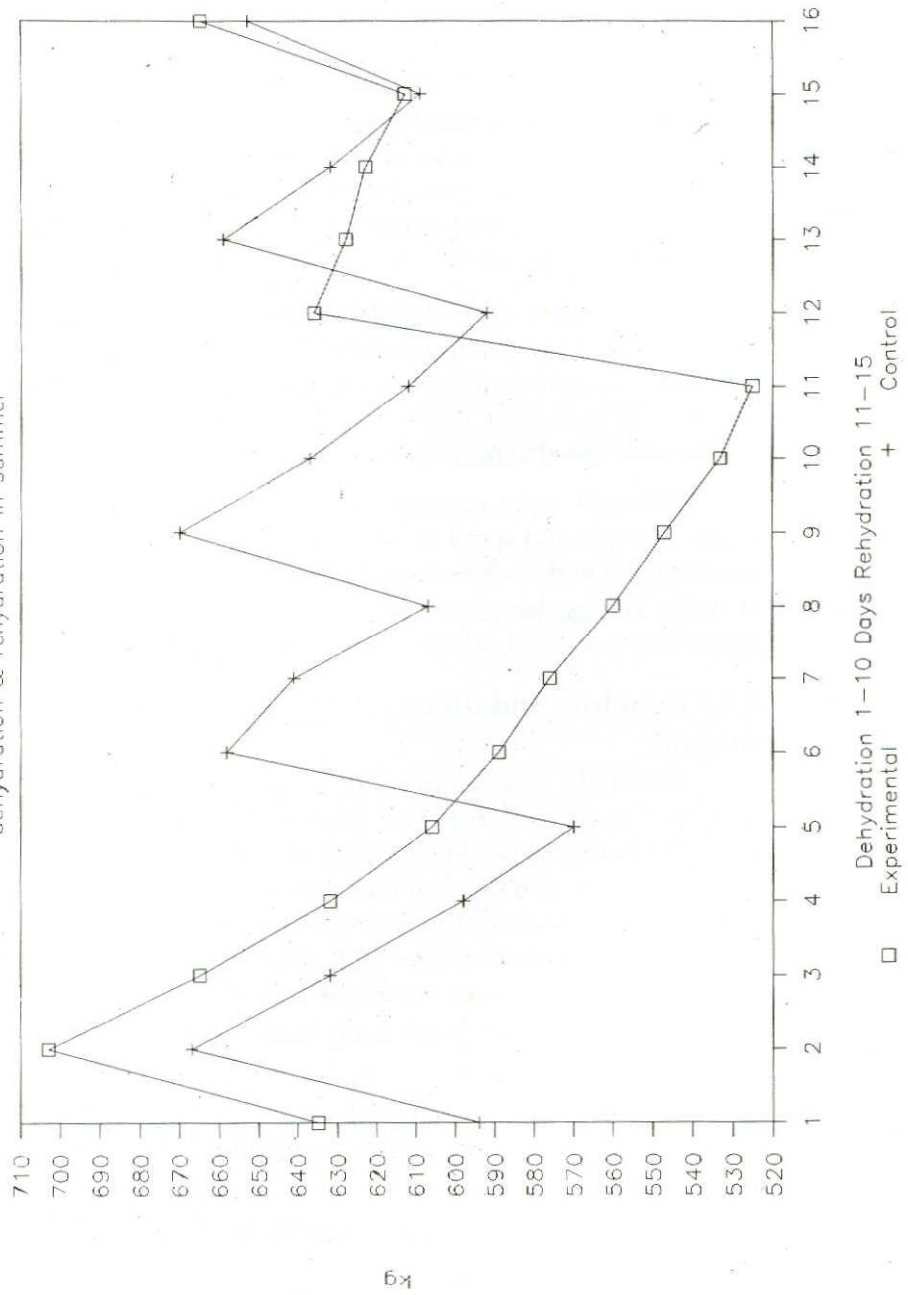
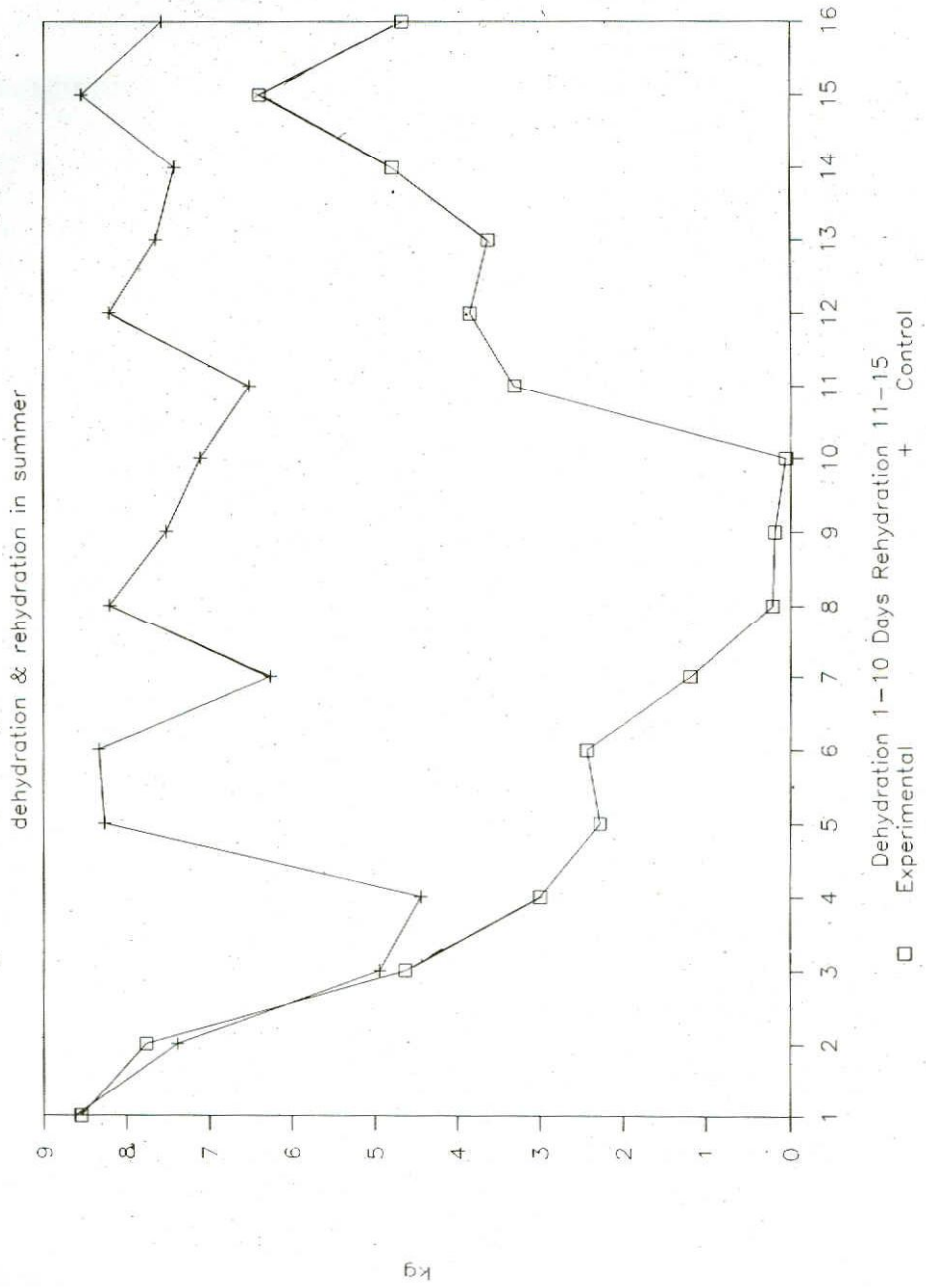


Fig. 6.1.1.2 Dry matter intake during



Ambient Temp. (°C)

Maximum 41.4 ± 0.93 °C (Range 33.9 - 47.0 °C)

Minimum 29.3 ± 0.99 °C (Range 20.7 - 33.8 °C)

Relative humidity (%)

8.00 AM 48.9 ± 3.73

3.00 PM 27.0 ± 2.50

Body weight changes :

The experimental camels lost 17% weight during 10 days dehydration (Fig. 6.1.1). The weight loss was gradual but continuous. The rate of fall in weight was higher initially i.e. 3-5% upto 6 th day followed by 1.5 to 2.8% upto 11th day.

The weight loss was compensated after rehydration within 5 days.

Control camels did not loose weight during the experiment. It was observed that in general the body weight increased by 13.8% (Range 11.3 - 15.4%) within 24 h of watering and subsequently weight was lost by 3.9, 8.7 and 12.1% on 2nd, 3rd & 4th day of watering, respectively.

Dry matter intake :

Dehydrated camels : The DMI decreased progressively from 13.5 to 2.0 g/kg b. wt. on day 7. The dehydrated camels consumed negligible quantity after 7th day onwards. On day 10 the decrease in DMI was 99.3% (Fig. 6.1.2) following rehydration the initial average DMI was not attained even upto 5th day.

Control camels : The control camels on an average consumed 11.7 ± 0.54 g/kg b. wt. dry matter per day during the experiment. In general after watering the DM intake increased by 39.6% followed by progressive fall of 17.0, 28.4 and 36.4% respectively after 24, 48 and 72 h.

DM voided :

The control camels on an average voided 2.85 ± 0.18 kg/d DM as faeces (4.53 ± 0.29 g/kg b. wt/d). The moisture content of faecal mass was 65 percent. It amounted to 5.15 ± 0.36 kg water loss per day through faeces.

On dehydration faecal output reduced from 3.32 ± 0.30 kg on day 1 to 0.28 ± 0.04 kg on day 10 (4.71 ± 0.38 g/kg b. wt. on day 1 to 0.46 ± 0.12 g/kg b. wt. on day 10). The reduction was 91.7%.

The moisture content of the faeces reduced from 65.2 to 24.4%. The average moisture loss through faeces 6.28 ± 0.75 kg on day 1 reduced to $0.09 \pm$

0.03 kg on day 10. The percent change in faecal moisture loss was 98.6 in dehydrated camels.

On dehydration the DM output (g/kg b wt/d) gradually increased but remained lower than normal values.

Water intake :

The water consumption of control camels was 107.2 ± 4.57 litres on the day of watering. This accounted for 180.9 ± 9.17 ml/kg b.wt. On an average 34.1 litre water was available through drinking and 0.5 litre through feed per day to each control. Thus total 34.6 litre water was available per day.

The experimental camels drank 113.5 ± 7.03 litre of water each before imposing dehydration (Fig. 6.1.3). During the period of 10 days dehydration 11.35 litre water was available through drinking and 0.195 litre through feed per day to each camel. On rehydration they consumed 120.4 ± 3.38 litre of water within 20 minutes. The intake of water after dehydration was almost similar to the intake of water before imposing dehydration.

During the entire experimental period the water available to the control animals was about 200 percent higher than the experimental camels on per day availability basis. The economy in use of water and regulatory responses for the excretion of waste products was exhibited by the volume of urine voided and sodium, potassium, urea and creatinine excreted in the urine.

Excretion of urine :

The control camels on an average excreted urine 3.8 ± 0.40 ml/kg b. wt. The volume of urine increased by almost 123% after watering. It reduced by 25.0, 48.7 and 55.2% respectively after 1, 2 and 3 days of watering (Fig. 6.1.4).

The excretion of urine in dehydrated camels after day 3 although lower but quite comparable to controls. The dehydrated camels on day 2 excreted 4.7 ± 1.00 ml/kg b. wt. This reduced to 0.5 ± 0.08 ml/kg b.wt. on day 11. Urine became dark brown in colour and of thick consistency; often white crystals were seen after day 7.

It was observed that the volume of urine excretion did not come to normal even after rehydration. There was a gradual increase in the volume and normal urine output was recorded only after 2nd watering.

Digestibility :

Control camels : Overall DM digestibility in controls was $60.2 \pm 2.54\%$.

Fig 6.1.3 Water intake during dehydration & rehydration in summer

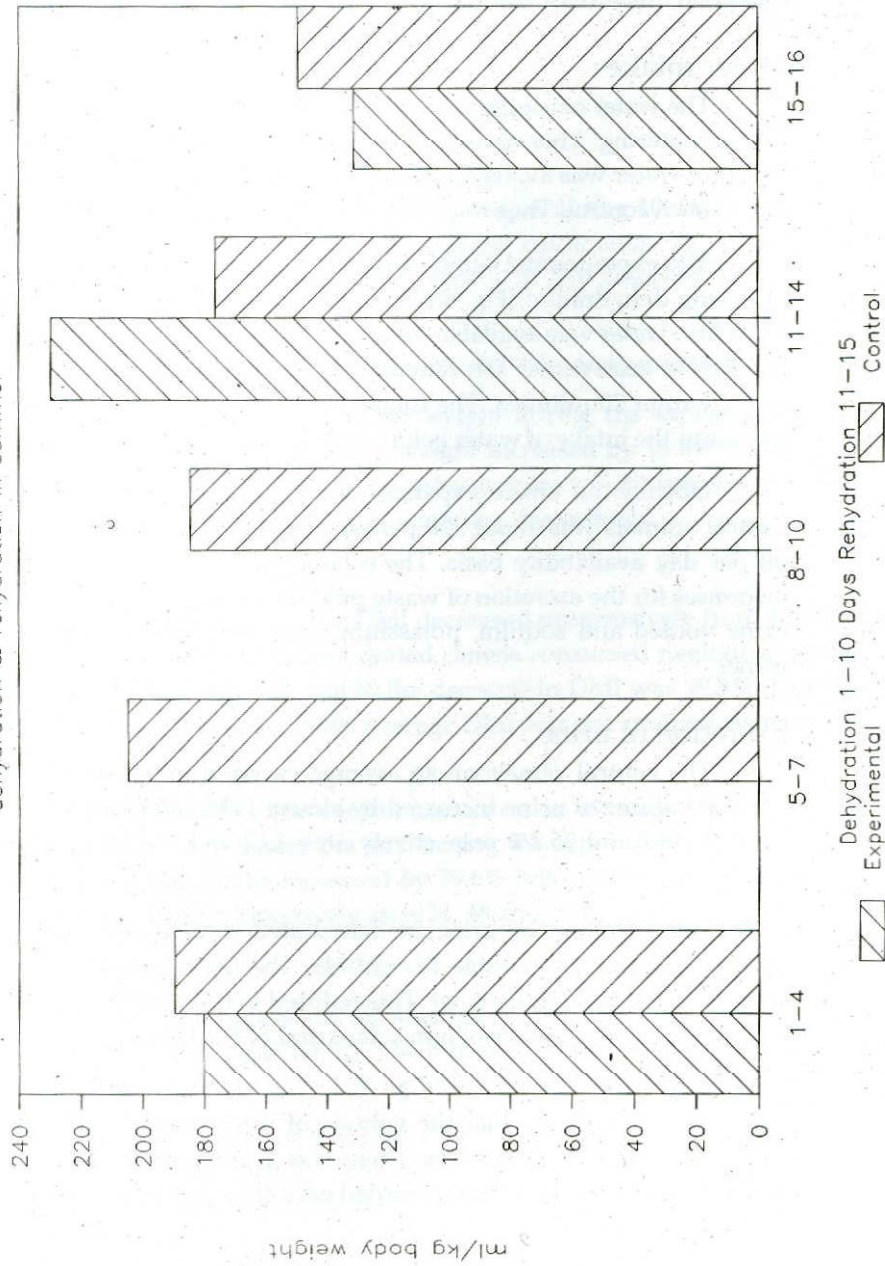
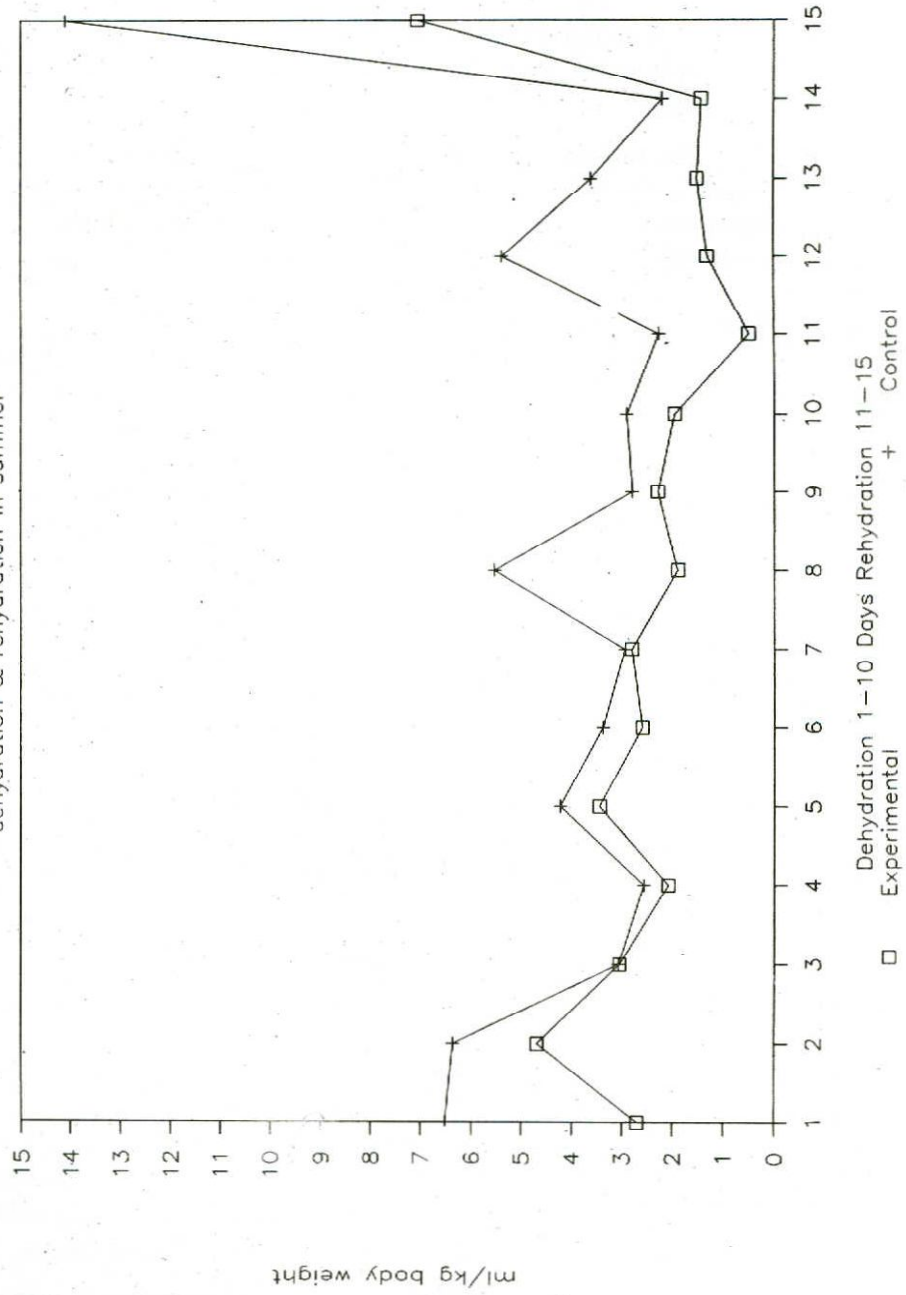


Fig 6.1.4 Excretion of urine during
dehydration & rehydration in summer



Dehydrated camels : The DM digestibility progressively declined upto 7th day and thereafter, the faecal DM output was more than DMI hence the DM digestibility was found negative upto 10th day.

Rehydration : The digestibility values increased very high shortly after water was made available and reached almost normal within 4 days of rehydration.

The digestibility coefficients of organic matter, crude protein, ether extract, crude fibre and nitrogen free extract showed trained similar to DM digestibility i.e. decline after dehydration and approaching normal initial levels within 4 days of rehydration (Fig. 6.1.5).

Nitrogen balance

With the advancement of period of dehydration the animal came to negative balance of nitrogen (-10.86 ± 14.68 g/day) on 5th day and reached -30.60 ± 2.67 g/day on 10th day. Immediately after rehydration the animals were found to be in positive balance of nitrogen 25.85 to 39.09 g./day (Table 6.1.3).

Excretion of Sodium in urine

The average excretion of sodium in control camels was 21.3 ± 2.41 mEq/ 1 (Range 9.0 to 40.5 mEq /1). On dehydration sodium excretion sharply increased day 4 onwards upto day 10. It ranged from 38.0 to 310.6 mEq/ 1 showing an increase of 243 percent.

Average excretion of sodium in control camels ranged from 0.65 to 2.16 g/d (Average 1.16 ± 0.14).

On dehydration, sodium excretion per day increased sharply from day 4 to day 7 (6.41 to 13.10 g/d). It showed a declining trend from day 8 to day 10 (7.62 to 4.98 g/d; Fig. 6.1.6). On rehydration the excretion of sodium (mEq/ 1 and g/d) returned to normal levels comparable to controls within 24 hrs.

Excretion of Potassium in urine

Wide variation in excretion of potassium was observed in control camels. It ranged from 114.1 ± 53.84 to 670.4 ± 87.20 mEq/ 1 . Total potassium voided through urine ranged from 9.4 ± 5.45 to 45.2 ± 11.21 g/d, average being 30.8 ± 2.76 g/d. The excretion of potassium in urine on an average declined by 57% within 24 h after each watering and gradually increased on day 2, 3 and 4 respectively by 2.5, 149.0 and 130.3%.

In dehydrated camels the excretion of potassium in urine decreased from 704.0 ± 33.06 on day 3 to 150.4 ± 23.08 mEq/ 1 on day 12. The fall in

5

Fig 6.1.5 Digestibility coefficient of nutrients during dehy. & rehy. in summer

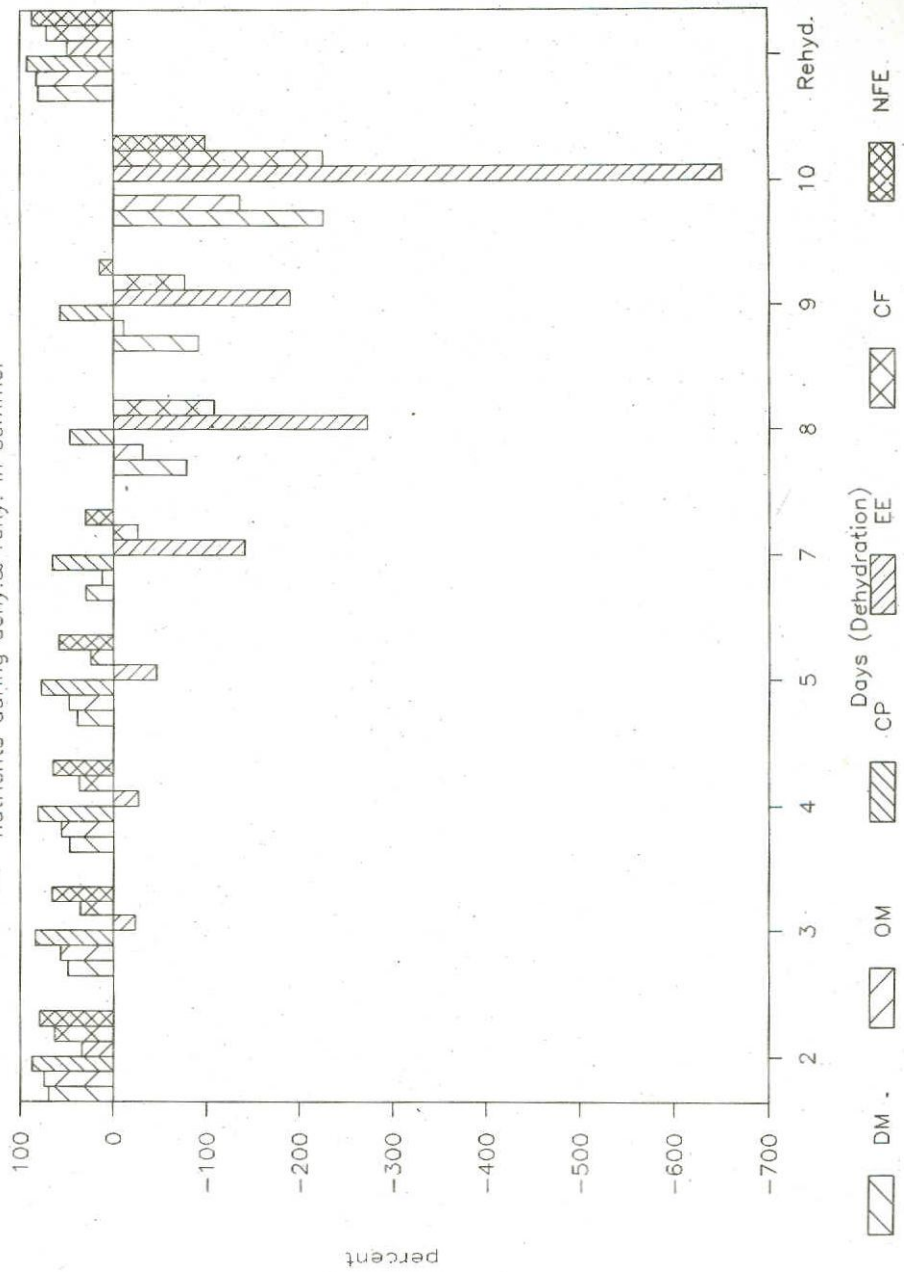
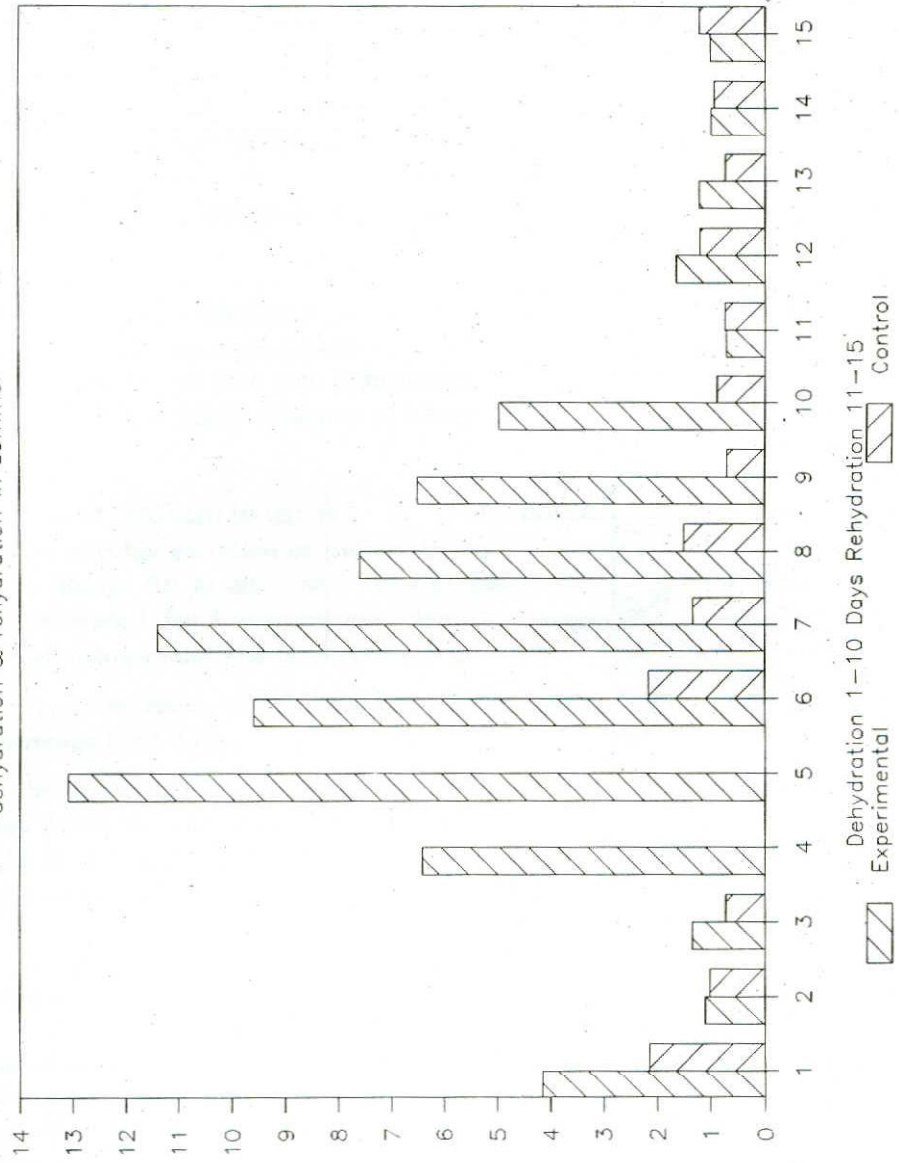


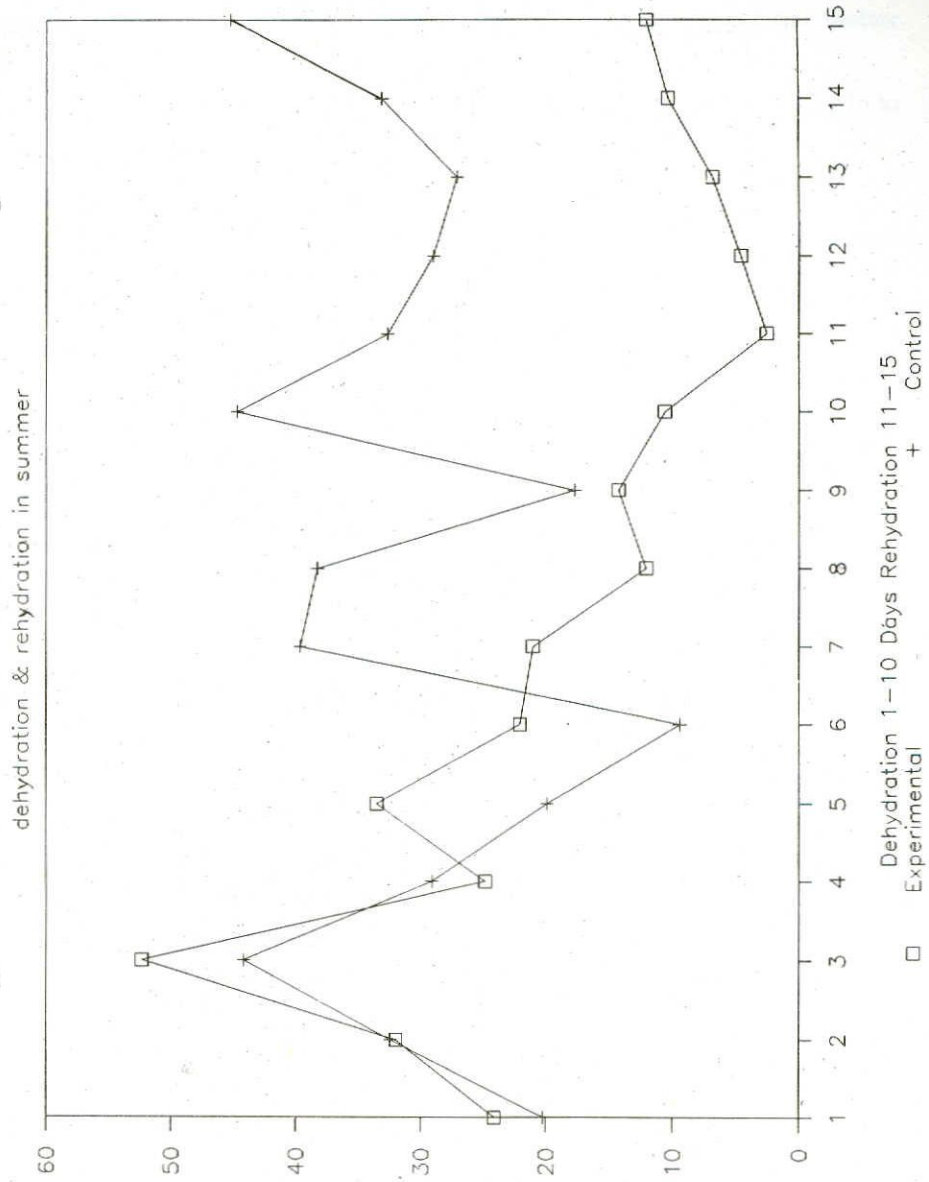
Fig 6.1.6 Sodium in urine during

dehydration & rehydration in summer



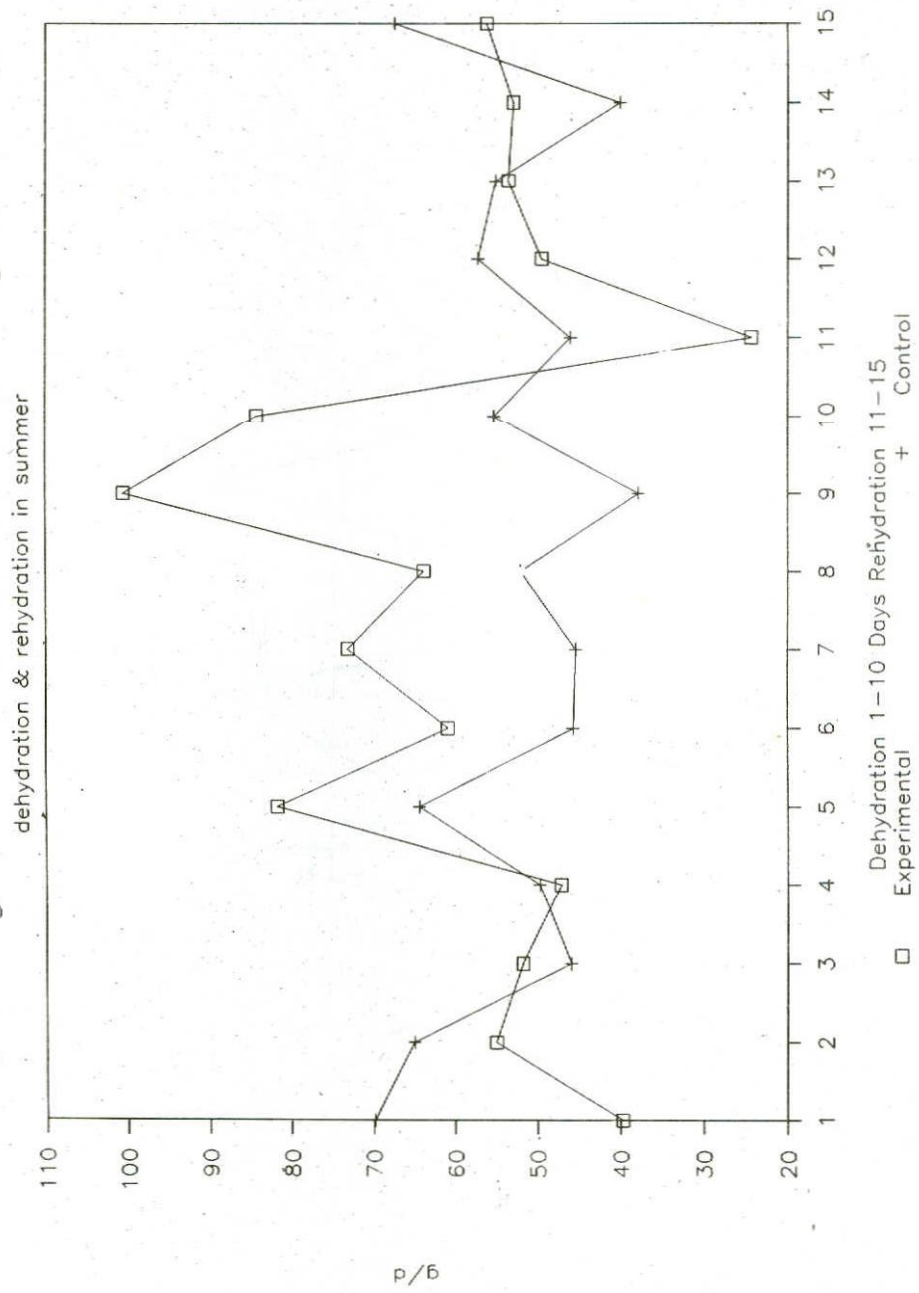
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Fig 6.1.7 Potassium in urine during



p/6

Fig 6.1.8 Urea in urine during



potassium excretion continued even after 48 h of rehydration. Total declined in excretion of potassium was 78.7%.

Even after 5 days of dehydration normal pattern of excretion of potassium was not observed. This was obviously linked with the dry matter intake after rehydration.

The total excretion of potassium per day decreased from 52.3 ± 14.16 to 2.6 ± 0.68 g from day 3 to day 11. The decrease was 95% (Fig. 6.1.7).

Urea excretion in urine

Control camels on an average excreted urea 28.0 ± 1.42 mg/ml (Range 18.3 ± 7.96 to 36.1 ± 13.89 mg/ml). The total urea in urine per day was 53.2 ± 2.60 g (Range 37.9 ± 15.41 to 69.9 ± 10.80 g/d).

Urea excretion in dehydrated camels gradually increased from day 3 to day 10 (Fig. 6.1.8). The overall increase was about 300% (day 1st 20.8 ± 1.17 to 82.8 ± 4.66 mg/ml on day 10 th). Total excretion (g/d) increased by 153% (Range 39.7 ± 6.06 to 100.6 ± 15.93 g/d). The normal level of urea in urine was attained within 5 days of rehydration.

Creatinine excretion in urine

Average value of creatinine in urine of control camels was 0.95 ± 0.14 mg/ml (Range 0.23 ± 0.15 to 1.80 ± 0.78 mg/ml). The total creatinine in urine per day was 1.69 ± 0.23 g (Range 0.48 ± 0.12 to 3.45 ± 1.47 g/d).

The level of creatinine in urine of dehydrated camels increased from 0.40 ± 0.13 on day 1 to 4.60 ± 1.69 mg/ml on day 10. The creatinine level further increased on day 11 (8.00 ± 3.03 mg/ml) within 24 h of rehydration amounting to an increase of 1916 %.

The normal level of creatinine in urine was, however, attained on 15th day i.e after 5 days of rehydration.

The total excretion of creatinine in urine per day increased from 0.71 ± 0.16 to 6.66 ± 0.83 g/d on dehydration (Fig.6.1.9). The increase was 836%.

Fig 6.1.9 Creatinine in urine during

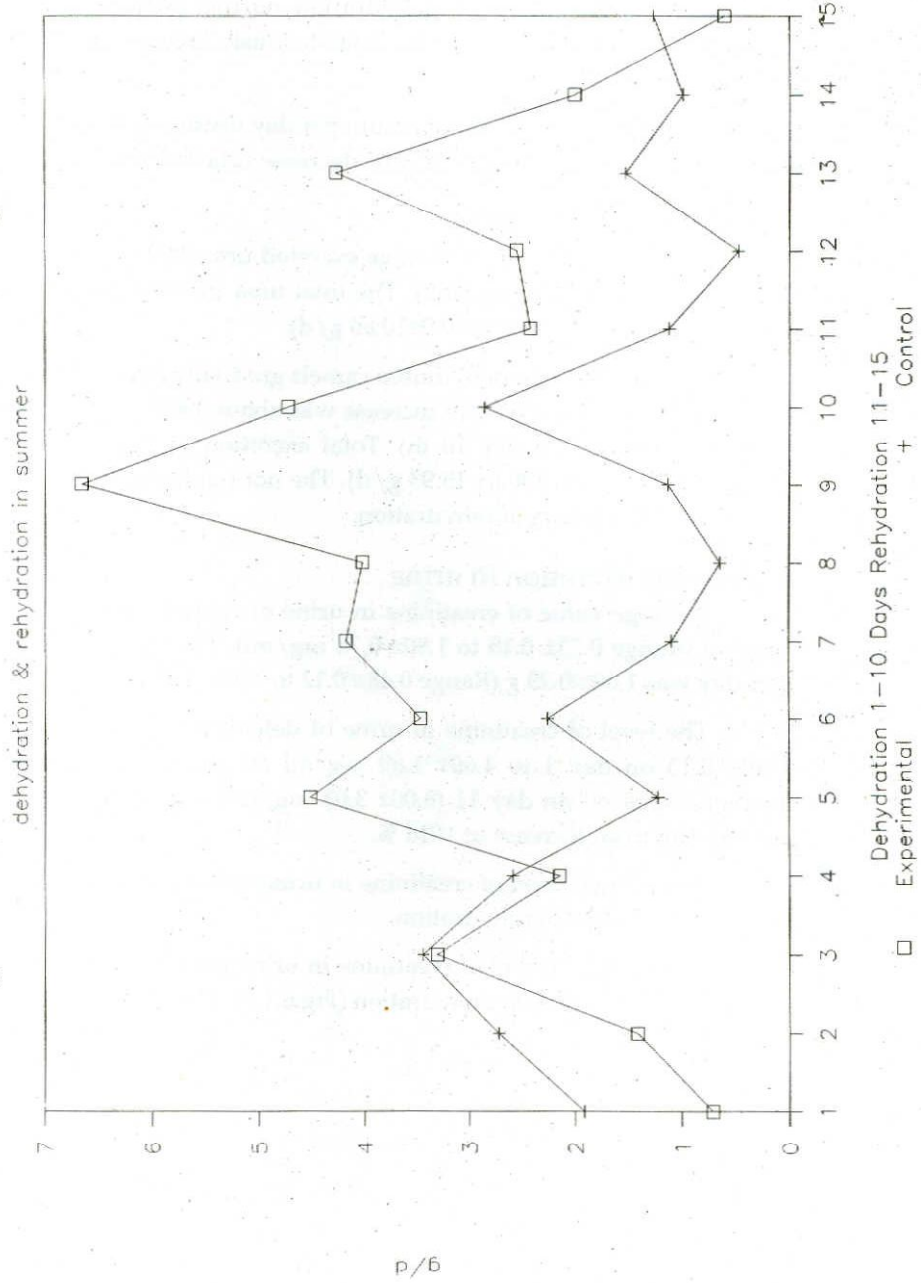


Table 6.1.1
Draught performance of camels in a loading car

Parameters	Draught (% Body weight)		
	10	15	20
Endurance period (hr)	1.12 ± 0.12	0.81 ± 0.82	0.64 ± 0.04
Speed (kmph)	3.54 ± 0.07	3.07 ± 0.14	2.76 ± 0.19
Tractive force (kg)	56.03 ± 1.65	88.16 ± 1.64	113.23 ± 3.46
Horse Power (hp)	0.73 ± 0.02	1.00 ± 0.05	1.15 ± 0.08
Loss in body weight (%)	0.86	1.16	0.91
Increase in respiration rate (%)	224.57	261.86	256.43
Increase in pulse rate (%)	50.36	40.34	46.40
Increase in rectal temperature (%)	6.35	6.23	5.27

Table 6.1.2
Speed and strides of male & female camels

	Walk	Trot	Gallop
Speed (km/h)			
Male	6.01 ± 0.058	13.89 ± 0.577	25.70 ± 1.472
Female	6.45 ± 0.105	16.36 ± 0.768	26.97 ± 0.333
Duration of stride (sec)			
Male	1.48 ± 0.030	0.78 ± 0.009	0.64 ± 0.021
Female	1.33 ± 0.024	0.72 ± 0.020	0.60 ± 0.018
Stride/sec			
Male	0.68 ± 0.014	1.28 ± 0.016	1.55 ± 0.050
Female	0.75 ± 0.013	1.40 ± 0.039	1.67 ± 0.058
Length of stride (m)			
Male	246.18 ± 4.404	301.12 ± 11.619	459.16 ± 17.748
Female	235.59 ± 2.588	324.24 ± 13.693	447.13 ± 24.565

Table 6.1.3
Nitrogen balance (g/d) during dehydration and rehydration in summer

Days	Nitrogen intake	Nitrogen excretion		Nitrogen balance
	Feed	Faeces	Urine	
Dehydration				
2	118.77 ± 11.04	15.69 ± 2.37	23.75 ± 5.65	79.33 ± 3.55
3	70.87 ± 11.05	11.67 ± 1.86	16.51 ± 1.99	42.69 ± 8.39
4	46.23 ± 7.13	8.92 ± 1.47	17.83 ± 1.49	19.48 ± 5.62
5	34.96 ± 3.14	8.09 ± 0.94	37.73 ± 12.51	-10.86 ± 14.68
7	18.20 ± 4.79	4.90 ± 0.39	31.32 ± 5.91	-18.02 ± 9.84
8	3.36 ± 1.73	2.56 ± 0.07	22.30 ± 6.31	-21.50 ± 14.32
9	2.88 ± 1.66	2.02 ± 0.56	28.81 ± 5.04	-27.95 ± 4.90
10	0.96 ± 0.48	1.51 ± 0.21	30.05 ± 2.71	-30.60 ± 2.67
Rehydration				
1	50.75 ± 3.44	3.01 ± 1.10	8.65 ± 1.62	39.09 ± 5.36
2	58.91 ± 2.99	1.48 ± 0.15	28.23 ± 8.56	29.20 ± 6.37
3	55.56 ± 11.65	5.16 ± 0.26	24.54 ± 2.34	25.85 ± 13.66
4	73.27 ± 4.15	9.26 ± 0.42	29.44 ± 1.68	34.58 ± 5.65
Control				
	108.98 ± 4.50	18.97 ± 2.41	25.53 ± 5.75	63.14 ± 8.68

6.2 Studies on quantitative and qualitative genetic parameters in Indian camels

Project code No. P.I. 86/2-ICN/L-10/5220

Project Leader : M.S. Sahani
Associate : N.D. Khanna
: S.N. Tandon

The Indian camel population presently is around 14 lakhs mostly confined to north western dry region of the country. Ten breeds/strains of Indian camel having specific characteristics inhabiting different breeding tracts are (1) Bikaneri, (2) Jaisalmeri (3) Kachchhi (4) Marwari (5) Mewari (6) Sindhi (7) Shekhawati (8) Riverine (9) Mewati and (10) Double humped camels. In this country, camels are mostly used for draught and riding purposes, though camel milk is also utilised as by product. Among all, the Bikaneri breed is most famous and widely distributed and mainly developed for draught and baggage (Fig. 6.2.1). Jaisalmeri is gracious riding camel breed (Fig. 6.2.2). The camels of Kachchhi breed are heavy set and good milch animals (Fig. 6.2.3). These animals are also very good for draft, though bit slow. Mewari camels are comparatively short stature and have been developed as hill camel. Heavy riverine camels are available in the areas having good rainfall and these animals are mostly used for hauling heavy cart loads. Limited number of double humped bactarian camels are also available in the Ladhak district of Jammu & Kashmir state of India.

Three breeds namely, Bikaneri, Jaisalmeri and Kachchhi are being studied. The salient characteristics of these breeds are presented in (Table 6.2.1 - 6.2.3).

Table 6.2.1
Average body weights (kg) in different age groups of three
Indian camel breeds.

Body weight	Bikaneri		Jaisalmeri		Kachchhi	
	Male	Female	Male	Female	Male	Female
At birth	42.15	38.82	36.86	34.69	33.95	31.47
	± 0.77	± 0.64	± 1.18	± 1.88	± 0.96	± 1.33
6 months	170.13	176.67	183.00	170.00	181.20	169.14
	± 4.26	± 5.54	± 7.02	± 5.40	± 5.22	± 8.31
1 year	229.18	223.00	226.00	201.20	202.00	201.83
	± 4.03	± 7.41	± 23.80	± 13.50	± 4.71	± 7.25
2 year	273.25	263.33	264.00	225.75	293.60	279.16
	± 5.82	± 14.55	± 30.12	± 17.68	± 26.77	± 5.22
3 year	391.50	340.00	N A	341.43	378.25	N A
	± 12.38	± 11.15	N A	± 9.12	± 8.64	N A
Adult	617.33	577.83	574.80	537.00	576.75	563.74
(4 years and above)	± 17.02	± 9.79	± 12.73	± 11.61	± 44.73	± 14.73

N A = Not available

Table 6.2.2
Body measurements and weights of adult camels in three
Indian breeds

Body measurements (cm)	Bikaneri		Jaisalmeri		Kachchhi	
	Male	Female	Male	Female	Male	Female
	n=10	n=20	n=5	n=3	n=6	n=10
Leg length						
Fore	151.44	140.60	150.60	140.28	150.33	138.20
	±1.78	±4.12	±3.12	±2.68	±2.48	±1.38
Hind	160.55	149.60	162.00	150.28	161.50	145.80
	±2.08	±3.29	±1.99	±2.62	±1.61	±1.52
Body length	165.70	158.20	156.40	157.28	156.33	158.00
	±2.06	±4.32	±1.62	±1.38	±6.76	±4.93
Heart girth	223.11	215.00	210.20	211.28	206.33	214.30
	±2.55	±4.22	±3.06	±2.34	±5.78	±2.99
Height at withers	209.22	195.60	206.40	191.85	195.83	189.80
	±2.55	±5.45	±2.37	±2.12	±4.09	±3.29
Neck length	129.77	120.00	119.60	115.28	111.66	115.40
	±3.27	±3.56	±2.93	±2.20	±5.27	±1.61
Circumference of foot pad						
fore	73.89	67.40	75.60	66.42	75.66	68.20
	±1.77	±1.20	±1.02	±1.11	±2.83	±0.81
Hind	62.44	59.20	64.60	56.85	66.50	59.90
	±0.89	±1.15	±0.98	±0.88	±1.28	±0.99
Circumference of neck						
at base	113.44	92.60	98.00	92.85	97.33	94.30
	±5.48	±2.35	±2.99	±1.85	±6.88	±2.14
at head	74.00	57.80	64.00	56.71	66.61	54.90
	±1.64	±1.35	±1.81	±0.97	±3.49	±0.99
Face length	56.25	54.67	58.25	54.33	61.00	57.00
	±2.86	±1.20	±1.87	±1.20	±1.08	±0.58
Body weight (kg)	668.44	592.00	578.20	592.57	633.66	533.40
	±19.43	±25.73	±14.13	±19.60	±48.04	±30.15

n = number of observations.

Table 6.2.3
Reproductive & productive parameters of three Indian camel breeds.

Traits	Bikaneri	Jaisalmeri	Kachchhi
Gestation length (days)	381.85 ±1.17 (111)	384.72 ±3.88 (18)	381.67 ±5.69, (27)
Age at first Service (days)	1424.97 ±41.41 (66)	1412.99 ±16.50 (2)	1094.50 ±3.42, (6)
Age at first calving (days)	1855.51 ±40.18 (75)	N A	N A
Calving interval (days)	741.89 ±9.83 (91)	676.00 ±19.36 (5)	738.40 ±10.69 (10)
Milk yield lit/day	3.8-11.0	3.0-8.0	5.2-14.6
lit/day (at peak)	14.0	N A	18.0

Figures in parentheses indicate number of observations

N A = Not available

Herd structure

During the year the opening and closing strength of herd was 248 and 262 camels respectively (Table 6.2.4). The breed wise opening strength in Bikaneri, Jaisalmeri, Kachchhi, crossbreds, Arabi and Marwari was 125,51,59,11,1 and 1, respectively and the closing strength in same order was 125,64,57,14,1 and 1 camels, respectively. During the year, there were 38 calvings. Seven camels (2 males of Bikaneri and 4 males and 1 female of Jaisalmeri breed) were purchased. In the current year, disposals due to auction and sale were 13 and 3 respectively. Fifteen camels died during the year.

The ratio of males to females at the beginning of year was 1 : 2.03 and at the end of year was 1 : 1.76. The age wise composition of herd is presented in figure 6.2.4. The reproductive parameters are presented in Table 6.2.5.

Body weights and measurements

The breedwise monthly body weights and body measurements of the calves born during 1991-92 are presented in Table 6.2.6. The average birth weight in Bikaneri, Jaisalmeri, Kachchhi and crossbreds (Arabi x Bikaneri) groups were 38.43 ± 0.91 , 38.53 ± 1.24 , 30.75 ± 1.99 and 38.8 ± 2.23 kg respectively. The Bikaneri, Jaisalmeri and cross-bred groups did not show any marked variation in weight and at birth and at one month of age, whereas the Kachchhi calves were significantly ($P < 0.01$) lighter as compared to other breeds. The second and third month body weights did not reveal any significant differences although, Bikaneri, calves were found to be heavier among all the other breeds at 2 months of age followed by crossbreds, Jaisalmeri, and Kachchhi breeds.

The biometrical measurements (body length, height and heart girth) at birth in Bikaneri breed were highest followed by Jaisalmeri, crossbreds and Kachchhi breeds. The breed and sex significantly ($P < 0.05$) affected the weight at birth.

The average daily gain during first month in Bikaneri, Jaisalmeri and Kachchhi calves was 616.3, 660.0 and 563.3 g. The average daily gain during second month in Bikaneri and jaisalmeri calves was 553.3 and 546.6 g respectively.

Sire effect on body weights

The sire-wise least square means for weight at different stages of growth (birth to 3 years) in different camel breeds are presented in Table 6.2.7. The Bikaneri camel calves were heavier than Jaisalmeri and Kachchhi calves. The sex effect was found to be significant ($P < 0.01$) in Bikaneri breed at

Fig 6.2.4 Age wise composition of herd at N.R.C.C.

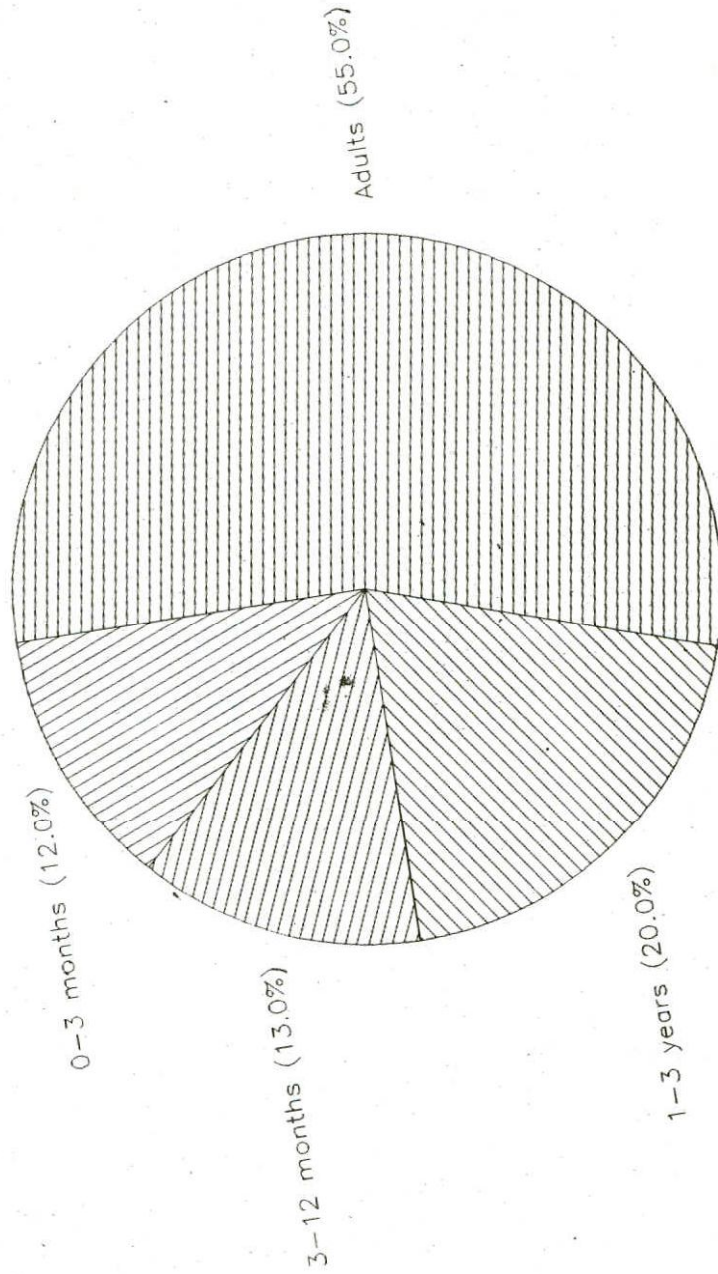
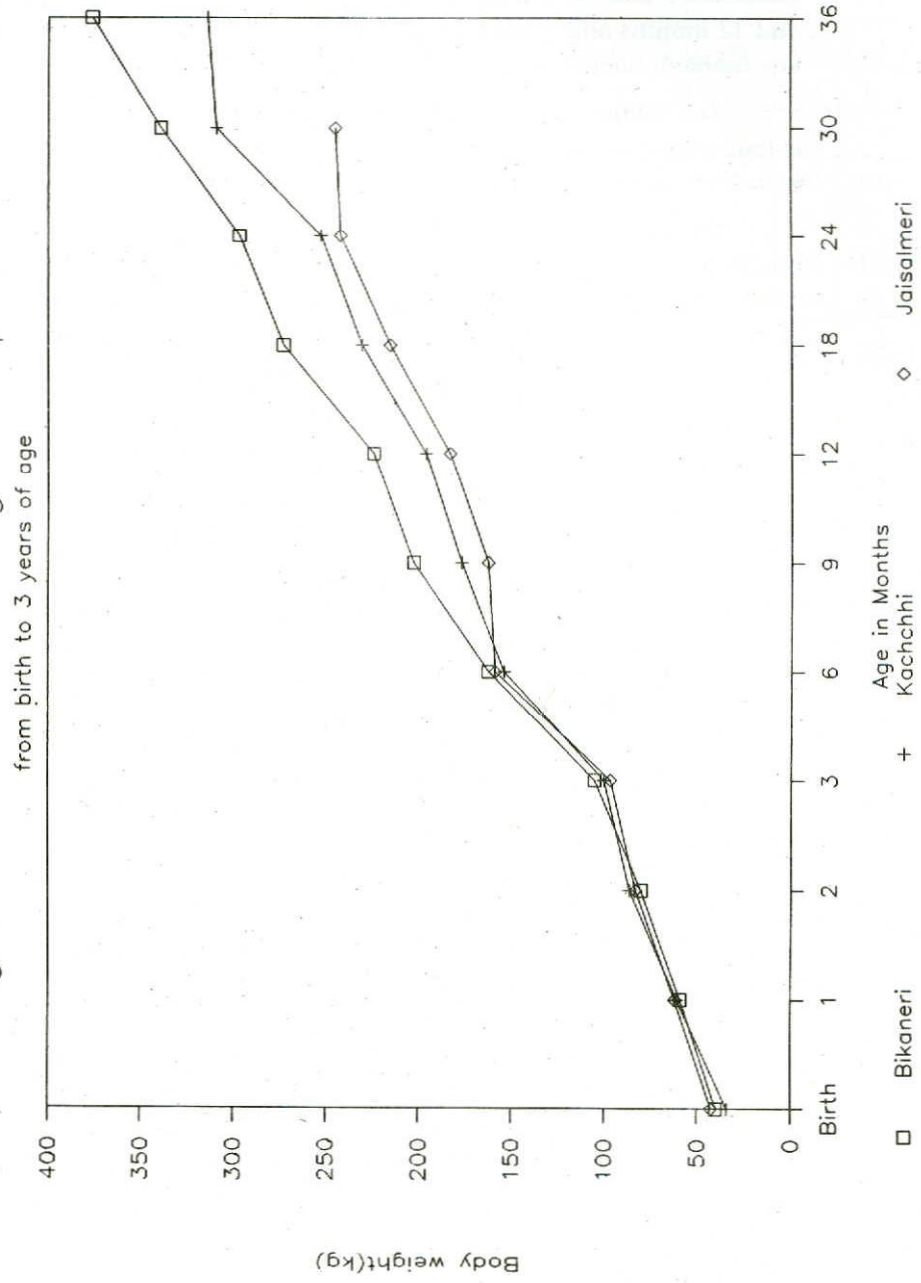


Fig 6.2.5 Breed wise growth pattern



birth and at 3, 6, 9 and 12 months of age whereas the sire effect was significant ($P<0.01$) at 6 and 12 months of age and at 2 years of age. In Kachchhi breed the contribution of sire 6 was significant ($P<0.01$) at 3, 6, 9 and 12 months and 2 years of age. The contribution of sire 5 did not show any marked differences upto 12 months of age.

The biometry viz. body length, height and heart girth and body colour were recorded for various sires used for breeding in different breeds in order to estimate contribution of individual sires.

The monthly body weights from 1 - 2 year of age indicated that Bikaneri and Jaisalmeri breeds were heavier than Kachchhi breed. The average body weight at 3 to 4 years of age in Bikaneri camels were found to be higher than Kachchhi and Jaisalmeri breeds. Breed wise growth pattern from birth to 3 years is presented in figure 6.2.5.

Milk production

Month wise daily milk production of front and rear teats and their total was recorded in six lactating Bikaneri females (Table 6.2.8). The milking was recorded twice a week at 8 and 16 hrs of interval by hand. The daily production during different months of lactation varied from 3.99 ± 0.24 l/d to 7.04 ± 0.55 l/d. The monthly milk production indicated increasing trend upto 7 th month of lactation and thereafter it started declining. The production from the rear teats was higher than the front teats by 23.4 to 35.4% at different stages of lactation except for first two months where the difference was not significant. The Dry matter, fat and solid not fat in milk varied from 9.85 to 10.81, 2.34 to 3.38 and 7.22 to 7.78 percent respectively.

Hair production

The average annual hair production in 0-1 and 1-2 year age group of Bikaneri, Jaisalmeri and Kachchhi calves was 1.062 ± 0.14 , 0.725 ± 0.07 , and 1.04 ± 0.08 kg and 0.969 ± 0.07 , 0.675 ± 0.07 and 0.733 ± 0.08 kg respectively. The production of hair in adults of above three breeds was 1.09 ± 0.04 , 0.866 and 0.930 ± 0.05 kg respectively.

Table 6.2.4
Breed, age and sex-wise camel herd strength during 1991-92

Breed/Age	Opening		Calving		Purchase		Death		Disposal		Closing	
	M	F	M	F	M	F	M	F	M	F	M	F
Bikaneri												
0-3 month	02	06	08	11	-	-	01	01	-	-	07	10
3-12 month	02	-	-	-	-	-	-	-	-	-	-	-
1-3 year	15	14	-	-	-	-	02	-	-	01	12	17
3 & above	26	60	-	-	02	-	02	01	02	12	30	49
Total	45	80	08	11	02	-	05	02	02	13	49	76
Jaisalmeri												
0-3 month	03	04	07	04	-	-	-	01	-	-	07	02
3-12 month	-	01	-	-	-	-	-	-	-	-	-	-
1-3 year	03	12	-	-	03	01	-	-	-	-	03	09
3 & above	05	23	-	-	01	-	-	-	-	-	11	32
Total	11	40	07	04	04	01	-	01	-	-	21	43
Kachchhi												
0-3 month	05	04	02	03	-	-	-	01	-	-	02	02
3-12 month	01	06	-	-	-	-	-	-	-	-	-	-
1-3 year	05	08	-	-	-	-	-	-	-	-	06	09
3 & above	10	20	-	-	-	-	02	03	01	-	12	26
Total	21	38	02	03	-	-	02	04	01	-	20	37
Crossbred (Arabi & Bikaneri)												
0-3 month	-	02	01	02	-	-	01	-	-	-	-	02
3-12 month	-	-	-	-	-	-	-	-	-	-	-	-
1-3 year	02	-	-	-	-	-	-	-	-	-	-	03
3 & above	01	06	-	-	-	-	-	-	-	-	03	06
Total	03	08	01	02	-	-	01	-	-	-	03	11
Marwari												
3 & above	01	-	-	-	-	-	-	-	-	-	01	-
Arabi												
3 & above	01	-	-	-	-	-	-	-	-	-	01	-
Grand Total	82	166	18	20	06	01	08	07	03	13	95	167

M- Males, F- Females

Table 6.2.5
Average values of certain reproductive parameters

Age at 1st service (days)	1471 ±6.3
Age at 1st calving (days)	N.A.
Gestation length (days)	385±3.0
Calving interval (days)	655±24.9
% of calving	95.0
Calving rate	37.0
% of breedable females	70.0

Table 6.2.6
Least square means of body weights (birth to 3 month) and biometry at birth in different breeds of camel calves

	Bikaneri	Jaisalmeri	Kachchhi	Cross-bred
Body weights kg				
Birth	38.43± 0.91(18)	38.53± 1.24(10)	30.75± 1.92(4)	38.8± 2.23(3)
One month	60.92± 2.30 (16)	59.69± 3.59(8)	47.90± 6.80(2)	61.4± 6.80(2)
Two months	80.17± 2.98(16)	73.67± 4.66(8)	72.92± 8.82(2)	77.92± 8.82(2)
Three months	101.92± 3.58(16)	94.46± 5.66(8)	90.87± 10.59(2)	103.37± 10.59(2)
Body measurements cm				
Body length	65.69± 0.81(18)	64.05± 1.11(10)	62.00± 1.70(4)	63.70± 1.90(3)
Height	108.96± 0.87(18)	106.36± 1.18(10)	102.00± 1.82(4)	108.53± 2.11(3)
Heart girth	80.36± 0.90(18)	79.74± 1.23(10)	74.50± 1.192(4)	78.29± 2.20(3)

Table 6.2.7
Sire and sex-wise least square means of body weights (kg) in
different camel breeds

Breed, Sire/Sex	Birth	3 months	6 months	9 months	12 months	2 years	3 years	
Bikaneri								
S1	M	39.0 ± 0.66 (6)	93.5 ± 1.16 (4)	149.7 ± 0.67 (4)	184.3 ± 1.60 (4)	238.3 ± 3.02 (3)	281.6 ± 1.60 (2)	360.0 ± 0.0 (1)
	F	37.7 ± 0.48 (11)	90.0 ± 0.67 (11)	144.8 ± 0.91 (11)	180.8 ± 0.87 (8)	206.5 ± 0.60 (9)	262.5 ± 1.20 (9)	330.0 ± 1.02 (6)
S2	M	39.4 ± 0.43 (14)	92.6 ± 0.81 (14)	160.3 ± 1.10 (8)	186.3 ± 1.20 (8)	215.7 ± 0.96 (10)	275.0 ± 0.82 (9)	339.7 ± 1.60 (7)
	F	34.6 ± 0.91 (5)	83.4 ± 1.35 (5)	138.4 ± 1.70 (5)	182.5 ± 1.76 (4)	210.0 ± 1.64 (4)	261.7 ± 1.90 (4)	330.0 ± 0.0 (1)
S3	M	38.7 ± 0.57 (8)	91.8 ± 0.62 (8)	165.2 ± 1.28 (4)	192.1 ± 1.26 (7)	220.0 ± 1.05 (10)	286.8 ± 1.20 (7)	370.2 ± 2.20 (4)
	F	37.6 ± 0.53 (11)	87.9 ± 0.84 (11)	141.5 ± 0.90 (8)	172.2 ± 0.91 (9)	205.0 ± 0.88 (10)	261.0 ± 1.27 (8)	348.3 ± 1.80 (3)
Jaisalmeri								
S4	M	36.3 ± 1.10 (6)	95.8 ± 1.44 (6)	150.5 ± 1.60 (6)	177.8 ± 0.92 (6)	216.2 ± 1.66 (4)	271.6 ± 1.59 (3)	335.0 ± 0.00 (1)
	F	36.3 ± 0.74 (11)	84.0 ± 1.00 (9)	144.7 ± 0.97 (9)	165.1 ± 1.13 (11)	202.9 ± 1.11 (11)	237.8 ± 1.10 (7)	334.3 ± 4.00 (4)
Kachchhi								
S5	M	34.8 ± 0.92 (5)	92.0 ± 0.95 (5)	142.5 ± 1.20 (4)	176.2 ± 1.48 (4)	198.0 ± 1.48 (4)	255.0 ± 2.00 (3)	327.5 ± 1.80 (4)
	F	32.5 ± 0.81 (7)	84.2 ± 0.96 (7)	134.7 ± 1.40 (7)	163.0 ± 1.87 (6)	196.9 ± 1.34 (6)	234.2 ± 1.62 (5)	310.4 ± 1.60 (5)
S6	M	34.4 ± 0.65 (12)	88.6 ± 0.73 (11)	145.1 ± 1.05 (11)	175.5 ± 0.86 (11)	202.0 ± 0.88 (11)	257.0 ± 1.03 (9)	324.5 ± 1.60 (6)
	F	33.6 ± 0.40 (19)	86.2 ± 0.41 (18)	131.8 ± 0.66 (16)	164.3 ± 0.75 (16)	193.8 ± 0.80 (15)	240.2 ± 1.02 (12)	317.0 ± 1.31 (7)

S = Sire number

Table 6.2.8
Month-wise average daily milk production (litre/day) in
Bikaneri Camels

Month	Front teats	Rear teats	Total/day	Range
January	2.31±0.14	3.11± 0.32	5.42± 0.38	4.10 - 6.29
February	2.20± 0.15	2.71± 0.20	4.91± 0.34	3.30 - 5.68
March	2.63± 0.29	3.52± 0.32	6.16± 0.56	4.36 - 8.04
April	2.75± 0.15	3.83± 0.20	6.59± 0.34	5.90 - 7.84
May	2.36± 0.17	3.01± 0.61	5.38± 0.40	3.79 - 6.42
June	3.43± 0.24	3.47± 0.29	7.04± 0.52	4.76 - 8.25
July	2.89± 0.49	3.17± 0.33	6.06± 0.80	4.13 - 8.55
August	2.07± 0.17	2.77± 0.20	4.85± 0.34	3.36 - 5.75
September	1.78 ± 0.22	2.41 ± 0.22	4.19 ± 0.37	3.65 - 5.84
October	1.72± 0.13	2.26± 0.12	3.99± 0.24	3.06 - 4.96

Biochemical polymorphism studies

In all 112 blood samples (65 Bikaneri, 24 Jaisalmeri, 20 Kachchhi, 2 Crossbreeds and 1 Marwari) were collected processed and typed for different proteins/enzyme polymorphism viz. haemoglobin, transterrin, acid phosphatase, phosphohexose isomerase, phosphoglucomutase and glucose-6-phosphate dehydrogenase to explore the possibility of polymorphism.

Horizontal starch gel electrophoresis of Haemoglobin exhibited single band in all the samples. The transferrin was separated at ph 7.6, and it exhibited three band pattern. Phosphohexose-isomerase migrated towards anode at ph 7.00. The acid phosphatase exhibited one band in 106 samples while one additional fast band was observed in 6 samples. No variation was recorded in other enzyme systems presently studied.

Forty one milk samples from Bikaneri, Jaisalmeri and Kachchhi animals were collected and analysed for different milk proteins viz. alpha, beta and kappa caseins and beta lactoglobuline. Almost all the samples exhibited uniform pattern.

6.3 To develop suitable management practices for rearing camel

Project code no : P.I 86/3-ICN /1-05/5220

Project Leader : S. N. Tandon
Associate : N. D. Khanna
Technical Assistance : N. Sharma

Under this project, investigations were continued on the behavioural pattern of camels kept under semi intensive management system at the camel breeding farm of this centre. Data on grazing behaviour in different seasons are being collected.

Collection of information on the traditional camel keeping in the field has also been initiated this year. The home tract of two important camel breeds namely Bikaneri and Kachchhi breeds were selected for this purpose. Bikaner district has 52,000 camels out of 7,21,000 camels available in Rajasthan state (base 1988). For Kachchhi breed, information was collected from Kachchh district of Gujarat state, where the present camel population in the state is 58,000.

6.3.1 Traditional camel management in Bikaner district

In Bikaner district, two villages, namely, Gadwala and Hussansar were selected. In the Gadwala village, there are no irrigation facilities and largely dependent on rain fed agriculture, while in Hussansar village, irrigation facilities from canal are available. Some salient findings are presented herein :

The camel population has increased in both the villages but camel numbers per 100 persons has decreased.

Grazing was practised in both the villages, although draft camels were maintained as stall-fed. In Gadwala village, camels were sent for grazing during November through June in groups of 100-200 camels in nearby areas where pastures and water was available. Leaves of Bordi (*Zizyphus mauritania*), Khejri (*Prosopis cineraria*), Jhal (*Salvadora oleoides*), Phog (*Calligonum ploygonoides*) and crop residue of Moth (*Phaseolus aconitifolius*) and Mung (*Vigna radiata*) were the stable feeds of the camels.

Working animals were also provided with guar 1 kg/day, oil 500 g/day and 250 g alum twice a day in addition to 15-20 kg roughage. Working animals were offered water once daily in Gadwala while in Hussansar, it was twice daily. In both the villages, camel herds kept in the rangeland were watered twice a week.

The draft camels are generally put to work in early morning hours,

given rest during hotter period of the day and again used in the evening. Camels worked for 8-10 hrs a day. As per rough estimate, a camel could plough one hectare of land in a day while working for 10-12 hrs. In village Gadwala almost all agricultural operations i.e. ploughing, levelling, sowing and watering etc. of fields and local transportation are done through camels. In Hussansar village, agricultural operations were performed by both tractor and camels. The local transport was done exclusively by camels. A camel cart owner could earn Rs 200 to 250 a day.

The mortality in calves at village Gadwala was about 20-25% while at Hussansar it was 10-15%. The adult mortality at village Gadwala varied between 3-8% while at Hussansar between 2-5%. Diarrhoea and other digestive disorders were the common ailments. Mange was prevalent in almost 10-15% cases in both the villages. Surra and infestation of internal parasites were common problem encountered in both the villages.

Prophylactic measures were generally not practised. Service of veterinary dispensary controlled by stockman is available at village Gadwala while the animals are treated by the farmers with their own traditional knowledge at village Hussansar. The camels are brought to the Veterinary hospital Bikaner or Veterinary College, Bikaner for treatment of serious cases and chronic ailments.

Females at 4 years of age are bred during December through March. Intercalving period was reported to vary between 2-3 years. At Gadwala few studs are available for breeding, but mostly the female camels are brought to the NRCC Bikaner for availing stud services. At Hussansar, breeding is done with available studs at the village level.

Milk from camel is consumed by the traditional camel keepers and their families. A she camel could produce 6-8 litres of milk per day. Milking is done as per the need of the house hold. The calf is allowed to suckle freely. The camel milk is used for preparing tea and kheer. The fresh milk is used without boiling. At village Gadwala, use of camel milk is very common while at Hussansar due to availability of milk from other sources use of camel milk is not so popular.

6.3.2 Traditional camel management in Kachchh district of Gujarat state.

Eighty percent camel population in this district is maintained by Rabaries and are widely used for transportation of man and material. The camels are kept in small herds (5-15 camels) to large herds (80-150 camels). A few herds having more than 500 camels were also available.

The most prevalent vegetations in the area are luna grass, mothia and the fodder trees (Acacia, Khari and Juliflora). Migration of camels to distant places during lean months is a common practice. Grazing in summer and winter period is done for about 14-16 hr and 10-12 hrs every day respectively. Generally camels are watered twice a week.

Normally one stud is used in a single herd and is replaced after 3 to 4 years. Feeding of ghee and eggs to the studs during breeding season is practised. Boiled guar is offered to almost all breeding males. Breeding season is from November to March. Repeat breeders are generally treated with turmaric, sweet oil and salt for 3-4 days. Paste of this mixture is also applied over the vagina. Estimated milk production of this area varies from 4-10 litres per day with peak 15-16 litres. The camel milk is used extensively for household consumption. Mange, Surra, camel pox and internal parasites are common ailments.

6.4. Studies on camel nutrition

Project Code No. P.I. - 90/4- ICN/L/5220

Project Leader : R.C.Jakhmola

Associate : A.K. Nagpal

6.4.1 Studies on growing camels

Twenty four camels (age 1 year; average weight 204 ± 3.9 kg) were randomly divided into three groups for a feed lot experiment. Roughage (Moth chara ; Phaseolus aconitifolius; CP 11.5% on a DM basis; ME=2.04 Mcal/kg DM) was offered ad libitum. In addition to roughage, a concentrate (CP=18.8% on a DM basis; ME= 2.40 Mcal/kg DM; Co-operative cattle feed plant, Bikaner) was offered at three levels to give rise to three treatments, HPN (concentrate @ 1.5 kg/head/day), MPN (concentrate @ 1.0 kg/head/day) and LPN (no concentrate).

Intake of roughage was recorded daily. Animal were weighed fortnightly and daily weight gain for a period of 120 days was calculated using regression $wt = W_0 e^{gt}$, where, wt = weight of camel after time 't', W_0 = Initial weight of camel, g = rate of growth, and e = exponential function (2.718). Blood samples from individual animals were drawn on day-60 and day-120 and serum was separated. The serum was analysed for glucose, Cholesterol, total protein, calcium and activities for aspartate transaminase (AST), alanine transaminase (ATL) and alkaline phosphatase (ALP).

Intake of roughage in LPN was $60.69/\text{kg } W^{0.75}$ (Table 6.4.1) and it increased by 12% in MPN where concentrate was fed to the camels. However, when amount of concentrate was increased further in HPN, the roughage intake decreased drastically (roughage intake in HPN being 12% less than that of LPN).

The camels in LPN had gained on an average 212 g/day which was significantly ($P < 0.05$) lower than the weight gain observed in HPN and MPN. The conversion efficiency of feed (DM intake/kg gain) was also similar in HPN and MPN and it was about 35% higher than the efficiency observed in LPN.

The differences among groups for the concentration of glucose, total protein and cholesterol were insignificant inspite of the fact that the animals in HPN and MPN were consuming about 80% higher CP and 50% higher ME than the animals in LPN. It is generally considered that even with the longer period of restriction, the body progressively adopts it self in order to maintain as adequate a functional status as limited supply of nutrients

allows. Moreover, the roughage source used in this study was a leguminous plant residue which was moderately rich in energy and protein and was able to support a growth rate of 212 g/day in addition to maintenance. Concentration of calcium and bilirubin in serum remained more or less unchanged. Similarly, activities of AST, ALT and ALP were similar among groups.

6.4.2 Studies on adult male camels :

Three male camels were offered mothchara ad libitum either as a sole feed or with either of the energy supplements (1) Crushed barley ; ME 3.2 Mcal/kg DM; (2) Liseed oil; ME 7.3 Mcal/kg) in a way that they provide approximately 10% additional ME, in a 3x3 latin square design. Daily feed intake was recorded. Both supplements were offered before roughage. Animals were watered once daily. The animals are used for semen donation twice weekly. The average daily intake of nutrients are presented in Table 6.4.2 and the constituents of serum in Table 6.4.3. The effect, on various blood constituents, of the treatments, was non significant.

The effect on adult camels of feeding concentrate was indicated by reduction in the intake of roughage. Average intake ($\text{g/kg W}^{0.75}$) of roughage was 64.4 on sole feeding of mothchara and it decreased to 56.5 $\text{g/kg W}^{0.75}$ when concentrate was included @ 2.5 kg/head/day (Table 6.4.4). However total drymatter intake increased with the level of supplementation. The digestibility of DM on roughage fed animals was 64.8 % which increased to 67.3 % and 69.0 % on concentrate feeding @ 1.5 and 2.5 kg/head/day, respectively. However, the effect of 1.0 kg concentrate was not enough to influence digestibility.

Table 6.4.1
Intake of dry matter and body weight gain by camels in
different groups

	Treatments		
	HPN	MPN	LPN
Dry matter intake (g/kg W ^{0.75})	81.7 ^{b*}	85.9 ^b	60.6 ^a
(kg/100 kg W)	2.10	2.21	1.61
Roughage intake (g/kg W ^{0.75})	53.4 ^a	67.6 ^c	60.6 ^b
CP intake (g/kg W ^{0.75})	10.1 ^b	9.5 ^b	5.4 ^b
ME intake (kcal/kg W ^{0.75})	172.7 ^b	176.5 ^b	118.9 ^a
Concentrate to roughage ration on a DM basis	40:60	20:80	0:100
Body weight gain (d/day)	372 ^b	419 ^b	212 ^a
Feed conversion efficiency (kg/kg gain)	11.6	11.2	15.7

* Means bearing similar superscripts do not differ significantly (P0.05)

Table 6.4.2
Effect of different energy suppliments on intake of nutrients
by camels

	Treatments			
	NS	SC	SO	±SEm
Dry matter (g/kg W ^{0.75})				
Roughage	60.7	60.6	63.5	2.47
	±1.26	±1.99	±2.72	
Total	60.7	64.3	64.7	2.49
	±1.26	±2.03	±2.71	
ME (kcal/kg W ^{0.75})	123.8	135.3	138.1	5.129
	±2.57	±4.22	±5.57	
CP (g/kg W ^{0.75})	6.98	7.42	7.30	0.286
	±0.144	±0.234	±0.256	

NS = No supplement

SC = Supplementation of barley

SO = Supplementation of linseed oil

Table 6.4.3
Serum constituents in the camels receiving different energy supplements.

	Treatments			
	NS	SC	SO	±SEm
Glucose (mg/dl)	103.3 ±3.85	102.1 ±0.26	92.3 ±3.86	2.48
Cholesterol (g/dl)	23.99 ±7.173	20.29 ±4.212	19.16 ±6.845	5.91
AST (IU/l)	51.61 ±3.720	45.38 ±5.299	50.67 ±8.659	5.807
ALT (IU/l)	9.06 ±1.692	13.64 ±1.949	12.52 ±1.087	1.552
Calcium (mg/dl)	8.31 ±1.523	9.95 ±1.392	8.52 ±1.096	1.083
Phosphorus (mg/dl)	4.13 ±0.089	5.73 ±0.901	4.53 ±0.235	0.592

NS = No supplements; SC = Barley Supplementaion;

SO = Supplementation of oil

Table 6.4.4
Average daily intake of nutrients by camels under different levels of supplementation.

	Level of supplementation (kg/head/day)			
	0	1.0	1.5	2.5
Dry matter (g/kg/W ^{0.75})				
Roughage	64.4	58.5	61.1	56.5
Total	64.4	65.2	75.5	79.1
DM digestibility (%)	64.8	64.1	67.3	69.0
Digestible DM intake (g/kg W ^{0.75})	41.7	41.8	50.8	54.6

6.4.3 Studies on Mineral utilisation in camels

A. Effect of dehydration during winter

Six adult Bikaneri camels (age 4-5 years), maintained on a sole roughage diet of dry moth chara (*Phaseolus aconitifolius*) were put on twice a week of watering schedule for two months. The animals were then randomly divided into 2 groups of 3 each. One group on twice a week watering schedule served as control. The water intake of another group (experimental) was withheld for a period of 20 days and on 21st day, the water was offered ad. libitum followed by a regular twice a week watering schedule. During the course of 20 days water deprivation & next 4 days of rehydration, a metabolism trial on all the six animals was conducted to study the minerals intake and their utilisation. The samples of 24 days metabolism trial of control group were pooled while those of experimental group were divided into seven periods i. e. 0-3 days (I), 4-6 days (II), 7-10 days (III), 11-14 days (IV), 15-17 days (V), 18-20 days (VI) and 21-24 days (VII). The pooled samples were analysed for macro and micro elements. The mineral composition of moth chara on DM basis was estimated to be 0.0755 % Na, 0.9052 % K, 28.25 ppm Zn, 296.25 ppm Mn and 912.5 ppm Fe. The intake of macro and micro elements decreased with increasing dehydration period. On rehydration camels regained 85.5 % of normal intake of all minerals (Table 6.4.5). Although dehydration resulted in decreased intake of all minerals, but their absorption increased.

B. Effect of dehydration during summer 1991

Six adult Bikaneri male camels maintained on sole roughage diet of dry moth chara (*Phaseolus aconitifolius*) were put to twice a week watering schedule for a pre experimental period of 4 months. The camels were divided into 2 groups of three each. Group I on a regular twice a week watering scheduled served as control while the group II (experimental) was deprived of water for 10 days followed by regular twice a week watering schedule. A metabolism trial on all the six animals of both the groups was conducted. The representative samples of feed, water, faeces and urine of control group were pooled for the entire 15 days while those of experimental group were pooled for each day. The pooled samples were analysed for sodium and potassium to study their availability.

Mineral composition of moth chara was 0.1256 % Na and 1.0402 % K on DM basis and that of water was 0.258g/1 and 0.007g/1. The intake of both Na & K declined progressively with water deprivation to the extent that one animal lost appetite on 8th day. After rehydration, Na intake slowly returned to normal but more time was required for normal level of sodium to return.

Sodium availability became negative (-6.85%) on 4th day onward but rehydration quickly promoted the Na absorption. Potassium availability also declined with dehydration period but remained positive. After rehydration, potassium concentration returned to prehydration value quickly.

C. Mineral intake and availability in dry and pregnant camels

Eleven adult female Bikaneri camels were divided into three groups. Group I had 4 dry camels and served as control. Group II had 3 camels - 2 in first and one in second pregnancy. Group III had 4 camels in fourth pregnancy. While dry camels of group I were given dry moth chara (*Phaseolus aconitifolius*) adlib., each pregnant camel was given in addition 2 kg concentrate ration/d. At the end of 130 days pre experimental period a digestibility trial was conducted on 9 camels to study the minerals intake and utilisation by the animals.

Moth chara contained on DM basis 0.0605% Na, 0.7528 % K, 28.25 ppm Zn, 124.44 ppm Mn and 510.0 ppm Fe. The minerals composition of concentrate on DM basis was 0.445 % Na, 0.7441% K, 90.0 ppm Zn, 147.0 ppm Mn and 690.00 ppm Fe. Pregnant camels consumed higher DM than dry camels. The DM digestibility was also higher in pregnant camels than dry camels. The intake of all minerals was higher in pregnant camels as compared to dry camels (Table 6.4.6). Sodium availability (%) was maximum in group II (26.71 ± 10.63) and minimum in group I (-4.53 ± 17.25). Potassium and Zn availability (%) was higher in group I than in group II and III. Manganese and Iron availability was higher in the pregnant camels (group II and III) as compared to dry camels (group I).

Table 6.4.5
Intake and availability of minerals from Phaseolus
aconitifolius in adult camels on dehydration and rehydration
during winter 1990-91

Days Period	Sodium		Potassium		Zinc		Manganese		Iron	
	Intake	Avail ability	Intake	Avail ability	Intake	Avail ability	Intake	Avail ability	Intake	Avail ability
	(g/d)	(%)	(g/d)	(%)	mg/d	(%)	mg/d	(%)	mg/d	(%)
Experimental group										
Dehydration										
0-3 I	5.038 ±0.773	1.880 ±10.32	60.401 ±8.790	77.42 ±2.37	188.50 ±27.43	61.64 ±4.04	1976.79 ±287.67	33.05 ±7.04	6088.87 ±886.07	23.82 ±8.01
4-6 II	4.088 ±0.555	13.76 ±9.45	49.013 ±6.649	78.97 ±2.30	152.963 ±20.752	64.99 ±3.84	1604.10 ±217.61	45.49 ±5.97	4904.88 ±670.27	31.43 ±7.51
7-10 III	2.879 ±0.588	-1.41 ±8.21	34.515 ±7.047	85.11 ±0.89	107.717 ±21.994	70.19 ±2.41	1129.60 ±230.65	42.42 ±4.65	3479.36 ±710.43	56.15 ±3.54
11-13 IV	2.894 ±0.543	22.80 ±2.17	34.700 ±6.515	93.07 ±0.43	108.29 ±20.333	69.64 ±0.85	1135.66 ±213.22	61.40 ±1.08	3498.01 ±656.77	43.79 ±1.58
14-17 V	2.258 ±0.146	6.88 ±0.38	27.077 ±1.746	91.93 ±0.03	84.503 ±5.451	60.02 ±0.16	886.15 ±57.14	49.05 ±0.20	2729.50 ±176.01	57.37 ±0.46
18-20 VI	1.931 ±0.234	21.48 ±6.38	23.152 ±2.802	93.53 ±0.53	72.275 ±8.745	73.55 ±2.14	757.71 ±91.71	51.08 ±3.97	2333.87 ±282.47	62.51 ±3.04
Rehydration										
2 1 - 2 4 VII	4.305 ±0.262	38.83 ±2.83	51.614 ±3.142	93.15 ±0.32	161.08 ±9.808	72.98 ±1.25	1689.22 ±102.85	67.87 ±1.49	5203.07 ±316.86	73.23 ±1.24
Control group										
0-24	5.222 ±1.085	5.04 ±1.96	62.578 ±13.011	84.36 ±0.32	195.298 ±40.606	67.22 ±0.75	2048.03 ±425.83	36.68 ±1.31	6308.28 ±1131.62	9.10 ±1.87

Table 6.4.6
Intake and availability of minerals in dry and pregnant camels

Group	Dry camels	first + second pregnancy	fourth pregnancy
	I	II	III
Number of animals	4	2+1=3	4
Sodium intake (g/d)	3.81±0.21	13.89±0.73	13.685±0.12
Sodium availability (%)	-4.53±17.25	26.71±10.63	21.28±10.19
Potassium intake (g/d)	47.44±26.34	67.45±9.13	73.63±1.52
Potassium availability (%)	82.55±3.26	73.61±7.70	73.76±4.62
Zinc intake (mg/d)	178.01±9.88	394.41±34.27	417.58±5.69
Zinc availability (%)	78.00±3.98	62.06±7.25	66.50±6.21
Manganese intake (mg/d)	784.14±43.54	1268.40±150.97	1370.48±25.07
Manganese availability (%)	22.50±6.79	32.42±5.92	33.93±6.65
Iron intake (mg/d)	3213.68±178.43	5362.92±618.74	5781.29±102.77
Iron availability (%)	19.82±12.00	29.88±11.20	26.31±8.79

6.5 Studies on camel reproduction

Project Code No. P.I. 90/5-ICN/L-31/5220

Project Leader	:	A.K. Rai
Associates	:	A.K. Roy
	:	N.D. Khanna
Technical Assistance	:	N. Sharma

6.5.1 Female Reproduction

1. Ovarian status during breeding season :

Rectal palpation of 15 camels (age, 6-10 years) was done during peak breeding season i.e. Dec. to Feb. The animals were randomly selected and examined for the presence of graffian follicles (GF). The GF were graded depending on their approx. size as A-2 to 4 mm, B- 5 to 7 mm, C- 8 to 12 mm, and D- 20 to 25 mm. B and C types were considered mature follicles.

A matured follicle was, found present on both the ovaries in 11 cases (13.4%) and in 49 cases (59.8%) on either of the ovaries. The follicles were absent on both the ovaries in 2 cases (2.4%). In 9 cases (11%) immature follicles were present either on both the ovaries or one ovary with immature follicles and the other without any follicle. Over size follicles (D type) on one ovary and a mature follicle on the other ovary was recorded in 5 cases (6.1%), whereas, only over size follicle on either ovary was found in 6 cases (7.3%). The result indicated that in about 80% cases a mature GF was present on either ovaries during breeding season.

Only in 2 cases mucous discharge was observed which was translucent and turbid in nature.

6.5.2 Semen collection and preservation

During the month of February and March, semen was collected from 5 camel studs (age 6-10 years) using oxen artificial vagina (AV). The temperature of the AV was maintained at 46-47 °C and a sphincter was used on the liner to provide suitable constriction. The semen was collected directly in freshly prepared extender as below :-

Extender : Tris EYCG (pH 6.8)

Tris	:	3.028 g
Citric acid monohydrate	:	1.675 g
Fructose	:	1.25 g
Glycerol	:	8.0 ml

Glass redistilled water	:	92.0 ml
Egg yolk (antibiotics)	:	25.0 ml

The semen volume varied from 3-11 ml in 16 collections. The frequency of collection was twice weekly. The final dilution was made 1:3. Progressive sperm motility was observed in all the cases which was rated not less than +++++. The sperm concentration was 3.5 to 7.3×10^8 /ml. Very thin to thick gel was present in all the semen samples.

The diluted semen was gradually cooled to bring down the temperature to 8-10°C in 30 minutes. It was then preserved at 8-10°C++++. The periodical examination of the preserved semen at 2, 4 & 6 h revealed sperm motility.

Insemination : Experiments with respect to standardisation of doses of insemination and other protocol to induce ovulation are in progress.

6.5.3 Post-partum status of genitalia

Six she camels were examined through rectal palpation after 45 - 60 days post-partum. The uterus was found to have attained normal shape and size. However, no graffian follicle could be palpated on the ovaries.

These animals were injected with 5 ml Pg alpha 2 (UPJOHN) I/M and the animals were examined after 10 days. No change in ovarian status was observed. These animals were further injected with PMSG 1000 IU(Folligon) I/M on 12th day. No palpable GF was observed after 96 hrs of injection. This treatment was given almost at the end of the breeding season.

INTER INSTITUTIONAL COLLABORATION

7.1 Pharmacokinetics of sulphamethoxazole

Report by Dr. M. Kapoor, Head, Deptt. of pharmacology, College of Veterinary and Animal Science, Bikaner

Sulphamethoxazole (SMZ) was administered, intravenously, to six healthy camels of both sexes at a dose of 50 mg/kg of body weight. These animals weighed between 240-300 kg. The blood samples were collected at 5, 10, 20, 30 and 40 minutes post administration and then at 1, 2, 3, 4, 5, 6, 8, 10, 12, 18 and 24 hours after the drug administration in heparinized tubes. These samples were analysed for plasma concentration of SMZ.

The peak plasma concentration of SMZ was 170 µg/ml at 5 minutes which declined to 2.5 µg/ml at 24 hrs.

On comparison with SMZ given at 100 mg/kg I/V (previous study) the dose of 50 mg/kg I/V appears to be quite satisfactory as the peak plasma level attained with this dose is well within the range of MIC of sulpha drugs (50-150 µg/ml of plasma).

7.2 Studies on Endocrine profile of camel

Report by Dr. S.P. Agarwal, Department of Veterinary Physiology, Haryana Agricultural University, Hisar.

Low dose gonadotrophic treatment for overcoming seasonal ovarian inactivity in female camels

The experiment was conducted at National Research Centre on Camel, Bikaner (non breeding season). Twelve sexually inactive female camels were treated with a single dose of 1000 IU of Folligon (a FSH dominant gonadotrophin) I/M followed by mating on third day post-treatment.

Another eight animals were injected with saline and served as control. Blood samples from the animals were collected on day prior to treatment, on day of treatment, on day of mating and at different intervals following mating. The sera received from Bikaner were analysed for progesterone using RIA technique. The progesterone profiles revealed that the ovaries were activated in 40% of the animals in treated group as against 25% in control group.

Post partum female camels and their neonates

Blood samples from 10 freshly calved female camels and their neonates were collected within hours after parturition/birth and sampling was continued at different intervals for 21 days. Sera received from N.R.C. on camel, Bikaner were analysed for progesterone, cortisol and thyroid hormones using RIA techniques. The progesterone level in dams varied between 0.5 and 0.2 ng/ml on the first day of calving followed by a gradual decline, disappearing on day 9 while it was barely detectable or undetectable in neonates. Cortisol levels in dams and neonates were high (25 to 30 ng/ml) at parturition and declined to 6 to 7 ng/ml in dams but disappeared in neonates by day 14 post birth. The thyroid hormones in dams were low (T4 : 70; T3: 1.6 ng/ml) on day 1 post partum but gradually increased (T4:110; T3:2.2 ng/ml) until day 21. Conversely, the thyroid hormones, in neonates were four to five times higher at birth but declined afterwards, maintaining almost double the concentration as that in dams.

7.3 Adaptive responses of camel to dehydration and rehydration following water restriction

Deepti Khanna, Department of Zoology, Dungar (Autonomous) College, Bikaner. (Ph. D. Project, Advisor Dr. M.L. Gupta).

Dehydration and rehydration studies were carried out on 6 camels during summer. The animals were offered water twice a week for a pre experimental period of four months and maintained on mothchara (*Phaseolus aconitifolius*) chaff as a sole feed. Three camels were dehydrated for a period of 10 days and the other three served as control. The water was offered to dehydrated camels on 11 th day and subsequently twice a week as per schedule. The animals were weighed daily. The feed and water consumption was also recorded daily.

The pulse rate, respiratory frequency, rectal temperature and sweating rate of the camels were recorded at 8.00 a.m. and 3.00 p.m. The blood samples were collected at 8.30 a.m. and the following estimations were made :

- a. Haematological studies - RBC, WBC, Platelet, Haemoglobin, Haematocrit, MCV, MCHC, ESR, blood pH and blood gases.

- b. Biochemical studies - Blood glucose, total protein, albumin, bilirubin, Blood urea, creatinine, Lactate dehydrogenase, Acid phosphatase, Aspartate aminotransferase and Alanine aminotransferase.
- c. Serum electrolytes - Sodium, Potassium and Calcium.
- d. Hormonal studies - T3 and T4.

The data collected during the summer and winter dehydration and rehydration studies were tabulated and subjected to statistical treatment. Further work on preparation of graphs, tables and interpretation of the result is in progress.

7.4 Haemato - biochemical and hormonal studies in periparturient female camels (*Camelus dromedarius*) and their neonates.

Dr. A. M. Pande, Deptt. of veterinary Physiology, H. A. U. Hisar. (Ph.D. Project, Advisor Dr. S.P. Agarwal).

Eight camels in their last months of pregnancy belonging to 2nd or 3rd parity were selected.

The blood samples were collected at weekly intervals one month before the expected date of parturition and on alternate days in the last week of gestation. After parturition, the blood samples of dams and neonates were collected from day one of parturition at an interval of 3 days during the first week followed by every 7th day upto 2 months.

Pulse, respiration and recta temperature were recorded daily. The body weight of the calves was recorded at weekly interval.

The blood samples were processed for RBC, WBC count; Haemoglobin concentration, MCV, PCV, ESR and other haematological indices.

The serum samples were analysed for glucose, SGOT SGPT, ALP, cholesterol and calcium. The plasma samples were processed for the estimation of ascorbic acid and analysis of total protein and bicarbonate.

The samples have been stored for the estimation of electrolytes (Sodium, Potassium, phosphorus, magnesium and chloride), fractionation of proteins and radio-immuno assay of hormones (T3, T4, Estrogen, progesterone and cortisol).

7.5 Early growth and its association with certain blood parameters in different breeds of camel

Dr. U.K. Bissa, College of Veterinary and Animal Sciences Bikaner, (M.V. Sc. Project, Co-advisor Dr. N.D. Khanna).

The calf born during the year at NRCC were utilised in the present study. The blood samples were collected at birth, 3 and 6 months of age. The concentration of glucose, blood urea nitrogen, total protein and activity of amylase and alkaline phosphatase were estimated. The statistical analyses is in progress.

The growth in terms of body weight and certain body measurements were recorded. The genetic studies on heritability of traits and relationship with blood parameters is in progress. Growth curve will be developed and prediction equations will be computed

7.6 Genetic analysis of blood polymorphism in relation to performance of Marwari Sheep.

Dr. Sanjay Verma, College of veterinary and Animal Sciences Bikaner, (M.V. Sc. Project, Co-advisor Dr. S.N. Tandon).

Facilities and scientific guidance for analysis of 170 blood samples of marwari sheep were provided for different biochemical variant viz. haemoglobin, transferrin, albumin, carbonic anhydrase and alkaline phosphatase on starch gel electrophoresis using standard techniques.

The gene frequency and genotype frequency were calculated and pattern of inheritance was studied. The data on growth, production and reproduction traits were collected. The analysis of genetic parameter is in progress.

PUBLICATIONS

8.1 List of articles published during 1991-92

1. Agarwal, S.P., Rai, A.K. and Khanna, N.D. 1991. Cortisol response of male camel (*Camelus dromedarius*) under different types of work load. *Journal of nuclear Agriculture and Biology*, 20(3) 149-152.
2. Agarwal, S.P., Rai, A.K. and Khanna, N.D. 1991. Effect of mating on hormone levels in male camels (*Camelus dromedarius*), *Indian veterinary Journal*, 68: 931-933.
3. Agarwal, S. P., Rai, A.K. and Khanna, N.D. 1992. Serum progesterone levels in female camels during oestrus cycle. *Indian Journal of Animal Sciences*, 61 : 37-39.
4. Agarwal, S.P., Rai, A. K. and Khanna, N.D. 1992. Hormonal studies in post-partum in female camels and their neonates. In : *Proceedings of the first International Camel Conference*, pp. 143. 148.
5. Khanna, N.D., Tandon, S.N. and Sahani, M.S. 1992. Calf mortality in Indian farmbred camels, R&W Publications, England. *Proceeding of the first International Camel Conference*, pp. 89-92.
6. Rai, A. K., Agarwal, S.P. and Khanna, N.D. 1991. Induction of early puberty in female camels. *Indian Journal of Animal Sciences*, 61(12): 1265-1267.
7. Rai, A.K., Roy, A.K. and Khanna, N.D. 1992. Speed and strides of different breeds of camel. *Indian Journal of Animal Sciences*, 62 (1):91-92.
8. Roy, A.K. and Rai, A.K. 1991. Draught performance of camel during load pulling. In: *Proceedings, National Symposium and Seventh Annual Conference of Animal Physiologist of India*. pp.18.

8.2 Articals under publications

1. Agarwal, S.P., Rai, A.K. and Khanna, N.D. (1992). Effect of physical exercise on plasma renin activity and angiotensin - I in male camel. Indian Journal of Animal Physiology.
2. Khanna, N.D. 1992. Camel breeds in India. International Journal of Camel Sciences.
3. Jakhmola, R.C. and Roy, A. K. 1992. Effect of supplimentation of concentrate on body weight gain and serum constituents in camel. Indian Journal of Animal Sciences.
4. Rai, A.K., Khanna, N.D., Agarwal, S.P. 1992. Effect of feeding *Leucaena leucocephala* with *Phaseolus aconitifolius* on growth and thyroid status of camel calves. Indian Journal of Animal Sciences.
5. Roy, A.K., Rai, A.K. and Khanna, N.D. 1992. Draught capacity and fatigue symptoms under ploughing stress in camel. Indian Journal of Animal Sciences.

9.

VISITORS

The National Research Centre on Camel, Bikaner received 3109 visitors during the year 1991-92. These included scientist, educationists, administrators and Indian/Foreign tourists.

10.

SUMMARY OF RECOMMENDATIONS OF QUINQUENNIAL REVIEW OF THE NRCC, BIKANER (1984-90)

The ICAR constituted QRT to review the activities of the NRCC, Bikaner vide letter No. 28/6/90 IA-I dated 10th March, 91 where Dr. N.R. Bhasin (Chairman), Professor P.N. Mehrotra (Member Secretary), Professor S.P. Agarwal and Professor G.R. Purohit (Vice Prof.C.S. Mathur) were members.

The QRT examined critically the objectives, fund allocation, staff position, research achievements of the centre and the future research projects. The following major suggestions and recommendations were made :-

(I) Taking an overall view of the importance of the centre, it was recommended that the centre be upgraded as an institute and be named as **National Camel Research Institute.**

The outline of necessary infrastructure and facilities was given in details for the proposed institute. Six Division/Units proposed were

1. Camel Physiology and Reproduction
2. Camel Nutrition
3. Camel Genetics and Breeding
4. Camel Health
5. Camel Management and Camel Products
6. Extension and training

The Committee felt that in view of the proposal for upgrading the NRCC to the level of an Institute with wider ramification and broad based mandate, the objectives may be revised as :-

1. To study, evaluate and preserve camel genetic resources.
2. To take up breeding programme for genetic improvement of important breeds of camels.
3. To study camel draughtability and measures for its improvement.
4. To investigate nutritional requirement of the camel and feed resources determination and evaluation.
5. To study camel reproduction and improvement of camel reproductive efficiency.
6. To undertake research on camel health including major camel diseases and to develop a programme of monitoring, surveillance and control of camel diseases.
7. To study traditional practices on camel management, and develop a package on camel management practices keeping in view socio-economic importance of the camel.
8. To study camel products (Milk and fibre) and to take up their evaluation and utilisation.

(II) The requisite number of staff in different categories is essentially needed for carrying out the mandate of the institute. Necessary recommendation in this respect have been made in text of the report. It is estimated that roughly the following should be the cadre strength in each category :-

Scientist	25
Technical	40
Administrative	25
Auxiliary	10
Supporting	55
Total	<u>155</u>

(III) It was suggested that the strength of Bikaneri breed should be raised to 120 breedable females and that of Jaisalmeri and Kachchhi each to 60 breedable females. The centre should also maintain 5-10 representative

animals of different other camel breeds/strains so as to conserve the camel germplasm resources available in the country. It would be necessary to develop matching facilities of camel sheds feed and fodder godown etc.

(IV) The Centre should conduct survey for the evaluation and preservation of camel genetic resources. Camel breed evaluation and genetic variability should be worked out.

(V) The camel nutrition research should include evaluation of local feed and fodder, developing nutrient requirements at different stages of development and growth, nutrient requirement of working animals and alternative feed resources during drought and crisis period. Studies on camel rumen microbiology should also be initiated.

(VI) Research on draughtability and camel physiology should be continued as per the objectives of the centre. The institute should also involve in improving the present camel-drawn carts and matching implements. The institute should also develop Radioimmuno assay laboratory for conducting advance studies on hormones and other relevant areas.

(VII) The QRT observed that at present practically no work was done on camel health. It was recommended that a separate unit of ' Camel Health' should be established for conducting research on disease surveillance, monitoring and diagnostics.

(VIII) The institute should develop package of practices for the economic upkeep of camels under field conditions. Research should be conducted for the utilisation of camel by-products such as milk, meat, fibre and hide. Study should also be conducted on economics of camel maintenance under field condition.

(IX) The institute should work to improve reproductive efficiency of camel. Artificial insemination, deep freezing of semen and embryo transfer technology should constitute the frontal research areas in this discipline.

(X) It was recommended that emphasis should be directed for the extension and transfer of technology developed by the institute. There should be more contact with camel breeders, State Animal Husbandry Department, Agriculture Universities and Border Security Force. The institute should also develop specialised courses on camel management, production and health for the progressive camel breeders and animal husbandry workers.

(XI) The QRT recommended that the library of the camel institute should be developed in a manner that it should become a Referral Library.

(XII) Proper action should be taken to fence the whole rangeland area and it should be developed for growing fodder/feed for camel use.

सारांश

वर्ष 1991-92 में केन्द्र पर 59 स्वीकृत पदों में से 2 पद रिक्त थे। केन्द्र पर परियोजना निदेशक के अतिरिक्त 6 वैज्ञानिक, 10 टैक्नीशियन, 11 प्रशासकीय तथा 29 अन्य कर्मचारी (वाहन चालक व सहायक) कार्यरत थे।

केन्द्र हेतु वर्ष 1991-92 के दौरान 65 लाख रु . योजना मद में तथा 31 लाख रु . गैर योजना मद में स्वीकृत किये गये जिसमें से 43.66 लाख रु . योजना मद में तथा 28.89 लाख रु . गैर योजना मद में व्यय किये गये।

केन्द्र के उष्ट्र प्रजनन फार्म पर 1-4-91 को ऊँटों की कुल संख्या 248 थी जिसमें बीकानेरी नस्ल के 125, कच्छी नस्ल के 59, जैसलमेरी नस्ल के 51, मारवाड़ी नस्ल का 1, अरबी नस्ल का 1, तथा अरबxबीकानेरी संकर नस्ल के 11 ऊँट थे।

वर्ष के अन्त में फार्म पर ऊँटों की संख्या 262 थी। इस सत्र में केन्द्र पर 38 बच्चे पैदा हुए जिसमें से 18 नर तथा 20 मादा थे। इस वर्ष अप्रसूता ऊँटनी के प्रथम गर्भधारता की आयु 1398 दिन, पहली ब्यात की आयु 1856 दिन, गर्भावधि 382 दिन, एक गर्भ से दूसरे गर्भ धारण करने का अन्तराल 739 दिन था।

केन्द्र के उष्ट्र फार्म पर मृत्यु दर (प्रति हजार उष्ट्र दिवस प्रतिदिन) 0 से 3 माह की आयु में 1.20, 3 से 36 माह में 0.07 तथा 3 साल से अधिक की आयु में यह दर 0.14 रही।

चरागाह विकास के क्षेत्र में वृक्षारोपण, घास प्रत्यारोपण व टिब्बा स्थिरीकरण इत्यादि कार्य किये गये। घास प्रयारोपण में सेवण, ग्रामना, अंजन आदि के चरागाह विकसित किये गये। वृक्षारोपण में 12 हजार पौधे लगाए गये तथा 40 हजार पहले लगाये गये वृक्षों की देखभाल की गई।

वर्ष 1991-92 के दौरान आसपास के क्षेत्र से ऊँट पालकों एवं किसानों द्वारा लाई गई ऊँटनियों को प्रजनन हेतु उत्तम नस्ल के नर ऊँट की सुविधा निःशुल्क उपलब्ध करवाई गई। राष्ट्रीय उष्ट्र अनुसंधान केन्द्र द्वारा नस्ल सुधार कार्यक्रम के अन्तर्गत उन्नत नस्ल के ऊँट राजस्थान सरकार के पशुपालन विभाग के माध्यम से ग्राम पंचायत स्तर पर दिये जाते रहे हैं।

अनुसंधान का ब्यौरा :

केन्द्र में वर्ष 1991-92 के सत्र में नीचे लिखे विषयों पर अनुसंधान किया गया।

1. ऊँट की बोझा ढोने की क्षमता पर अध्ययन।
2. ऊँट की अनुवांशिकी तथा अभिजनन विषयों पर अध्ययन।
3. ऊँट के रख-रखाव पर अध्ययन
4. ऊँट के पोषण पर अध्ययन।
5. ऊँट के प्रजनन पर अध्ययन।

(1) ऊँट की बोझा ढोने की क्षमता पर अध्ययन

(अ) बोझा ढोने की क्षमता

ऊँट के शारीरिक भार के 10, 15 और 20 प्रतिशत स्थिर खिंचाव बल पर बोझा ढोने के प्रयोगों में पाया गया है कि जैसे-जैसे खिंचाव बल बढ़ाया जाता है निरंतर कार्य करने की अवधि और गति में कमी होती जाती है। भार के 20 प्रतिशत स्थिर खिंचाव बल पर अधिकतम बल 1132 ± 3.48 किग्रा - बल और 1.16 ± 0.075 अश्व-शक्ति उत्पन्न हुआ।

विभिन्न चालों पर गति सम्बन्धी तुलनात्मक अध्ययन में 10 किमी चलने के बाद ऊँटों की अपेक्षा ऊँटनियों के चलने की गति टहलते हुए, दुलकी और सरपट, तीनों ही चालों में अधिक पाई गई। ऊँट के चलने की गति, गर्दन की लम्बाई और टांगों की लम्बाई में परस्पर घनात्मक सम्बन्ध भी ज्ञात हुआ।

(ब) पानी पीने पर प्रतिबन्ध के प्रभाव का अध्ययन :

बीकानेरी नस्ल के ऊँटों को पीने के पानी से वंचित रखने पर 10 दिनों में उनके शारीरिक भार में 17% कमी आई और चारा खाने का औसत 13.5 ग्रा/किग्रा भार से घटकर 2.0 ग्रा/किग्रा भार तक हो गया। मल और मूत्र विसर्जन में क्रमशः 91.7 और 89.3 प्रतिशत कमी आई। पाचन शक्ति में गिरावट हुई। विसर्जित मूत्र में सोडियम, यूरिया और क्रिएटिनिन के अंशों में क्रमशः 243, 153 और 1916 प्रतिशत वृद्धि हुई जबकि पोटेशियम का अंश 78 प्रतिशत घट गया। 10 दिनों के पश्चात पानी उपलब्ध कराने पर इन ऊँटों ने 120.4 ± 3.38 ली . पानी 20 मिनट में पिया। पानी पिलाने के उपरान्त इन ऊँटों के शारीरिक भार में हुई कमी की पूर्ति 5 दिनों में ही हो गई, यद्यपि चारा खाना, मल और मूत्र का विसर्जन इस अवधि में सामान्य नहीं हो पाया पाचन शक्ति सामान्य हो गई और शरीर में नाइट्रोजन का संतुलन भी घनात्मक हो गया। मूत्र में सोडियम, यूरिया और क्रिएटिनिन का अंश तो सामान्य हुआ किन्तु पोटेशियम का अंश पानी से वंचित रखने की पूर्व स्थिति में नहीं आ सका।

(2) ऊँट की अनुवांशिकी तथा अभिजनन विषयों पर अध्ययन

शारीरिक भार में वृद्धि नर बच्चों में मादा बच्चों की अपेक्षा अधिक आँकी गयी। कच्छी नस्ल के बच्चे जन्म के समय अन्य नस्लों की तुलना में कम भार के थे परन्तु उनकी देह-भार वृद्धि अपेक्षकृत अधिक रही।

शरीर के विभिन्न अंगों के माप का शरीर भार से सम्बन्ध ज्ञात करने के लिये अनुसंधान कार्य किया गया। शरीर के अंगों का माप बीकानेरी में अधिक तथा जैसलमेरी एवं कच्छी में कम रहा। बीकानेरी नस्ल के पशुओं में जन्म से 3 वर्ष तक की अवधि में देह-भार उनके पिता के देह-भार से अधिक प्रभावित हुआ जबकि अन्य नस्लों में यह प्रभाव कम आँका गया। बीकानेरी नस्ल की ऊँटनियों ने 4 से 7 लीटर प्रतिदिन दूध दिया तथा पिछली थनों की जोड़ी से अगले थनों की अपेक्षा 23-35 प्रतिशत अधिक दूध प्राप्त हुआ।

पहले वर्ष की आयु के बच्चों से अधिक बाल प्राप्त होते हैं। बीकानेरी नस्ल के पशुओं में अन्य नस्लों की अपेक्षा बाल उत्पादन क्षमता अधिक थी। इस केन्द्र में ऊँट के रक्त एवं सीरम में बायोकेमिकल पोलिमॉरफिज्म के क्षेत्र में अनुसंधान कार्य शुरू किया गया।

(3) ऊँट के रख-रखाव पर अध्ययन

भारतवर्ष में ऊँटों की अधिक संख्या राजस्थान एवं गुजरात राज्यों में हैं। ऊँट का रख-रखाव दोनों राज्यों में भिन्न प्रकार से होता है। इस भिन्नता का अध्ययन करने हेतु इस वर्ष बीकानेर जिले के 2 ग्रामों एवं गुजरात राज्य के कच्छ जनपद के उष्ट्र पालकों से वार्तालाप किया गया तथा उष्ट्र पालन सम्बन्धी जानकारी ली गई। बीकानेर जिले के गाढ़वाला गांव में सिंचाई की सुविधाएँ नहीं हैं तथा हुसनसर गांव में सिंचाई की सुविधाएँ इन्दिरा गाँधी नहर परियोजना से उपलब्ध है। दोनों ही गाँवों में पिछले दशक में ऊँटों की संख्या बढ़ी है यद्यपि प्रति व्यक्ति ऊँटों की संख्या में कमी आई है। दोनों ही स्थानों में ऊँटों को चारागाहों में चरने के लिए छोड़ा जाता है। गाढ़वाला में नवम्बर से जून तक ऊँटों को 100 से 200 के झुण्ड में आसपास के क्षेत्र में जहाँ पर्याप्त मात्रा में चारा एवं पानी उपलब्ध हो, चरने के लिए भेजा जाता है। जबकि हुसनसर में अधिकतर ऊँट अपने गांव के चारागाहों में ही चरते हैं। गाढ़वाला में खेती सम्बन्धी सभी कार्य ऊँटों के द्वारा किये जाते हैं जबकि हुसनसर में कृषि कार्यों का बड़ा भाग ट्रैक्टरों से किया जाता है। कृषि कार्यों में लगे ऊँटों को घर पर ही चार-दाना खिलाया जाता है। गाढ़वाला के ऊँट पालक ऊँटनियों के दूध को अपने घर में भी प्रयोग करते हैं।

कच्छ के अधिकतर ऊँट रेबारी जनजाति के द्वारा पाले जाते हैं तथा विभिन्न यातायात सम्बन्धी कार्यों के उपयोग में लाये जाते हैं। चारे की कमी वाले महीनों में ऊँटों को दूर-दराज के स्थानों में चराने के लिए ले जाया जाता है। साधारणतया एक झुण्ड में एक नर को प्रजनन कार्य के लिए 3 से 4 वर्ष तक प्रयोग में लाया जाता है। नर को प्रजनन काल की अवधि में अतिरिक्त भोजन (उबाली गई ग्वार, घी आदि) दिया जाता है। इस क्षेत्र में ऊँटनियों का दूध घरेलू कार्य के लिये प्रयोग में लाया जाता है।

(4) ऊँट के पोषण पर अध्ययन

इस परियोजना के अंतर्गत ऊँटों की ऊर्जा, प्रोटीन तथा लवणों की आवश्यकता ज्ञात करने के लिए प्रयोग किये गये। एक से दो वर्ष के बच्चों को जब केवल मोठचारा दिया गया तो उनकी देह-भार वृद्धि 212 ग्राम प्रतिदिन रही। एक किग्रा दाना (जिसमें 18.8% प्रोटीन तथा 2.4 मेगा कैलोरी चयापचन ऊर्जा थी) देने से देह भार वृद्धि 419 ग्राम प्रतिदिन हो गई परन्तु सीरम में ग्लूकोज, कुल प्रोटीन, कोलेस्ट्रॉल, कैल्शियम तथा फॉस्फोरस की मात्रा में कम परिवर्तन आँका गया।

वयस्क ऊँटों के प्रजनन काल की अवधि में मोठचारा एवं 10% अतिरिक्त ऊर्जा के श्रोतों के रूप में जौ तथा तेल दिया गया। ऊँटों को सप्ताह में 2 बार वीर्य संकलन के लिए प्रयोग में लाया गया। प्रयोग की अवधि में ऊँटों के सीरम में ग्लूकोज, कोलेस्ट्रॉल, कैल्शियम एवं फॉस्फोरस की मात्रा पर अधिक प्रभाव नहीं पड़ा।

ऊँटों को पानी न मिलने की अवस्था में प्रतिदिन खाये जाने वाले चारे की मात्रा में निरंतर कमी आती है जिसके फलस्वरूप सोडियम, पोटेशियम, जिंक, मैग्नीज तथा लौह-तत्व शरीर को कम मात्रा में प्राप्त होते हैं। पुनः पानी पिलाये जाने पर सोडियम की मात्रा धीरे-धीरे पूर्ववत हो जाती है। पोटेशियम की उपलब्धता तीव्र गति से पूर्ववत हो जाती है।

ग्याभिन ऊँटनियाँ सामान्य ऊँटनियों की अपेक्षा अधिक चारा खाती हैं। अधिक मात्रा में शुष्क पदार्थ पचाती हैं जिसके कारण विभिन्न लवणों जैसे सोडियम, पोटेशियम, मैग्नीज, जिंक एवं लौह-तत्व की उपलब्धता ग्याभिन ऊँटनियों में सामान्य ऊँटनियों की अपेक्षा अधिक अधिक हो जाती है।

(5) ऊँट के प्रजनन पर अध्ययन

प्रजनन काल में अण्डाशय की अवस्था का स्पृश्यता द्वारा निरीक्षण करने पर 80% ऊँटनियों में परिपक्व फोलीकिल दाहिने, बाएँ अथवा दोनों अण्डाशयों में उपस्थित पाया गया।

EYCG को ऊँट के वीर्य संरक्षण के लिए एक उपयुक्त माध्यम पाया गया। जनन के उपरान्त 40-45 दिनों में बच्चेदानी अन्तराभिमुख हो जाती है

सहयोगिक कार्यक्रम पर अध्ययन :

केन्द्र ने अन्य अनुसंधान संस्थानों तथा कृषि विश्वविद्यालयों के साथ विभिन्न विषयों पर सहयोगिक अनुसंधान कार्य किया। इस मद में स्नातकोत्तर विद्यार्थियों द्वारा किया गया अध्ययन कार्य भी सम्मिलित है।

इस सत्र में 8 शोध पत्रों का प्रकाशन किया गया तथा 5 शोध पत्र प्रकाशन हेतु भेजे गये। वर्ष 1991-92 में केन्द्र पर लगभग 3109 लोगों का अभ्यागमन हुआ।

इस वर्ष केन्द्र के अनुसंधान कार्यों तथा अन्य दूसरे सभी कार्यों की समीक्षा एक पंचवर्षीय पुनर्विलोकन समीक्षा समिति द्वारा की गई। इस समिति ने केन्द्र के अब तक की प्रगति की सराहना की। ऊँट के मरुस्थल प्रदेश में बहुउद्देशीय उपयोग को देखते हुए इस केन्द्र को पूर्ण संस्थान का दर्जा देने की संस्तुति की है। इस समिति द्वारा भविष्य में अनुसंधान कार्य की रूपरेखा तथा संसाधनों एवं स्टाफ को बढ़ाने के बारे में विस्तार से सुझाव दिये हैं।

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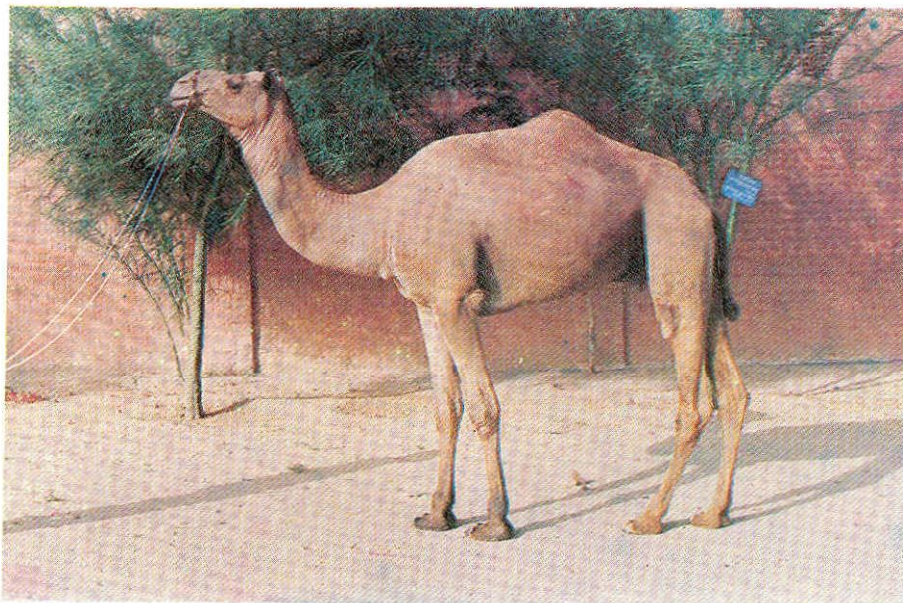


Fig. 6.2.3. Kachchi Camel

