



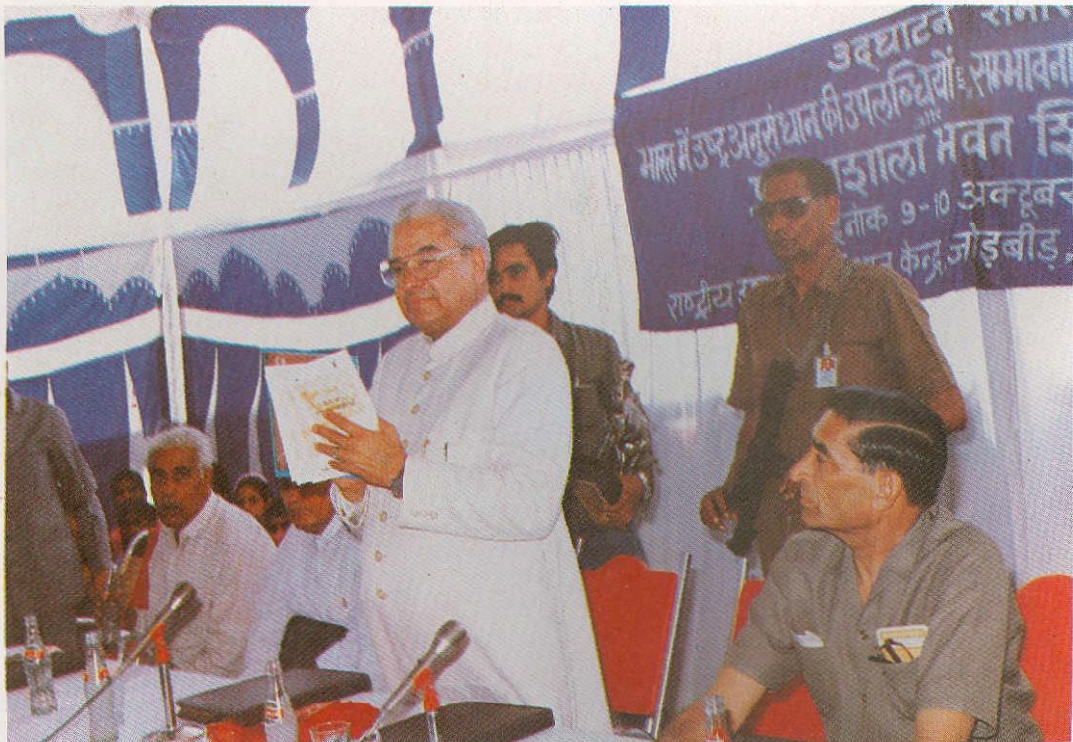
# ANNUAL REPORT 1988



**NATIONAL RESEARCH CENTRE ON CAMEL  
BIKANER**



Shri Bhajan Lalji, Hon'ble Minister of Agriculture laying foundation stone of Lab-cum-Office Building complex on 9th October, 1988.



Shri Bhajan Lalji, Hon'ble Minister of Agriculture releasing booklets on Camel Management in Hindi prepared for distribution to the Camel breeders.



## **ANNUAL REPORT 1988**



(Estd. 5th July, 1984)

PROJECT DIRECTOR: DR. N.D. KHANNA

**NATIONAL RESEARCH CENTRE ON CAMEL  
BIKANER**

## Contents

1	Introduction	3
2	Objectives and mandate	4
3	Staff position	5
4	Facilities	6
5	Camel strength	6
6	Camel health	8
7	Research projects	9
8	Inter-Institutional collaboration	55
9	Land and fodder development	63
10	Publications	63
11	Other activities	65
12	Financial statement	68
13	Advisory committee	70
14	Visitors	71
15	Annexure	71
16	Acknowledgements	75

# 1. INTRODUCTION

The distribution of camel is extent in the dry lands of India. About 0.32 m sq km hot desert is located in parts of Rajasthan (61%), Gujarat (20%), Punjab and Haryana (9%) and Andhra Pradesh and Karnataka (9%). Due to restrictive resource endowment, the livestock farming has economic edge in this zone. It is well established that the camel is an important component of desert livestock production system. Camel is a multipurpose animal, the principal uses being draught, transport and agricultural operations. The other utility areas are milk, hair, hide and meat. Camel utilizes various adaptive mechanism which are most suited to life in the arid lands. It can survive in the hot climate with high solar radiation and sustain on coarse fodder, salty and thorny bushes. Camel production system, therefore, has a great potential in the dry land.

India with camel population 1.1 m (base) 1985; ranked third after Somalia and Sudan having highest camel population in the world.

There has been 68.2% increase in camel population from 1945 to 1985. As per 1982 census, Rajasthan accounted for 70% of Indian camel population followed by Haryana (11.2%), Gujarat (6.9%) and Punjab (5.9%). 11 arid districts of Rajasthan had almost 60% of total Indian camel population.

The camel density in these districts was 3.06 per sq km and 4.78 per 100 persons and contributed 9.9% towards total domestic herbivore livestock biomass. The camel density in Rajasthan, Haryana, Gujarat and Punjab was 2.25, 2.78, 0.38 and 1.27 per sq km, respectively.

Recognising the importance of camel in the economic, social, ecological, agriculture and land use management in the dry lands, the Indian Council of Agricultural Research has established a National Research Centre on Camel (NRCC) at Bikaner with effect from 5th July, 1984 to carry out research on camel.

## 2. OBJECTIVES AND MANDATE

### 2.1 Objectives

- 1) To establish the work standards for baggage and riding camels.
- 2) To study and associate the work standards with physical, physiological and biochemical parameters.
- 3) To develop suitable management practices for camel improvement.
- 4) To develop suitable selection criteria on the basis of established standards for improvement of work capacity.
- 5) To conduct basic and applied research for camel improvement.

### 2.2 Missions

- 1) Establish work standards for baggage camel.
- 2) Establish work standards for riding camel.
- 3) Collection of base line data on physical, physiological and biochemical parameters.
- 3) Associate established work standards with physical, physiological and biochemical parameters.
- 5) Lowering the age at first service.
- 6) Improvement of management practices for reducing calf mortality and over all mortality.
- 7) Improvement of fertility rates.
- 8) Faster growth rate and early maturity.
- 9) Development of feed, fodder and browsing resources.
- 10) Improvement of camel health and

disease control.

### 2.3 Priorities and thrust in the 7th Plan

- 1) To study draughtability of camel and associate these with physical, physiological and biochemical parameters.
- 2) To develop suitable management practices for camel rearing.
- 3) To collect base line data on productive and reproductive traits in camels.

### 2.4 Research plan and perspective

As per the basic objectives of the Centre, three research projects have been initiated to generate information on (i) work standards of camels (baggage and riding type), work and rest cycle, nutrient requirements with possibilities of their use in different areas, (ii) biometrical and genetical studies to correlate with performance and draughtability, (iii) managerial practices for better upkeep and husbandry of camel rearing.

Supplementary informations are also being collected on disease control and health management. Areas of pasture and fodder development, range land management and planting fodder trees are concurrently in progress to increase fodder resources and self sufficiency.

At present, the following three research projects are under progress:-

- 1) To study work standards in camels and to associate the work standards with physical, physiological and biochemical parameters.
- 2) Studies on quantitative and qualitative genetic parameters in Indian camels.
- 3) To develop suitable managerial practices for rearing camels.

### 3.

## STAFF POSITION

3.1 At the time of establishment of the NRCC in the year 1984-85, 24 positions were sanctioned. Later, during 7th plan additional

31 positions have been created. The year-wise staff position at this Centre is given below:-

Staff categories	Sanctioned posts 6th plan	Positions filled (year-wise)					
		7th Plan	84	85	86	87	88
Project Director	1	—	1	1	1	1	1
Scientific Technical	2*	4	—	1	3	3	2
Category I	2	1	2	2	2	3	3
Category II	—	3	—	—	—	1	3
Category III	2	1	—	2	2	3	3
Administrative	4	6	3	6	7	7	8
Auxiliary	2	3	1	2	2	3	5
Supporting	11	13	11	11	14	22	22
<b>Total</b>	<b>24</b>	<b>31</b>	<b>18</b>	<b>25</b>	<b>31</b>	<b>43</b>	<b>47</b>

\* One converted to T-7 as per PIC recommendation.

### 3.2 The details of staff members in position during 1988:

**Project Director** : Dr. N.D. Khanna

**Scientific**

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

Senior Scientist (Animal Nutrition) : Vacant

Senior Scientist (Animal Reproduction) : Vacant

Scientist (Animal Gen. & Breeding) : Dr. S.N. Tandon

Scientist (Biochemistry) : Dr. H.K. Jindal Resigned on 15.05.1988

**Technical**

Farm Technician, T-7 (Health) : Dr. U.K. Bissa Joined on 5.12.1988

Vety. Officer, T-6 : Dr. U.K. Bissa Relieved on 04.12.1988

Livestock Farm Supdt. T-6 : Dr. N. Sharma

Farm Manager, T-6 : Sh. R.D. Prasad

Agriculture Asstt., T-II-3 : Sh. J.C. Joshi

Library Assistant, T-II-3 : Sh. Ram Dayal Joined on 11.05.1988

Livestock Asstt., T-2 : Sh. Mohan Singh  
Sh. Ram Chander

Lab. Technician, T-1 : Sh. Nand Kishore

**Administration**

Asstt. Admin. Officer : Sh. Santokh Singh

Asstt. Accounts Officer : Sh. G.R. Bhansali Relieved on 01.02.1988

Superintendent : Sh. Balwant Rai

Jr. Stenographer : Sh. M.P. Kumar

: Sh. Ram Kumar

Jr. Clerk : Sh. Kanwar Pal

: Sh. Ashok Kumar

: Sh. Jamil Ahmad

**Auxiliary**

Driver : Sh. Shivji Ram  
: Sh. Mehboob Hussain  
: Sh. Prabhu Dayal  
: Sh. Rafiq Alam

**Supporting**

SSG-I to V : 22

## 4. FACILITIES

i) Animals – 183 camels belonging to Bikaneri (119), Kutchi (37), Jaisalmeri (18), Arab (1) and cross-bred between Arab and Bikaneri (8) were available at the end of the year.

ii) Laboratories – Awaiting construction of proper laboratory building, the laboratories are presently housed at the Farm Office which has been renovated for this purpose. Apart from routine laboratory equipments, the centre has acquired some specialised equipments, namely, Coulter haematological counter, Blood chemistry analyser, Blood gas

analysers, UV-visual spectro-photometer, multichannel physiograph, Refrigerated centrifuge, Load cells with recorder and monitor etc.

iii) Farm land and other facilities – The centre has 824 hectares of land, two tubewells, one open well, two tractors, two jeeps, one mini bus, two water tankers and other agricultural implements. One fodder growing "Fometa" machine with maximum output of one tonne a day, has been provided to this centre. The Library had 268 books by the end of 1988.

## 5. CAMEL STRENGTH

There were 158 animals at the beginning of the year, out of which 112 were of Bikaneri breed, 30 Kutchi, 7 Jaisalmeri, 1 Arab, 8 Crossbreds between Arab X Bikaneri.

During the period under report 2 males and 8 females of Jaisalmeri breed were purchased. 38 calves (19 males and 19 females) were born at the farm. 10 animals died during this year. 12 animals were disposed off through auction. At the end of the year, the Centre had a total of 183 animals, consisting of 58 males and 125

females (Table 1). Of these, 43.7% were growing animals (between 0-3 years) of both sexes, 4.9% of the herd were studs which were used for breeding at the farm and for the extension work for providing services to the outside animals. 6.6% males were kept for draught capacity experiments and transport. The breedable females were 44.8% of the herd. The ratio of males and females at the end of the year was 32 : 68.



TABLE - 1  
Camel Strength-1988

Breed	Age group	Addition						Subtraction							
		Opening balance		Claving		Purchase		Death		Disposal		Closing balance			
		M	F	M	F	M	F	M	F	M	F	M	F		
Bikaneri	0-3 months	2	5	13	14	1	2	-	-	-	-	1	-	1	16
	3-12 months	3	4			-	-	-	-	-	-	14	-	10	15
	1-3 years	11	16			1	1	1	1	2	4	15	-	46	2
	3-15 years	17	52			1	-	-	-	-	-	3	-	-	-
	Above 15 years	-	2			-	1	-	-	-	-	-	-	-	-
Kutchi	0-3 months	-	-	3	4	-	-	-	-	-	-	2	-	2	1
	3-12 months	4	-			-	-	-	-	-	-	2	-	4	-
	1-3 years	2	2			-	-	-	-	-	-	4	-	4	21
	3-15 years	2	20			-	1	-	-	-	-	4	-	4	21
Jaisalmeri	0-3 months	-	-	1	1	1	-	-	-	-	-	-	-	-	-
	3-12 months	-	-			-	-	-	-	-	-	-	-	-	2
	1-3 years	-	1			-	-	-	-	-	-	-	-	-	-
	3-15 years	1	5		2	8	-	-	-	-	-	3	-	3	13
Arab	3-15 years	1	-			-	-	-	-	-	-	1	-	-	-
Arab X	0-3 months	-	2	2	0	-	-	-	-	-	-	-	-	-	-
	3-12 months	-	4			-	-	-	-	-	-	2	-	2	2
Bikaneri	1-3 years	1	1			-	1	-	-	-	-	1	-	1	3
	3-15 years	-	-			-	-	-	-	-	-	-	-	-	-
Total		44	114	19	19	2	8	4	6	3	9	58	125		

## 6. CAMEL HEALTH

### 6.1 Clinical cases

A total of 118 clinical cases were treated during the year 1988 consisting of digestive disorder (11), respiratory infection (7), reproductive disorder (10), circulatory disorder (1), contagious ecthyma (10), mange (36), wounds (39) and unspecified (4). In addition two cases of abortions were also recorded. The aborted foetuses were 9 months and 6 months. Routine bacteriological tests were also negative in the aborted animals.

### 6.2 Prophylactic measures

- i Ectoparasites – The animals and sheds were routinely sprayed with insecticides twice a year to control ectoparasites.
- ii Endoparasites: a) 25 percent of the herd was examined for the worm load. Eggs count per gm of faecal matter did not exceed 500. b) Whole herd was routinely drenched with anthelmintics twice a year.
- iii Trypanosomiasis – Chemotherapeutic agents (Quinapyramine sulphate & chloride)

were administered twice a year as a prophylactic measure against Surra.

### 6.3 Mortality

During the year, 4 calves aged 0-3 months, 3 animals aged 3 months to 3 years and 3 animals above 3 years died. Death due to severe enteritis was noticed in 5 cases, pneumonia in two cases and one each of metritis, cirrhosis of liver and heat stroke in a very young camel calf.

Age group-wise mortality:-

0-3 months 1.11/1000 camel days/day

3 months to 3 years 0.27/1000 camel days/day

Above 3 years 0.06/1000 camel days/day

Sex wise mortality:-

Male-0.19/1000 camel days/day

Female-0.13/1000 camel days/day

Overall mortality-0.15/1000 camel days/day

No major out break of any infectious or contagious disease was recorded at the farm during the year under report.

## 7. RESEARCH PROJECTS

7.1 Project Code No. P.I. 86/1-ICN/  
L-50/5220

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

Project Leader: A.K. Rai  
Associates: N.D. Khanna  
S.N. Tandon  
Technical Assistance: U.K. Bissa

The study on draughtability in Bikaneri camels was carried out using two wheel and four wheel camel carts with broad pneumatic tyres. Typical kutchra road of the desert area was used in all the experiments on draughtability with two wheel carts, whereas, pucca road was used for the four wheel cart.

Five adult Bikaneri males were used in rotation in this project where 2 animals were used in two wheel cart, one in four wheel cart and the remaining two served as controls, one each in sun and shed. Physical measurements of animals were recorded.

Load on the carts varied from 2.5 to 2.8 kg/kg body weight. Animals were made to pull load and used for riding for 4 hours a day continuously. The observations were recorded on 1st and 6th day.

### 7.1.1. Physiological parameters

Pulse, respiration and rectal temperature were recorded and blood samples were collected immediately before the animals

proceeded for draught/riding and within 5 minutes on their return after work. The percent increase in rectal temperature, pulse and respiration due to load pulling and riding is presented in Fig. 1.

There was a gradual increase in rectal temperature with increasing hours of work. In the animals pulling load on a 2 wheel cart, the average increase in rectal temperature was 4.9°C (13.1%), on a four wheel cart 2.2°C (5.9%), while in the control animals it was 0.5°C (1.3%). After 4 hr rest, the rectal temperature of experimental animals and control animals were almost comparable (Fig. 2).

In the animals under riding, the average increase in rectal temperature was found to be 2.9°C (7.7%). The increase was more pronounced during April and May as compared to July and August (Fig. 2).

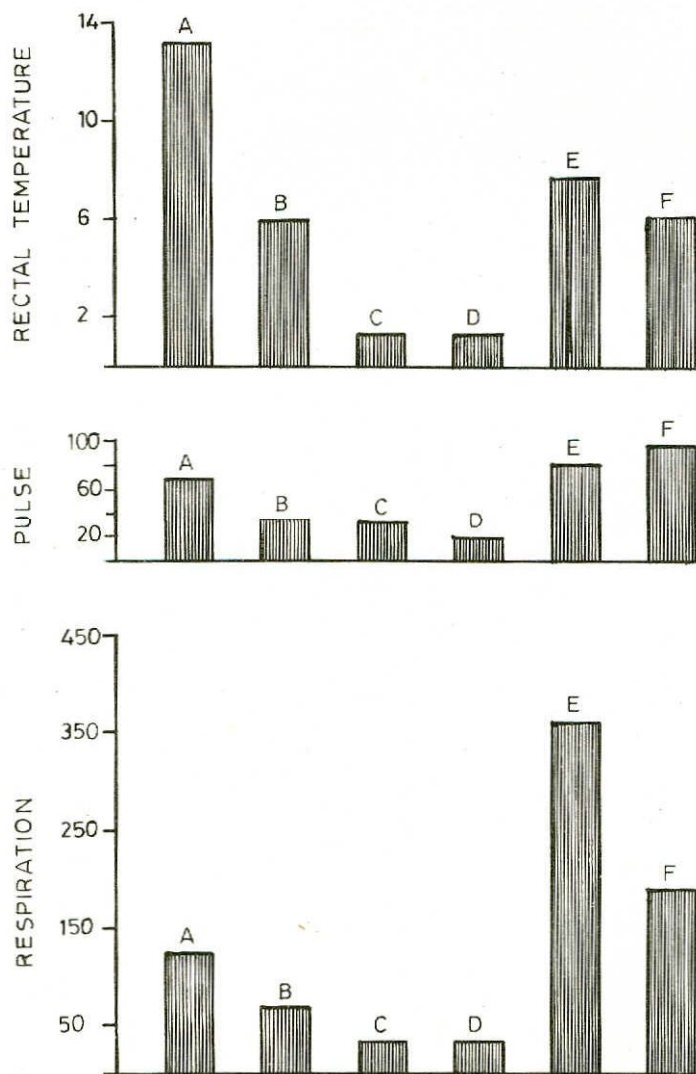
### 7.1.2. Blood gas parameters

The pH of blood of camels pulling 2 wheel cart recorded at rectal temperature showed a marginal increase at 1 hr but it declined after 4 hr of work. The initial levels were not achieved even after 24 hr rest. Significant increase in  $PCO_2$  and  $PO_2$  after 4 hr work was observed which declined following rest. The values for pH and blood gases when adjusted to 37°C, reflected slight increase in pH after 4 hr load pulling, the pH however, declined following rest.  $PCO_2$  and  $PO_2$  showed marginal fluctuations (Table 2).

The camels used in four wheel cart did not show change in blood pH at rectal temperature after 4 hr work, it, however, declined after 2 hr

Fig. 1

PERCENT INCREASE IN RECTAL TEMPERATURE, PULSE AND RESPIRATION RATES DUE TO LOAD PULLING AND RIDING



TWO WHEEL CART	A	CONTROL (SHED)	D
FOUR WHEEL CART	B	RIDING (APR - MAY)	E
CONTROL (SUN)	C	RIDING (JUL - AUG)	F

CHANGES IN RECTAL TEMPERATURE OF CAMEL  
DUE TO LOAD PULLING AND RIDING

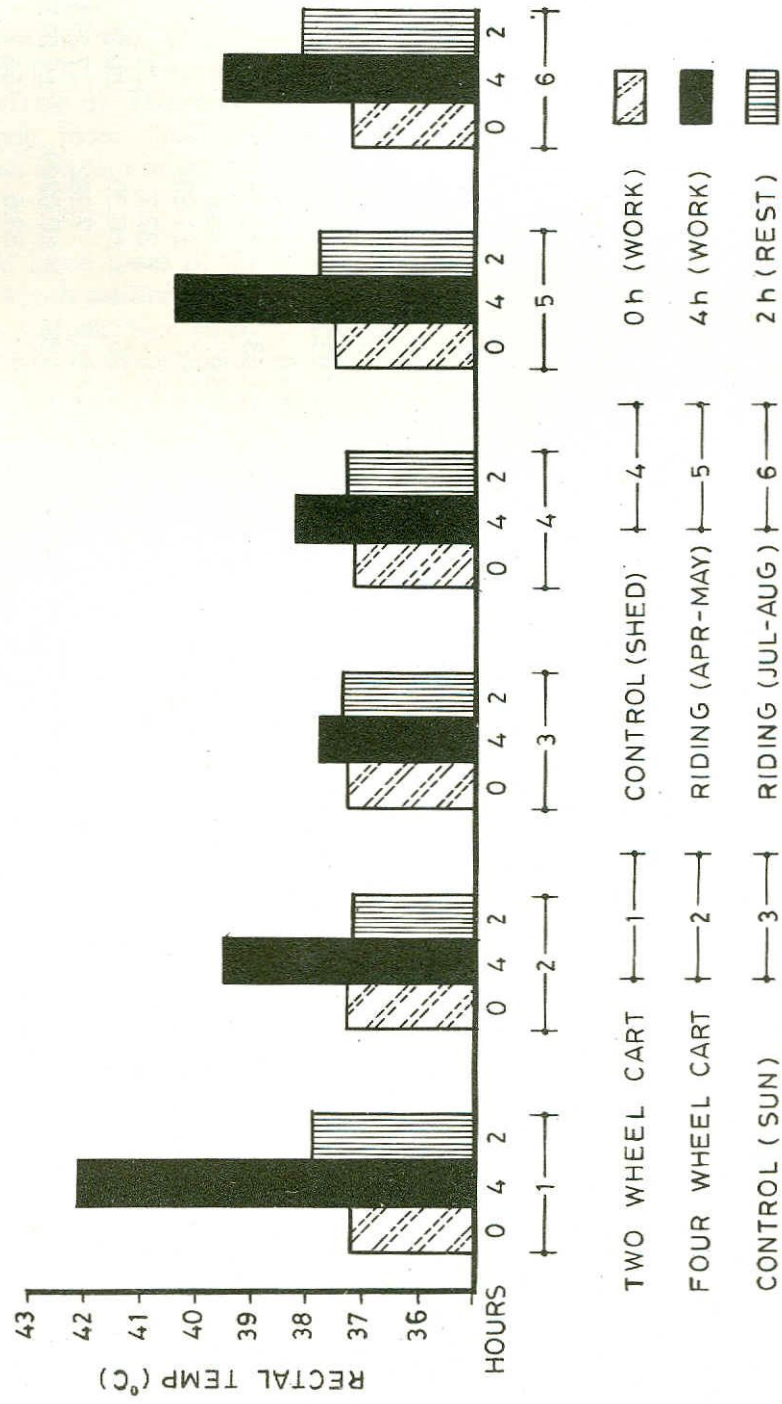


Fig. 2

TABLE - 2  
Changes in pH and blood gases of camels due to load pulling in a two wheel cart

	Work				Rest		
	0h	1h	4h	2h	4h	24h	
Hb (g/dl) At 37°C	12.0 ±0.26	11.7 ±0.28	11.0 ±0.25	12.9 ±0.26	13.0 ±0.32	11.9 ±0.70	
pH	7.327 ±0.0169	7.361 ±0.0250	7.357 ±0.0166	7.279 ±0.0306	7.291 ±0.0302	7.274 ±0.0130	
PCO <sub>2</sub> (mmHg)	52.4 ±1.53	49.4 ±2.55	49.2 ±2.07	54.0 ±1.53	52.1 ±2.58	56.4 ±2.70	
PO <sub>2</sub> (mmHg)	31.5 ±0.50	38.3 ±2.33	36.5 ±4.17	33.6 ±1.45	33.6 ±1.20		
Rectal Temp(°C)	37.2 ±0.11	38.1 ±0.55	42.1 ±1.35	37.9 ±0.26	37.7 ±0.30	37.1 ±0.05	
pH	7.324 ±0.0158	7.325 ±0.0319	7.284 ±0.0092	7.267 ±0.0287	7.282 ±0.0269	7.273 ±0.0115	
PCO <sub>2</sub> (mmHg)	52.8 ±1.39	51.9 ±3.80	61.4 ±3.05	55.9 ±1.38	53.6 ±2.03	56.7 ±2.95	
PO <sub>2</sub> (mmHg)	32.0 ±0.41	42.0 ±3.0	54.0 ±10.0	35.0 ±1.0	35.3 ±1.20	39.5 ±7.5	

rest. On the other hand, marginal increase was noted in  $PCO_2$  and  $PO_2$ . pH values adjusted at  $37^\circ C$  increased after 4 hr work and later sharply declined after 2 hr rest. Adjusted values of  $PCO_2$  and  $PO_2$  showed only marginal fluctuations (Table 3). The results suggested comparatively more stress on animals used in 2 wheel cart for similar load than 4 wheel cart.

Changes in pH and blood gases of the camels under riding for 4 hr showed increase in pH and only marginal fluctuations in  $PCO_2$  and  $PO_2$  both at rectal temperature and at adjusted  $37^\circ C$  (Table 4 and 5).

The magnitude of changes in rectal temperature, pH and blood gases of riding camels were comparable with the changes observed in camels used in 4 wheel cart. The respiratory frequency, however, was much higher in riding camels specially during April, May as compared to camels under load pulling (Fig. 1),

Control animals kept in sun and shed, did not show significant variations in rectal temperature, pH and blood gases (Table 6 and 7).

Studies on haematological changes in camels consequent to load pulling in two wheel cart, four wheel cart or riding did not reflect any significant variation in RBC, PCV and haemoglobin content in blood collected at different hours of work and rest (Fig. 3 and 4).

### 7.1.3 Biochemical parameters

For studying biochemical changes under riding, the blood samples were collected at 0 hr, 1 hr, 2 hr of riding and after 2 hr rest. Acid phosphatase (ACP), aspartate aminotransferase (AST) and creatine kinase (CK) were estimated in serum using Beckmensch DU clinical system. The ACP activity declined after 2 hours rest from an initial level of 4.53 to 3.49

u/l. The creatine kinase activity showed increasing trend with increase in period of exercise which did not decline following rest for 2 hr (Fig. 5).

### 7.1.4 Haematological studies

45 blood samples from three different age groups viz., below one year, 2-3 years and adult were collected during the months of December for haematological and biochemical studies (Table 8 and 9). The data were subjected to Duncan's Multiple Range Test. The results revealed no difference between sexes for RBC count in animals below one year, in growing animals (2-3 years) the count was lower in females than males, however, the pregnant females had higher RBC count than the adult males.

The RBC count of growing males (2-3 years) was significantly higher than the adult males, whereas, the females below one year and pregnant animals had higher RBC count than the growing females (2-3 years).

The WBC count did not exhibit significant sex difference in animals below one year and 2-3 years, however, the adult males had higher WBC count as compared to pregnant females.

No significant differences were found in other haematological attributes (Tables 10).

### 7.1.5 Enzyme studies

ACP activity was significantly higher ( $P < 0.01$ ) in growing animals (2-3 years) than the other 2 groups. There was no sex difference. ALP activity was higher in males than females in animals below one year and 2-3 years of age but adult females had higher ALP than adult males. LDP activity was higher ( $P < 0.01$ ) in males below one year and 2-3 years as compared to adults. AST activity was higher in animals below one year and 2-3 years as compared to adults (Table 11).

TABLE -3  
Changes in pH and blood gases of camels due to load pulling in a four wheel cart followed by rest

	Work			Rest	
	0h	1h	4h	2h	2h
Hb (g/dl)	10.9	9.7	10.5	10.8	10.8
At 37°C	±0.84	±0.54	±0.80	±1.2	±1.2
pH	7.210	7.337	7.344	7.261	7.261
	±0.103	±0.0065	±0.0075	±0.008	±0.008
PCO <sub>2</sub>	50.5	52.1	53.3	57.3	57.3
(mmHg)	±2.80	±1.80	±0.45	±1.00	±1.00
PO <sub>2</sub>	37.5	42.5	36.0	33.5	33.5
(mmHg)	±3.50	±0.50	±2.00	±1.50	±1.50
Rectal Temp (°C)	37.3	38.0	39.5	37.0	37.0
	±0.23	±0.26	±0.39	±0.02	±0.02
pH	7.313	7.320	7.312	7.250	7.250
	±0.0275	±0.0035	±0.0000	±0.0155	±0.0155
PCO <sub>2</sub>	50.6	54.9	57.9	57.8	57.8
(mmHg)	±3.10	±2.30	±0.95	±1.00	±1.00
PO <sub>2</sub>	38.0	46.5	42.0	33.5	33.5
(mmHg)	±3.00	±0.50	±4.00	±1.50	±1.50



TABLE - 4  
Changes in pH and blood gases of camels due to riding followed by rest at different hours

	Work						Rest		
	0h	1h	2h	3h	4h	2h	24h		
Hb (g/dl)	12.2	11.9	11.6	11.3	11.4	12.0	11.6		
At 37°C	±0.95	±0.68	±1.02	±1.35	±0.81	±0.70	±0.97		
pH	7.246	7.324	7.253	7.279	7.350	7.212	7.245		
	±0.0544	±0.0507	±0.0205	±0.0205	±0.0404	±0.0309	±0.0507		
PCO <sub>2</sub> (mmHg)	55.4	58.9	67.0	63.2	57.9	67.6	59.8		
	±1.23	±4.36	±3.23	±3.17	±4.84	±2.88	±5.25		
PO <sub>2</sub> (mmHg)	39.3	37.6	31.0	33.0	33.6	26.6	35.3		
	±5.81	±1.83	±2.31	±2.00	±1.54	±1.81	±4.96		
Rectal Temp (°C)	37.5	39.3	39.6	39.6	40.4	37.8	37.6		
	±0.07	±0.27	±0.07	±0.10	±0.34	±0.26	±0.06		
pH	7.289	7.275	7.216	7.242	7.301	7.202	7.237		
	±0.0341	±0.0361	±0.0194	±0.0209	±0.0361	±0.0317	±0.0512		
PCO <sub>2</sub> (mmHg)	56.2	65.2	75.2	70.8	66.7	71.9	61.3		
	±0.95	±4.38	±3.40	±3.81	±5.22	±3.82	±5.50		
PO <sub>2</sub> (mmHg)	40.7	42.0	37.3	39.0	43.0	29.8	36.8		
	±6.12	±1.41	±2.33	±2.00	±2.30	±3.07	±5.48		

TABLE -5  
Changes in pH and blood gases of camels due to riding followed by rest at different hours

	Work			Rest	
	0h	1h	4h	2h	
Hb (g/dl)	12.4	11.8	11.3	12.1	
At 37°C	±0.95	±0.87	±0.68	±0.79	
pH	7.303	7.354	7.376	7.281	
	±0.0077	±0.0408	±0.0322	±0.0089	
PCO <sub>2</sub>	58.2	55.4	52.0	57.8	
(mm Hg)	±0.26	±2.76	±3.11	±0.91	
PO <sub>2</sub>	32.8	34.0	32.8	34.4	
(mm Hg)	±0.92	±2.04	±0.80	±1.29	
Rectal Temp (°C)	37.2	38.7	39.5	38.1	
	±0.49	±0.64	±0.74	±0.19	
pH	7.302	7.314	7.338	7.266	
	±0.0069	±0.0207	±0.0217	±0.0082	
PCO <sub>2</sub>	58.4	59.4	57.8	60.8	
(mm Hg)	±1.00	±1.38	±1.82	±1.08	
PO <sub>2</sub>	33.0	39.3	39.8	37.2	
(mm Hg)	±1.10	±2.87	±2.58	±1.66	

TABLE --6  
Changes in pH and blood gases of control camels under sun

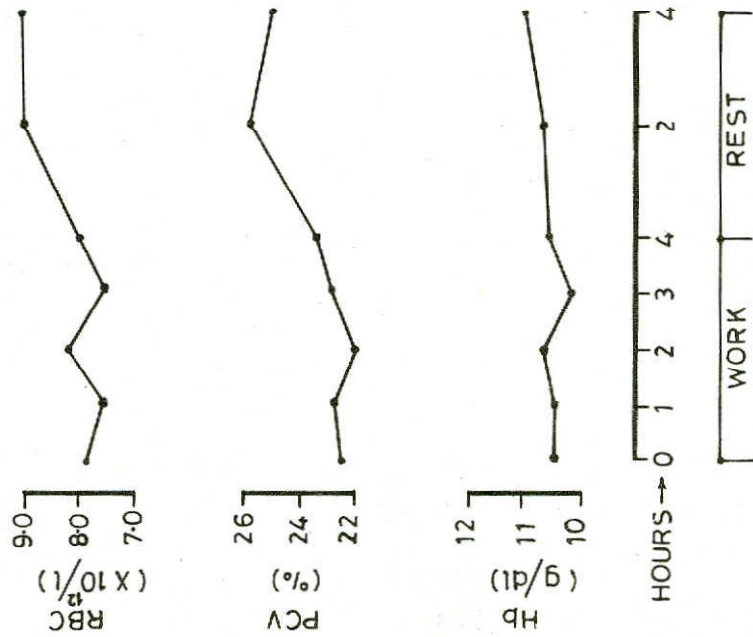
	Work				Rest		
	0h	1h	4h	2h	24h		
Hb (g/dl)	13.5	13.0	13.3	13.5	12.7		
At 37°C	±0.62	±0.75	±0.87	±0.61	±0.44		
pH	7.285	7.307	7.296	7.265	7.257		
	±0.0270	±0.0200	±0.0150	±0.0160	±0.0440		
PCO <sub>2</sub>	57.5	52.6	58.3	60.8	61.1		
(mm Hg)	±2.37	±1.30	±1.91	±2.40	±4.10		
PO <sub>2</sub>	43.8	38.5	34.8	34.0	34.5		
(mm Hg)	±4.74	±0.50	±2.06	±1.61	±3.50		
Rectal Temp (°C)	37.3	37.4	37.8	37.4	37.4		
	±0.20	±0.28	±0.20	±0.17	±0.37		
pH	7.281	7.302	7.285	7.259	7.251		
	±0.0250	±0.0200	±0.0140	±0.0160	±0.0480		
PCO <sub>2</sub>	58.2	53.5	60.3	62.0	62.4		
(mm Hg)	±2.31	±1.93	±1.79	±2.61	±5.10		
PO <sub>2</sub>	44.6	39.5	36.4	35.2	35.5		
(mm Hg)	±4.33	±0.50	±1.96	±1.53	±2.50		

TABLE -7  
Changes in pH and blood gases of control camels under shed

	Work						Rest		
	0h	1h	2h	4h	2h	4h	24h	4h	24h
Hb (g/dl)	14.0	13.9	14.5	14.2	14.1	14.7	13.7	14.7	13.7
At 37°C	±0.27	±0.30	±0.53	±0.25	±0.23	±0.40	±0.30	±0.40	±0.30
pH	7.269	7.257	7.166	7.261	7.257	7.281	7.262	7.281	7.262
	±0.0163	±0.0171	±0.0856	±0.0116	±0.0094	±0.021	±0.003	±0.021	±0.003
PCO <sub>2</sub> (mm Hg)	57.3	56.8	55.35	57.7	58.8	53.0	57.8	53.0	57.8
	±1.87	±1.63	±5.45	±1.94	±0.76	±4.50	±2.95	±4.50	±2.95
PO <sub>2</sub> (mm Hg)	32.8	34.0	39.0	31.5	32.8	35.5	31.5	35.5	31.5
	±1.45	±2.08	±2.00	±0.85	±0.48	±1.50	±3.50	±1.50	±3.50
Rectal Temp (°C)	37.2	37.3	37.2	37.7	37.3	37.7	37.7	37.7	37.7
	±0.09	±0.21	±0.12	±0.27	±0.18	±0.15	±0.20	±0.15	±0.20
pH	7.266	7.251	7.164	7.254	7.254	7.272	7.271	7.272	7.271
	±0.0164	±0.0154	±0.0842	±0.0121	±0.0103	±0.0185	±0.0175	±0.0185	±0.0175
PCO <sub>2</sub> (mm Hg)	57.8	57.9	56.0	58.9	59.1	54.4	59.6	54.4	59.6
	±1.92	±1.48	±5.95	±2.31	±0.89	±4.40	±3.55	±4.40	±3.55
PO <sub>2</sub> (mm Hg)	33.3	34.5	39.5	32.3	33.5	37.5	34.0	37.5	34.0
	±1.63	±2.08	±1.50	±0.95	±0.72	±1.50	±4.00	±1.50	±4.00

HAEMATOLOGICAL CHANGES IN CAMEL DURING LOAD PULLING

TWO WHEEL CART



FOUR WHEEL CART

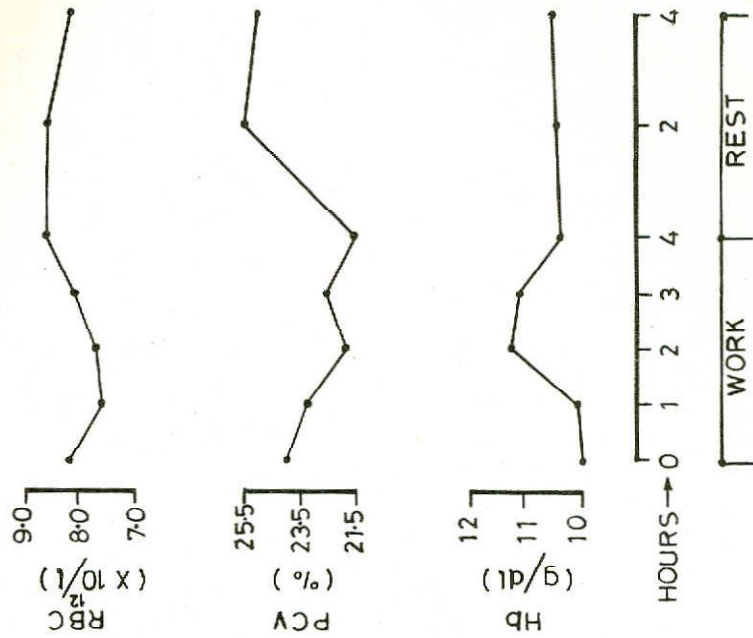
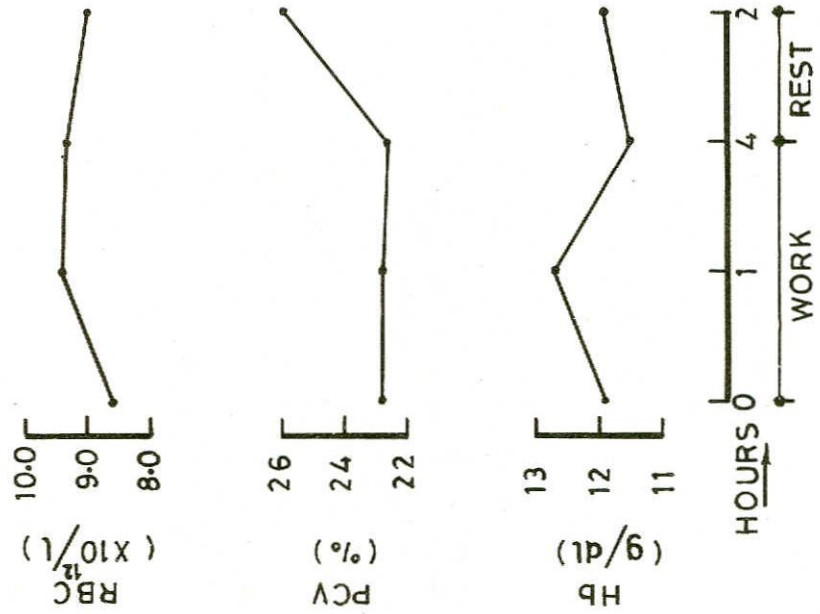


Fig. 3

Fig. 4

HAEMATOLOGICAL CHANGES IN CAMEL

UNDER RIDING



CONTROL

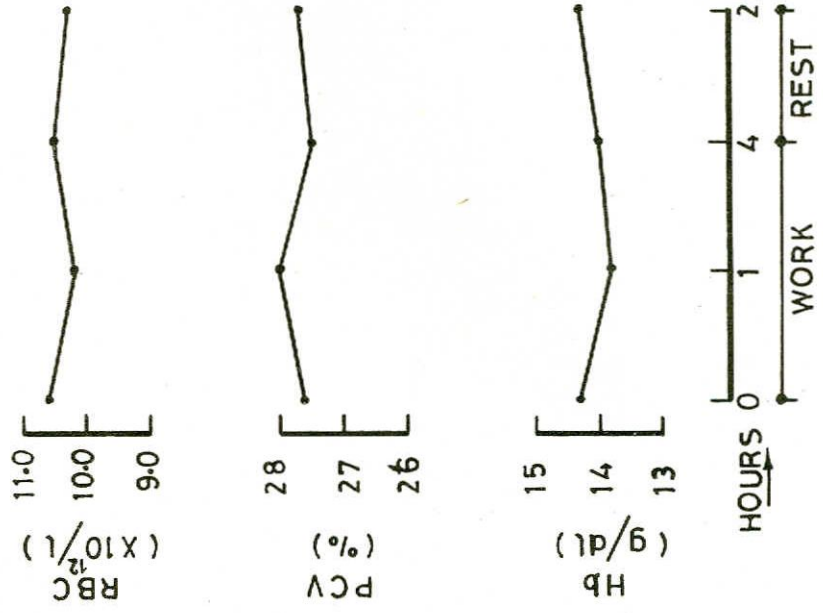


Fig. 5

### EFFECT OF RIDING ON SERUM ENZYMES OF CAMEL

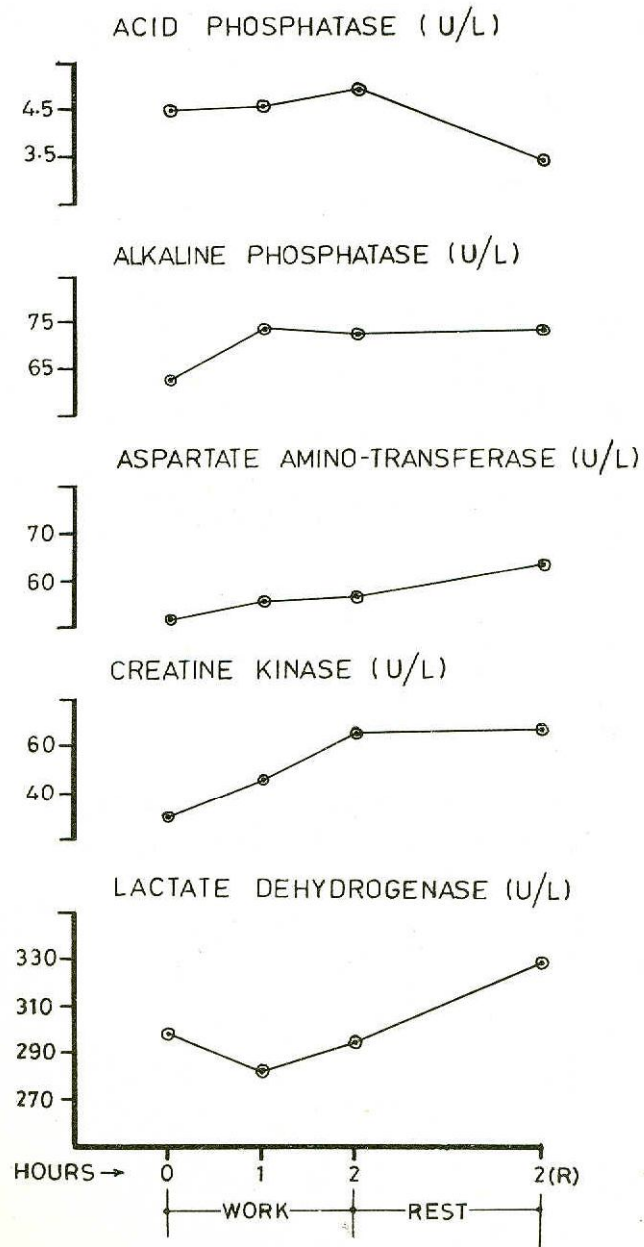


TABLE - 8  
Haematological attributes in different age groups of camel

	0-1 year		2-3 years		Adult	
	Male	Female	Male	Female	Male	Females pregnant
RBC ( $\times 10^{12}/l$ )	11.27 $\pm 0.39$	12.02 $\pm 0.74$	11.97 $\pm 0.57$	9.92 $\pm 0.60$	10.36 $\pm 0.42$	11.49 $\pm 0.29$
WBC ( $\times 10^9/l$ )	6.80 $\pm 0.70$	6.5 $\pm 0.58$	6.98 $\pm 0.58$	8.73 $\pm 0.58$	10.38 $\pm 0.51$	8.39 $\pm 0.56$
MCV (fl)	21.83 $\pm 2.46$	19.92 $\pm 1.16$	21.83 $\pm 1.92$	25.75 $\pm 3.29$	21.35 $\pm 1.21$	25.91 $\pm 1.76$
PCV (%)	24.48 $\pm 2.98$	23.95 $\pm 2.46$	25.65 $\pm 1.43$	25.55 $\pm 3.95$	21.14 $\pm 1.26$	29.97 $\pm 2.61$
Hb (g/dl)	11.33 $\pm 0.42$	12.53 $\pm 0.45$	12.10 $\pm 0.57$	11.37 $\pm 0.39$	12.76 $\pm 0.48$	12.29 $\pm 0.26$



TABLE - 9  
Serum enzymes in different age groups of camel

	Acid Phosphatase (u/l)		Alkaline Phosphatase (u/l)		Lactate Dehydrogenase (u/l)		Aspartate Aminotransferase (u/l)		Creatine Kinase (u/l)	
	M	F	M	F	M	F	M	F	M	F
Below 1 year	3.4 ±0.24	3.5 ±0.31	92.2 ±11.82	84.0 ±15.43	489.2 ±54.99	446.7 ±33.69	71.7 ±5.73	67.5 ±7.85	56.3 ±7.92	52.9 ±18.42
2-3 years	6.1 ±1.08	6.5 ±0.70	184.8 ±23.02	80.8 ±7.57	442.4 ±16.42	495.3 ±22.15	74.4 ±2.81	73.6 ±2.00	47.9 ±4.08	43.4 ±3.49
Adults	4.3 ±0.33	4.0 ±0.25	32.4 ±7.27	68.6 ±2.24	176.0 ±12.88	445.7 ±17.17	42.3 ±6.10	52.7 ±3.62	37.9 ±6.54	41.6 ±3.90

TABLE - 10  
Haematological parameters in different age groups and sexes

MSS						
	RBC	WBC	MCV	PCV	Hb	Remarks
Between Groups	2.2579 (2)	32.6049** (2)	35.7566 (2)	8.3308 (2)	3.1431 (2)	df given in Parentheses
Between Sex	0.0883 (1)	0.3151 (1)	52.1310 (1)	81.4547 (1)	1.0903 (1)	
Interaction	11.3245** (2)	14.5090* (2)	44.7965 (2)	128.6081 (2)	3.5038 (2)	
Error	1.8088 (45)	3.4143 (45)	37.6899 (45)	63.2335 (45)	1.4475 (45)	
G1	(MF)	(FM)				
G2	(F)(M)	(MF)				
G3	(M)(F)	(F)(M)				
M	(G <sub>3</sub> G <sub>1</sub> )(G <sub>1</sub> G <sub>2</sub> )	(G <sub>3</sub> G <sub>1</sub> G <sub>2</sub> )				
F	(G <sub>2</sub> )(G <sub>3</sub> G <sub>1</sub> )	(G <sub>2</sub> G <sub>3</sub> G <sub>1</sub> )				

\*\* P<0.01, G1 = Below 1 year, G2 = 2-3 years, G3 = Adult

M = Male, F = Female

Any two means in the same parenthesis are significantly not different.

TABLE - 11  
Serum enzymes in different age groups and sexes

		MSS					Remarks
		Acid phosphatase (ACP)	Alkaline phosphatase (ALP)	Creatine kinase (CK)	Lactate dehydrogenase (LDP)	Aspartate aminotransferase (AST)	df given in Parentheses
Between Groups		26.4836** (2)	24483.57** (2)	800.1199 (2)	125208.02** (2)	2551.64** (2)	
Between Sex		0.0341 (1)	6518.5397** (1)	19.9207 (1)	85135.39** (1)	2.0682 (1)	
Interaction		0.4112 (2)	17828.42** (2)	76.6289 (2)	93164.16** (2)	100.6691 (2)	
Error		1.8430 (42)	857.86 (42)	450.5645 (42)	3443.84 (41)	180.1880 (40)	
G1			(F) (M)		(FM)		
G2			(F) (M)		(MF)		
G3			(M) (F)		(M) (F)		
M	(G <sub>1</sub> G <sub>3</sub> )(G <sub>2</sub> )		(G <sub>3</sub> )(G <sub>1</sub> )(G <sub>2</sub> )		(G <sub>3</sub> )(G <sub>2</sub> G <sub>1</sub> )	(G <sub>3</sub> )(G <sub>1</sub> G <sub>2</sub> )	
F	(G <sub>3</sub> G <sub>2</sub> G <sub>1</sub> )		(G <sub>3</sub> G <sub>2</sub> G <sub>1</sub> )		(G <sub>3</sub> G <sub>1</sub> G <sub>2</sub> )		

\*\* P<0.01, G1 = Below 1 year, G2 = 2-3 years, G3 = Adult, M = Male, F = Female  
Any two means in the same parenthesis are significantly not different.

### 7.1.6 Feed and water uptake

Data is being collected on dry matter uptake per day of animals during work and rest period. The results so far indicated that dry matter uptake per 100 kg body weight per day did not show significant variation.

In general, the water consumption of camels was higher during the period of rest which followed work stress. The control animals consumed comparatively lesser water during the same period (Fig. 6). Seasonal variation in water uptake was more pronounced.

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

#### **Title:**

**Studies on quantitative and qualitative genetic parameters in Indian camels.**

Project Leader: N.D. Khanna  
Associates: S.N. Tandon  
A.K. Rai

### 7.2.1 Population trends and distribution of camels in India

In 1985, India had 6.3% of 17.4 million world camel population. The Indian camel population as percentage of the world population remained fairly constant during last four decades (Table 12). The world camel population recorded 74.8% growth from 1945-85 while that of India was 68.2% during the same period.

State-wise camel population from 1945 to 1982 is presented in table 13. Rajasthan had maximum camel population followed by Haryana, Gujarat and Punjab. The other states where there were more than one thousand camels were Himachal Pradesh, Jammu and Kashmir, Madhya Pradesh, Maharashtra and Uttar Pradesh (Fig. 7).

In Rajasthan, the camel population which was 58.10% of Indian Camel population in 1945 increased to 70.13% in 1982. In Haryana, the camel population was 30.35% of Indian camel population in 1966 declined to 11.22% in 1982. In Gujarat, the camel population was 4.87% of Indian camel population in 1961, increased in two decades, to 6.96%. Punjab had 5.94% of total Indian camel population. Camel density in Punjab was 1.27 per sq km and 0.38 per 100 persons.

District-wise camel density in Rajasthan during 1982 is presented in table 14. The camel density in this state was 2.25 per sq km and 2.22 per 100 persons. Seven district, namely, Barmer, Bikaner, Churu, Ganganagar, Jaisalmer, Jodhpur and Jhunjhunu had more than 50,000 camels (Fig. 8).

Camel population in 11 arid districts of western Rajasthan viz., Barmer, Bikaner, Churu, Ganganagar, Jaisalmer, Jalore, Jhunjhunu, Jodhpur, Nagaur, Pali and Sikar was 84.52% of total Rajasthan camel population and 59.28% of Indian camel population (base 1982). These 11 districts had 3.06 camels per sq km and 4.78 camels per 100 persons. Camel density per sq km was highest in Jhunjhunu district (6.41 per sq km) and lowest in Pali (0.97 per sq km). Camel per 100 persons was highest in Jaisalmer (21.85 per 100 persons) and lowest in Pali (0.94 per 100 persons). The total domestic herbivore livestock biomass (TDHLBM) was calculated on the basis of average tropical weights (Cattle 206 kg, Buffalo 205 kg, Sheep 30 kg, Goat 18 kg, Horse 250 kg, Donkey 107 kg and Camel 307 kg). It was observed that average TDHLBM in these 11 districts was 9471.18 kg per sq km. Lowest TDHLBM per sq km was recorded in Jaisalmer while Sikar had highest (Table 15).

# WATER CONSUMPTION OF CAMEL DURING WORK AND REST

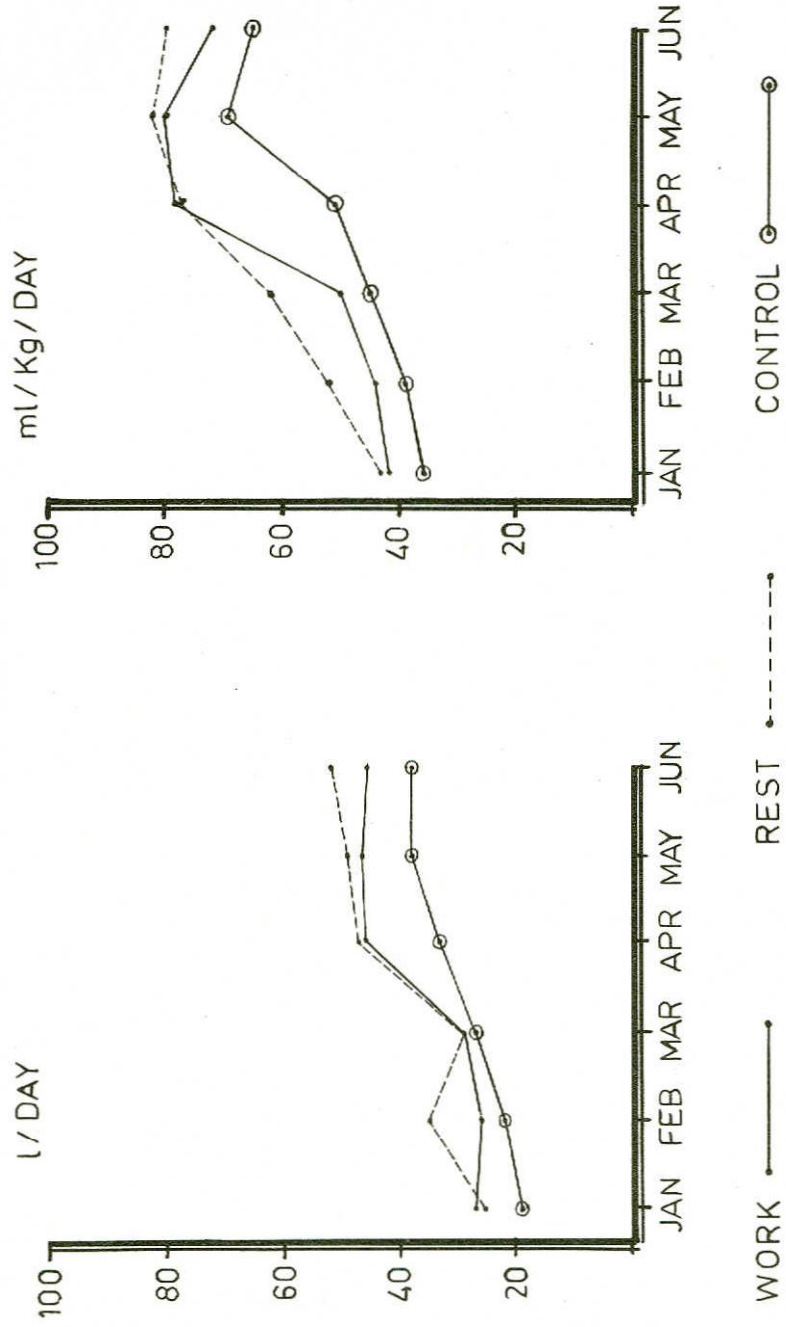


Fig. 6

TABLE - 12  
 Camel population trend in world and India during last four decades (thousand)

Year	Camel population		Rate of growth %	
	World	India	World	India
1945	9977	654	—	—
1951	10409	629	4.33	3.81
1956	11319	770	8.74	23.37
1961	11319	903	—	16.37
1966	11764	1028	3.93	13.84
1972	16405	1109	39.45	7.88
1977	17040	1068	3.87	3.70
1982	16530	1078	3.00	0.94
1985	17440	1100	5.51	2.04

TABLE - 13

Statewise Population of camels (in 1000s)

State	1945	1951	1956	1961	1966	1971	1977	1982
ANDHRA PRADESH	2	(A)	(A)	(A)	1	1	(A)	(A)
ASSAM	-	-	-	-	-	(A)	(A)	-
BIHAR	-	1	2	(A)	45	63	56	75
GUJARAT				44	312	133	130	121
HARYANA								
HIM PRADESH	-	-	(A)	1	1	1	1	1
JAMMU & KASHMIR	4	1	1	2	2	3	3	4
KARNATAK		1*	-	(A)	1	1	1	(A)
MADHYA PRADESH	1	11	11	16	20	14	12	16
MAHARASHTRA	27*	39*	45*	1	2	1	1	1
MANIPUR						1	1	1
PUNJAB	117@	195@	227@	224@	119+	102	74	64
RAJASTHAN	380	341	436	570	653	745	752	756
TAMILNADU				(A)	(A)	(A)	(A)	(A)
TRIPURA							(A)	(A)
UTTAR PRADESH	32	39	51	43	50	44	38	40
WEST BENGAL	-	-	-	(A)	(A)	(A)	(A)	-
CHANDIGARH				(A)	(A)	(A)	(A)	-
DELHI		1	2	2	2	1	(A)	(A)
TOTAL	654	629	776	903	1028	1109	1068	1078

Note:

\* erstwhile Bombay

\* Mysore State

@ Undivided Punjab

(A) Less than 500

+ State of Punjab

No camels were reported from Kerala, Meghalaya, Nagaland, Orissa, Andaman and Nicobar, Arunachal Pradesh, Dadra and N. Haveli, Goa, Lakshwadeep, Mizoram and Pondichery.

Fig. 7

DISTRIBUTION OF CAMEL IN INDIA ( BASE 1982 )

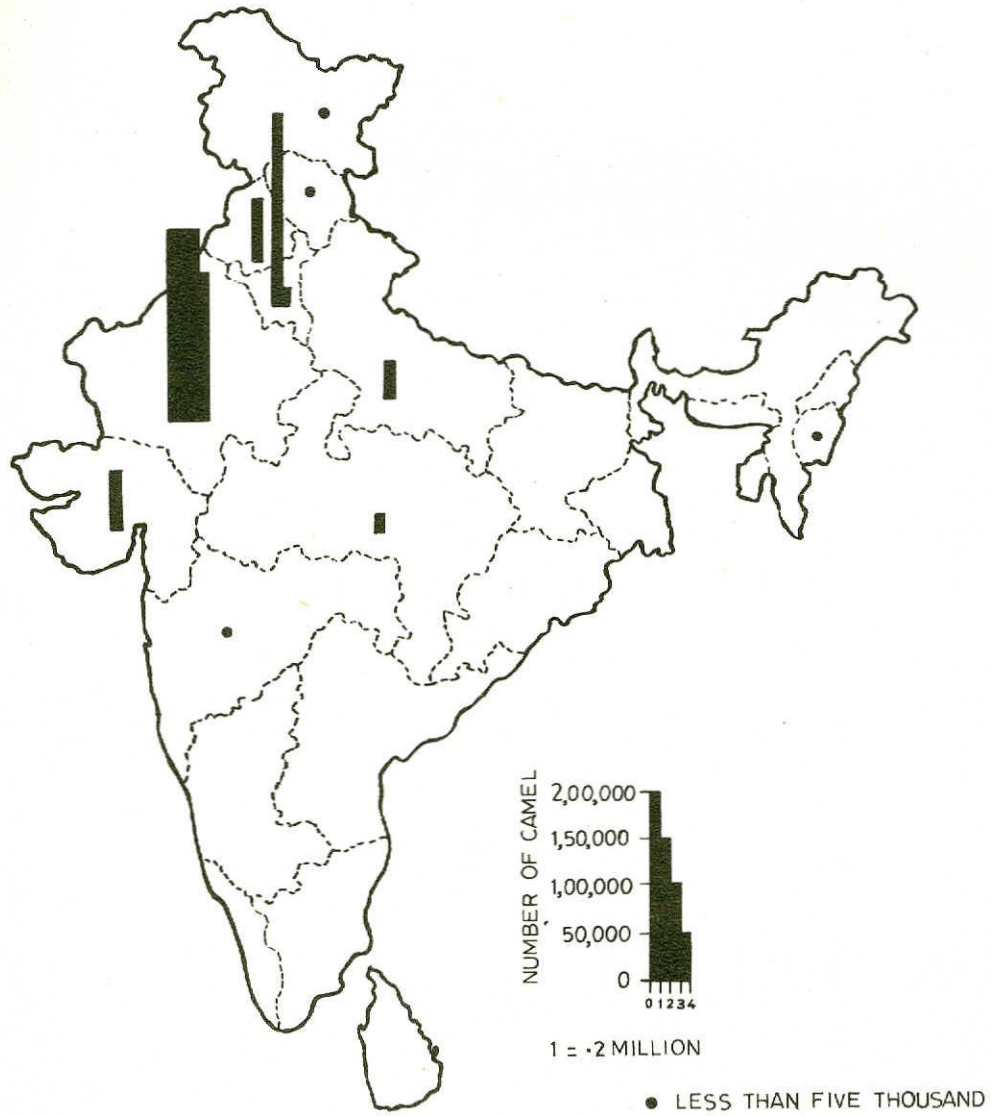




TABLE - 14  
Camel density in Rajasthan State (base 1982)

Sl. No.	District	Camel population (thousands)	Camel density per sq km.	Camel density per 100 persons
1.	Ajmer	4	0.47	0.28
2.	Alwar	17	2.02	0.97
3.	Banswara	3	0.60	0.34
4.	Barmer	109	3.84	9.78
5.	Bharatpur	3	0.58	0.23
6.	Bhilwara	12	1.15	0.92
7.	Bikaner	59	2.17	7.02
8.	Bundi	4	0.72	0.68
9.	Chittorgarh	6	0.55	0.49
10.	Churu	110	6.54	9.35
11.	Dhaulpur	2	0.68	0.34
12.	Dungarpur	2	0.53	0.20
13.	Ganganagar	116	5.62	5.76
14.	Jaipur	25	1.78	0.73
15.	Jaisalmer	52	1.35	5.76
16.	Jalor	15	1.03	1.22
17.	Jhunjhunu	38	6.41	3.18
18.	Jodhpur	50	2.19	3.03
19.	Jhalawar	2	0.32	0.25
20.	Kota	7	0.56	0.45
21.	Nagaur	40	2.25	2.46
22.	Pali	12	0.97	0.94
23.	Swaimadhampur	9	0.85	0.59
24.	Sikar	38	4.91	2.77
25.	Sirohi	4	0.78	0.74
26.	Tonk	2	0.28	0.26
27.	Udaipur	15	0.87	0.64
		756	2.25	2.22

Fig. 8

DISTRIBUTION OF CAMEL IN RAJASTHAN (BASE 1982)

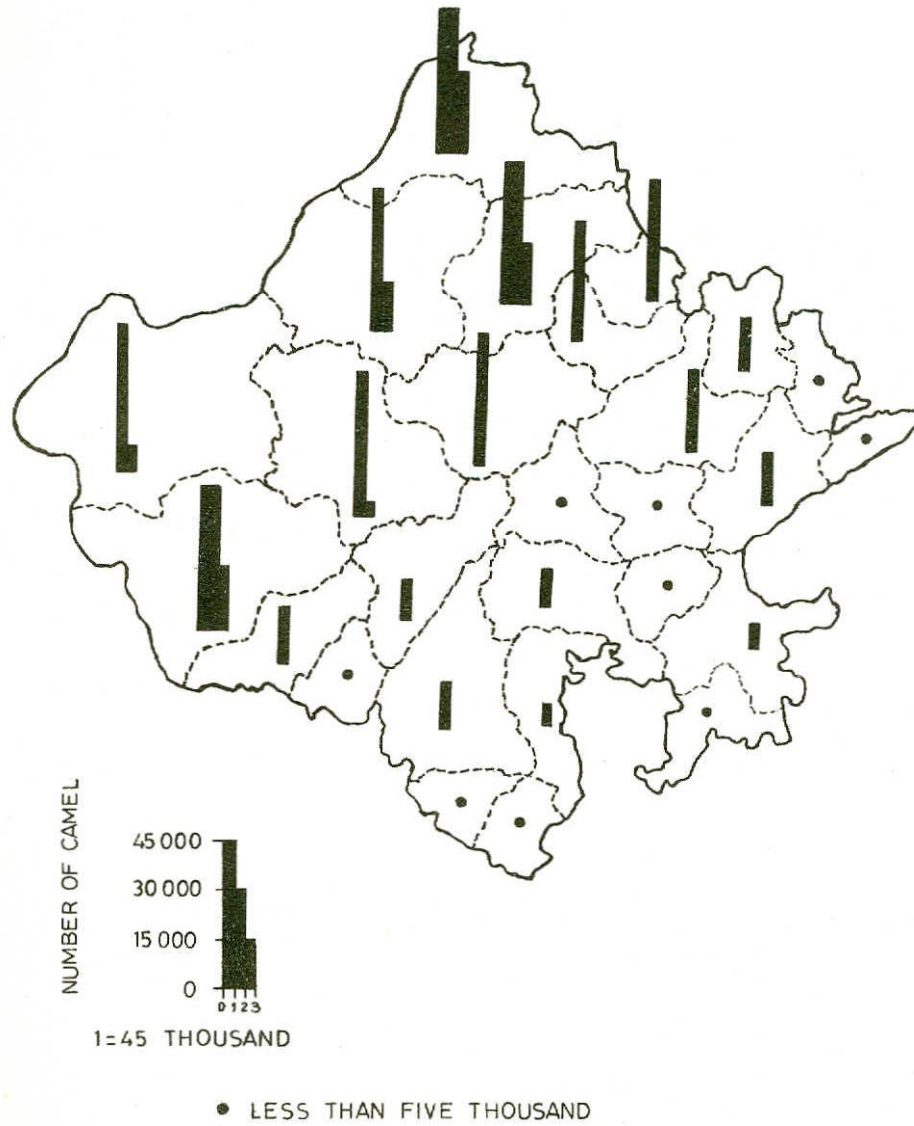


TABLE - 15

Camel density and total domestic herbivore livestock bio-mass (TDHLBM) in 11 arid districts of western Rajasthan (base 1982)

Sl. No.	District	Camel No. (thousands)	Camel density per sq. km.	Camel density per 100 persons	TDHLBM (in kg) per sq. km.	Camel mas as % of TDHLBM
1.	Barmer	109	3.84	9.79	7191.33	16.39
2.	Bikaner	59	2.17	7.02	6237.78	10.66
3.	Churu	110	6.54	9.35	10045.75	19.97
4.	Ganganagar	116	5.62	5.76	14145.42	12.20
5.	Jaisalmer	52	1.35	21.85	2716.56	15.30
6.	Jalor	15	1.41	1.66	13198.40	3.28
7.	Jhunjhunu	38	6.41	3.10	19297.13	10.19
8.	Jodhpur	50	2.19	3.03	8669.67	7.75
9.	Nagaur	40	2.26	2.46	13660.61	5.07
10.	Pali	12	0.97	0.94	14897.65	1.20
11.	Sikar	38	4.92	2.76	20479.43	7.37
11 arid districts		639	3.06	4.78	9471.18	9.92

Camel density in Haryana varied from 0.26/sq km (Ambala) to 8.60 (Sirsa) with state average at 2.78 per sq km. Camel density per 100 persons varied from 0.07 (Ambala) to 5.23 (Sirsa). Overall for state was 0.95 per 100 persons. The TDHLBM in Haryana was 31935.63 kg per sq km. Camel mass contributed 2.68% to TDHLBM (Table 16).

In Gujarat, the camel density was 0.38 per sq km and 0.22 per 100 persons. Out of 19 districts, highest camel density was recorded in Mehsana (1.39 per sq km) while lowest was in Dangs, Surat and Valsad where it was negligible. Camel density per 100 persons was highest in Kutch (3.34 per 100 persons). TDHLBM per sq km in the state was 14385.58 kg, ranging from 3509.14 kg (Kutch) to 33950.69 (Gandhinagar). Camel mass as percentage to TDHLBM in the state was 0.82 ranging from 6.73% in Kutch to negligible in the Dangs, Surat and Valsad districts (Table 17).

### 7.2.2 Biometrical measurements

Ten body measurements viz., leg length, heart girth, body length, face length, tail length, distance between eyes, height at withers, neck length, circumference of foot and hump factor were recorded in 16 males and 19 females born during the year 1988. The measurements were taken on 1st day, 3 months, 6 months, 9 months and 12 months of age. The measurements were comparatively higher in males than in females.

Prediction equations developed on data recorded last year were utilized to predict body weights. It was observed that the equation  $2.68 \times \text{heart girth} - 217.10$  gave good results with accuracy of almost 94%.

### 7.2.3 Birth weights and growth pattern in different genetic groups

Body weights and growth pattern was

analysed in data collected during 1985-88 in three camel breeds, namely, Bikaneri, Kutchi and Jaisalmeri and in crossbreds between Arab X Bikaneri (Table 18). The average birth weight (kg) was  $40.45 \pm 0.64$ ,  $34.00 \pm 1.09$ ,  $29.33 \pm 5.84$  and  $37.50 \pm 1.25$  in Bikaneri, Kutchi, Jaisalmeri and Crossbreds respectively (Fig. 9). Bikaneri calves were heaviest at birth while Jaisalmeri calves were lightest. Sufficient data on body weights of Jaisalmeri breed were not available, therefore, further analysis was confined to three groups only. Bikaneri animals had higher birth weight and continued to be heavier than other two breeds upto one year of age. At 2 years of age, Bikaneri and Crossbreds had almost similar weights. However, at 3 years of age, crossbreds were heavier than the pure breeds.

Body weight gain per day in four age groups in these three genetic groups is presented in table 19. Weight gain was highest in Kutchi (800 g/day) followed by Crossbreds (749 g/day) and Bikaneri (732 g/day) upto 3 months. However, the trend of body weight gain in these genetic groups changed significantly by 2 years of age (Fig. 10). At this point of time, the body weight gain was 209 g/day in Bikaneri, 207 g/day in Crossbred and only 132 g/day in Kutchi breed (Table 19). The results indicated substantial genetic variability of this parameter at different ages. Further, studies are in progress with respect to other body measurements.

An analysis was carried out to find-out the effect of dam's weight on the birth weight of calf. Data from 1985-88 were included in this study (Table 20). The results showed that there was a positive correlation between dam's body weight with the weight of calf. However, this trend was broken when body weights of dam's exceeded over 800 kg. This is an interesting observation which needs further confirmation with more data (Fig. 11).

Fig. 9

### AVERAGE BIRTH WEIGHTS OF FOUR GENETIC GROUPS

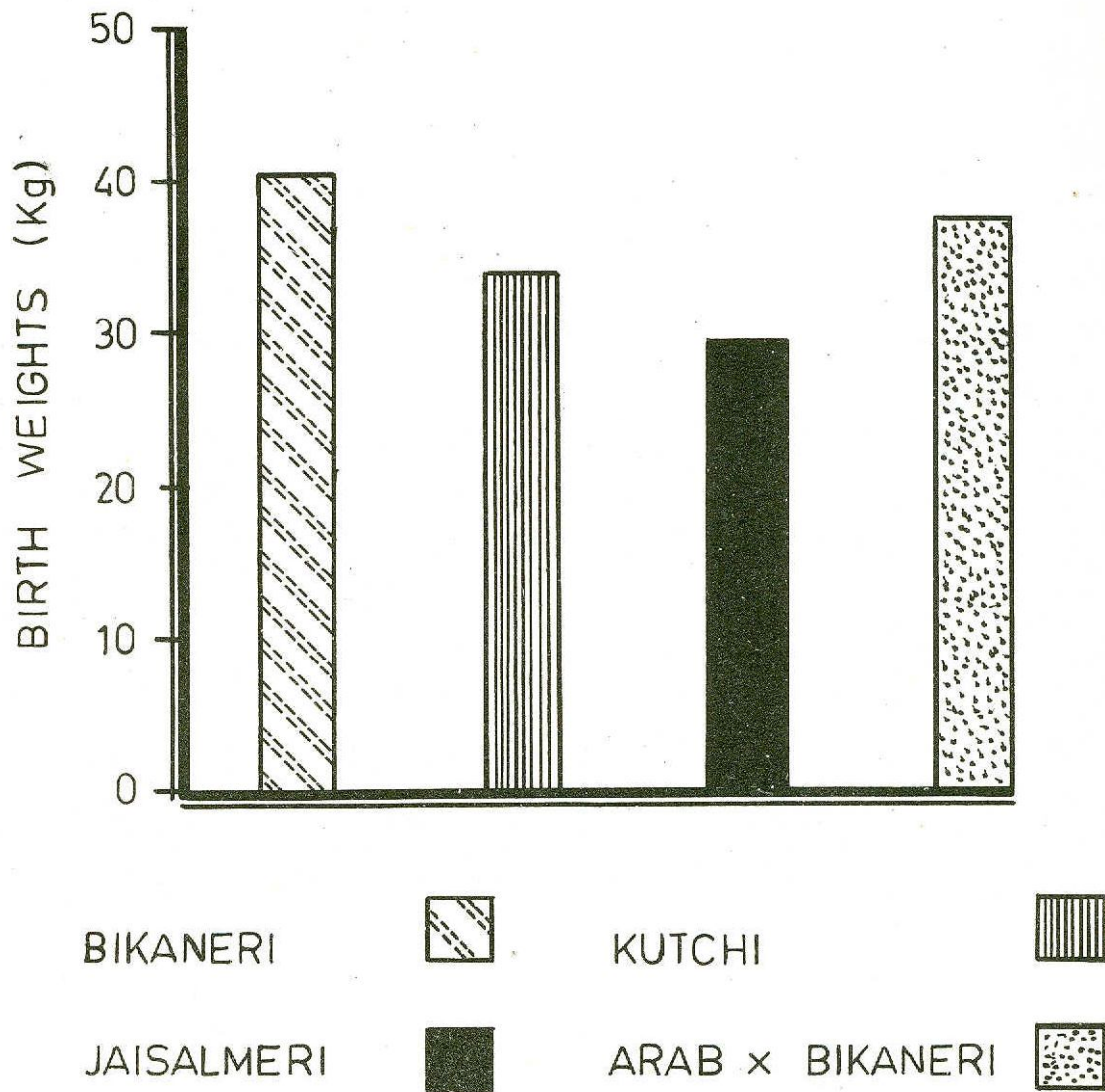
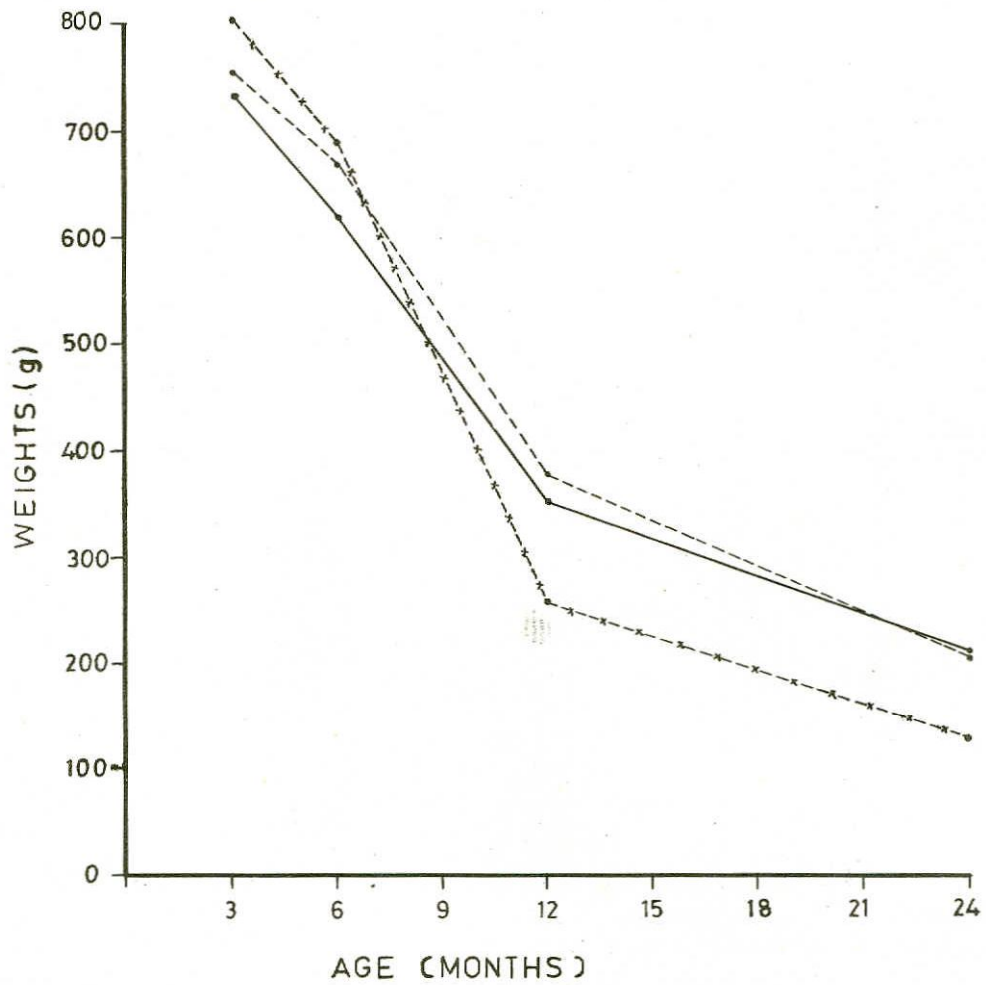


Fig. 10

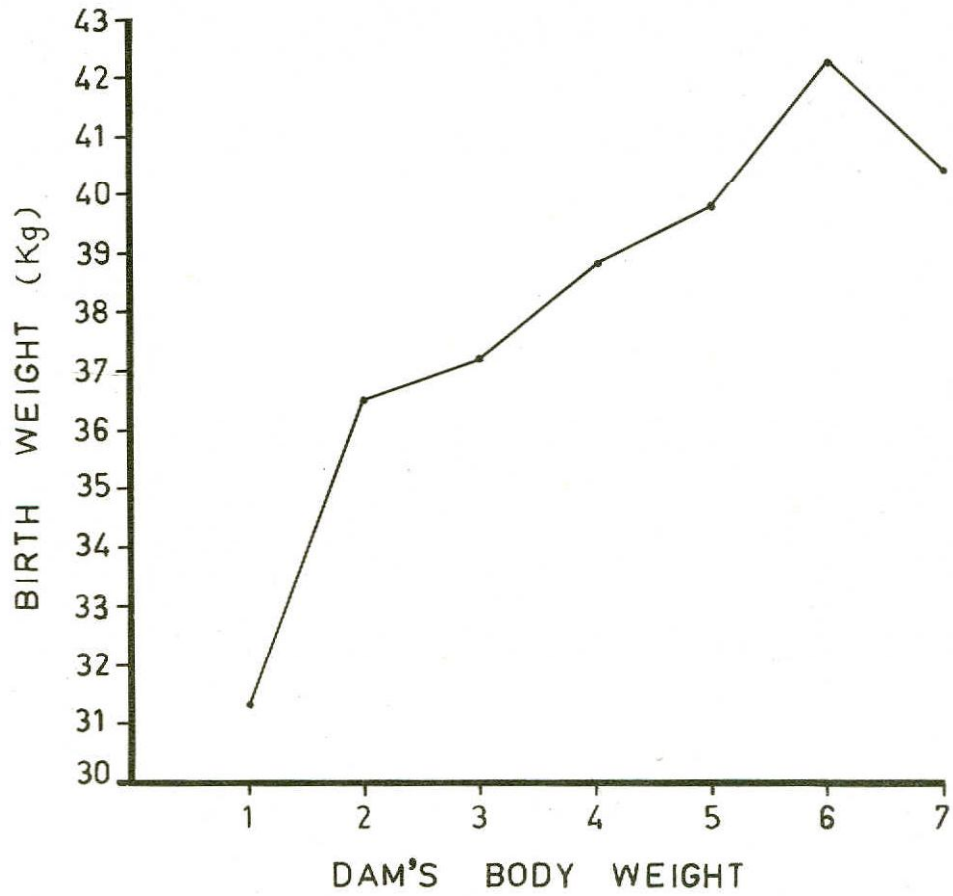
AVERAGE GAIN IN BODY WEIGHTS OF  
THREE GENETIC GROUPS



BIKANERI            ————●———  
KUTCHI             - - - - x - - - -  
ARAB x BIKANERI    ······●·····  
(CROSS BRED)

Fig. 11

### TREND OF BIRTH WEIGHT IN RELATION TO DAM'S BODY WEIGHT



1-BELOW 550 Kg

2-551- 600 Kg

3-601 - 650 Kg

4-651 - 700 Kg

5-701- 750 Kg

6-751- 800 Kg

7-ABOVE 800 Kg

TABLE - 16  
Camel density and total domestic herbivore livestock bio-mass (TDHLBM) in Haryana State (base 1982)

Sl. No.	District	Camel No (thousands)	Camel density per sq. km.	Camel density per 100 persons	TDHLBM per sq. km.	Camel mass as % of TDHLBM
1.	Ambala	1	0.26	0.07	36776.92	0.21
2.	Bhiwani	34	6.67	3.70	20769.02	9.80
3.	Faridabad	1	0.45	0.10	37889.55	0.36
4.	Gurgaon	4	1.48	0.47	34879.26	1.30
5.	Hisar	17	2.70	1.42	24022.38	3.45
6.	Jind	2	0.61	0.21	37483.03	0.50
7.	Karnal	1	0.27	0.08	45624.59	0.19
8.	Kurukshetra	1	0.27	0.09	42720.27	0.19
9.	Mahendergarh	20	6.67	2.09	30256.67	6.76
10.	Rohtak	4	1.05	0.30	31409.47	1.03
11.	Sirsa	37	8.60	5.23	21221.63	12.45
12.	Sonepat	1	0.45	0.12	40357.73	0.35
	Haryana	123	2.78	0.95	31935.63	2.68



TABLE -- 17

Camel density and total domestic herbivore livestock bio-mass (TDHLEBM) in Gujarat State (base 1982)

Sl. No.	District*	Camel Population	Camel density per sq. km.	Camel density per 100 persons	TDHLEBM per sq. km. (kg)	Camel mass as % of TDHLEBM
1.	Ahmedabad	2.1	0.24	0.05	14630.18	0.51
2.	Amreli	0.1	0.02	0.01	16866.42	0.03
3.	Banaskantha	12.2	0.96	0.73	18182.48	1.61
4.	Bharuch	1.2	0.13	0.09	9922.48	0.41
5.	Bhavnagar	0.2	0.02	0.01	15673.60	0.03
6.	Gandhi Nagar	0.9	1.44	0.33	33950.69	1.25
7.	Jamnagar	1.9	0.14	0.14	8876.81	0.49
8.	Junagarh	1.1	0.10	0.05	18051.73	0.18
9.	Kheda	1.6	0.22	0.05	29642.06	0.23
10.	Kutch	35.1	0.77	3.34	3509.14	6.73
11.	Mehsana	12.6	1.39	0.49	26041.12	1.65
12.	Panchmahal	1.0	0.11	0.04	31785.13	0.11
13.	Rajkot	0.4	0.03	0.02	15028.63	0.07
14.	Sabarkantha	3.4	0.46	0.23	25936.91	0.54
15.	Surendranagar	1.3	0.12	0.12	9593.58	0.40
16.	Vadodara	0.2	0.02	0.01	19070.31	0.04
	Gujarat	75.3	0.38	0.22	14385.58	0.82

\* Note: Camel population in the districts of Dangs, Surat and Valsad was negligible and has not been included in this table.

TABLE - 18  
Average body weights (kg) of different genetic groups (1985-88)

	Bikaneri	No. of animals	Kutchi	No. of animals	Crossbred (Arab X Bikaneri)	No. of animals	Jaisalmeri	No. of animals
Birth weight	40.45 ±0.64	47	34.0 ±1.09	8	37.50 ±1.25	12	29.33 ±5.84	3
1 month	60.54 ±1.89	41	52.40 ±5.31	5	53.33 ±6.46	6	51.67 ±11.17	3
3 months	107.67 ±2.47	43	96.37 ±3.77	8	104.00 ±3.52	9	-	-
6 months	174.42 ±3.51	38	157.75 ±7.56	4	173.00 ±5.27	7	-	-
1 year	238.57 ±3.80	53	207.43 ±4.61	4	229.60 ±7.56	10	-	-
2 years	318.62 ±5.58	48	262.50 ±11.35	4	320.00 ±23.91	5	-	-
3 years	405.10 ±7.35	30	361.25 ±23.16	4	427.00 ±53.00	2	-	-

TABLE - 19  
 Weight gain per day in different genetic groups (1986-88)

Age group	Genetic groups		
	Bikaneri g/day	Kutchi g/day	Cross breeds Arab X Bikaneri g/day
0-3 months	732	800	749
3-6 months	616	686	664
6-12 months	349	254	373
1-2 years	209	132	207

TABLE - 20

Body weight of dam's and birth weights of calves (kg)

Sl. No.	Body weight of dams at 13th month of pregnancy	No. of animals	Average birth weight of calves
1.	Upto 500	12	31.3 ± 1.73
2.	551 - 600	15	36.5 ± 1.24
3.	601 - 650	13	37.2 ± 1.53
4.	651 - 700	25	38.8 ± 0.98
5.	701 - 750	16	39.8 ± 1.10
6.	751 - 800	14	42.3 ± 1.21
7.	Above 800	7	40.4 ± 1.54

### 7.3 Project No.

P.I. 86/3-ICN/L-05/5220

Title:

To develop suitable management practices for rearing camel.

Project Leader: S.N. Tandon

Associates: N.D. Khanna  
A.K. Rai

Technical Assitance: N. Sharma

#### 7.3.1 Body weights

Average body weight of camels as on 31.12.1988 are presented in table 21. The body weights of Bikaneri and Kutchi breeds were comparable, though the former had an edge over latter. Jaisalmeri animals were lightest. Limited data on crossbreds between Arab x Bikaneri exhibited higher body weights.

The average body weights of Bikaneri females at 1, 2, 3, 4 and 5 yr. were 230, 322, 391, 463 and 496 kg respectively (data 1985-88). About 65% and 79% of adult

female body weight at 5 years was achieved at 2 and 3 years of age. Therefore, it was concluded that heifers at the age of 2-3 years can be mated so as to reduce the age at first calving. The age at first calving was observed to be more than 5 years at this farm during 1961-80.

Body weights of first calvers of two groups viz., "Folligon administered heifers" aged 2-3 years and controls aged 3-1/2 to 5 years were compared (Table 22). The results indicated that the difference in the body weights at the start and conclusion of pregnancy were 129 kg and 117 kg respectively. The weight loss due to parturition in the two groups was 47.4 and 51.0 kg. The birth weight of calves showed marked difference i.e. about 9.6 kg. These observations indicated that improved nutrition is necessary for the heifers which are to be mated at lower age to fillup gaps in the growth and stress due to pregnancy.

#### 7.3.2 Breeding

Out of 39 breedable females available during 1988, 33 conceived. 1.33 services per pregnancy were required. The fertility rate was 84.6%.

In 1988, 38 calves were born. Maximum calvings were recorded in January (18) followed by February (6), March (6), December (5) and one each in April, June and November.

The female and male ratio was 1 : 1. Calving data from 1961-88 indicated sex ratio as 1 : 1.2 between female and male calves.

A comparison of some of the reproductive traits on data from 1986-88 and 1961-85 at this farm is presented in table 23, which reflected marked improvement due to improved management practices.

TABLE - 21

Average body weights of different genetic groups of camels (kg) as on 31.12.1988

Sl. Age groups	Bikaneri		Kutchi		Jaisalmeri		Crossbreeds	
	No. of Observations	Average weight ±	No. of observations	Average weight ±	No. of observations	Average weight ±	No. of observations	Average weight ±
1. 6-12 months	30	198.95 ±6.22	3	193.33 ±12.03	2	166.00 ±13.00	4	200.50 20.74
2. 1-2 years	6	260.80 ±12.37	4	243.00 ±2.84	-	-	3	293.33 ±17.65
3. 2-3 years	18	404.93 ±13.16	-	-	-	-	2	410.50 ±9.50
4. 3-4 years	6	448.80 ±27.28	4	439.25 ±32.40	1	350.00	-	-
5. 4-5 years	8	433.25 ±30.10	2	436.00 ±44.00	6	431.66 ±25.82	-	-
6. 5-6 years	7	531.66 ±15.56	8	517.62 ±18.19	4	437.50 ±21.75	-	-
7. 6-7 years	4	515.50 ±61.24	2	547.00 ±23.00	3	438.33 ±28.95	-	-
8. 7-8 years	7	549.71 ±43.71	7	539.33 ±39.65	-	-	-	-
9. 8-9 years	11	626.18 ±27.21	2	508.00 ±8.00	1	650.00	-	-
10. 9-10 years	2	545.50 ±4.55	-	-	-	-	-	-
11. Above 10 years	19	613.22 ±27.71	-	-	-	-	-	-

TABLE - 22  
Average body weights (kg) of "Folligon treated" and control heifers in first parity

Sl. No.	Parameters	Animals administered Folligon (n = 5)	Controls 1st parity animals (n = 5)
1.	Age	2 - 3 years	3-1/2 - 5 years
2.	Initial average body weight	367.4	496.4
3.	Average body weight in the last month of pregnancy	511.8	628.0
4.	Average gain due to growth and pregnancy in 13 months	144.4	131.6
5.	Weight loss after parturition	47.4	51.0
6.	Birth weight of the calf	27.2	36.8

TABLE - 23  
 Comparison of some reproductive traits during 1961-85 and 1986-88

Sl. No.	Traits	1961-85	1986-88
1.	Gestation length (days)	389.3 ± 00.08 (532)	382.20 ± 2.02 (36)
2.	Age at 1st service (days)	1390.00 ± 25.00 (60)	1239.67 ± 80.84 (12)
3.	Age at 1st calving (in days)	1882.00 ± 28.67 (93)	1635.67 ± 82.33 (12)

NB - Figures in paranthesis indicate number of observations

### Oestrus

Studies on oestrus in camels have been initiated. Following observations are being recorded:

- 1) Vaginal discharge
- 2) Congestion of vulvar and vaginal mucosa
- 3) Interest in males
- 4) Mounting on other females
- 5) making oral sounds and other physical gestures

Some animals which did not exhibit any apparent oestrus symptoms when mated conceived. Further, information on this aspect is being collected.

One case of twinning was observed at the NRCC, in a Bikaneri female No. 55 which aborted in 9th month of gestation period (Fig. 12). The two foetuses were approx. 35 cm long including neck length and 20 cm at heart girth.

### 7.3.3 Milk production

Data on milk production was recorded in 4 Bikaneri animals at weekly interval. The highest milk yield was 10.8 kg per day and lowest 3.8 kg per day. A collaborative project on biochemical and microbial analysis in different

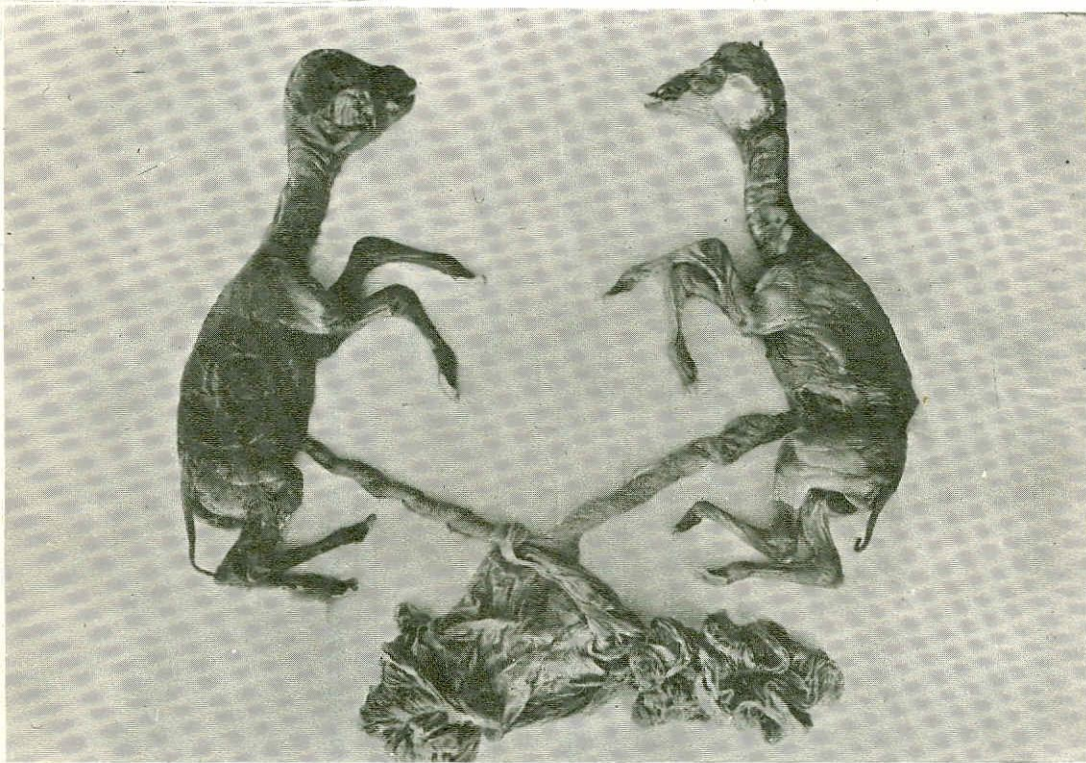


Fig. 12 Twin foetuses aborted after 9 months of gestation.

### Twining

Twining in camels is a very rare event. Inquiries and discussions with camel breeders at large revealed that sporadic cases of twinning in camels had been observed but in almost all cases there were abortions in late pregnancy.

stages of lactation has been initiated with the Dairy Chemistry Division of National Dairy Research Institute, Karnal. One sample each of colostrum and milk (one month) from Bikaneri breed was analysed. The samples were sent to Karnal in ice. The preliminary results are as under:-



## Results on Chemical Analysis of Camel Milk Samples

Parameters(%)	Samples	
	Colostrum	Milk (one month)
1. Titratable acidity (as lactic acid)	0.20	0.14
2. C.O.B. (Clot on boiling test)	+Ve	-Ve
3. Lactometer reading (CLR)	35.8	33.7
4. Total Solids	12.70	11.50
5. Fat	2.60	2.20
6. Lactose	5.41	5.62
7. Ash	0.74	0.69
8. Calcium mg/100 ml	111.10	106.70
9. Total crude proteins	3.93	2.77
10. Total true proteins	3.67	2.51
11. Casein	2.06	2.00
12. Whey proteins	1.61	0.52
13. Non-Protein nitrogen (NPN) mg/100 ml.	40.30	40.30

### Analysis of Protein Constituents:

- Lactoferrin, an iron-binding protein (protecting protein) is present and is being analysed quantitatively.
- Electrophoretic mobility of  $\alpha$  and  $\beta$ -caseins is slow as compared to cow and buffalo  $\alpha$  and  $\beta$ -caseins.
- Micell size seems to be smaller as compared to cow and buffalo milk casein micells.

### Microbiological analysis:

	I	II
1. MBR Test	More than 5 hrs	4-1/2 - 5 hrs
2. S.P.C.	Insignificant numbers of organisms	Slightly more organisms than Sample No. I
3. Yeast and mold counts	Nil	Nil
4. Growth of lactic culture	Produced acidity but a firm gel was not obtained.	Produced acidity but a firm gel was not obtained.
5. Growth of natural flora at 37°C.	Growth was observed in both the samples but did not gel.	
6. Size of the fat globules.	Fat globule size seems to be normal.	

Studies on keeping qualities of milk are also in progress.

### 7.3.4 Feeding

An experiment was conducted to study the effect of six months feeding of Moth Chara + Subabool in ratio of 60 : 40 on the feed intake and growth of young camel calves aged 2-3 years. The performance of the animals was compared with the animals of similar age group maintained on Moth Chara alone.

	No. of animals	Monthly weight gain (kg)	Fodder intake (kg)	DMI/100 kg/d (kg)
Moth Chara	3	10.75	7.88	1.67
Moth Chara + Subabool (60:40)	3	9.39	8.32	2.03

Subabool fodder was palatable after 2-3 days feeding. No adverse effect was observed in animals during the period of experiment.

A digestion trial for one week was also conducted on these animals in the last month of feeding. The digestibility coefficients were as under in the two groups.

	Moth Chara (%)	Moth Chara + Subabool (%)
Dry matter	74.62	71.81
Crude Protein	73.70	77.87
Ether extract	85.53	86.00
Carbohydrates	85.72	70.61

Dry matter digestibility was found to be higher in animals under Moth Chara feeding, whereas, digestibility of crude protein was better in animals under Moth Chara + Subabool feeding, although, dry matter intake

was almost same in both the group (Table 24 and 25)

For conducting digestion trial urine and faecal bags were specially designed and fabricated for male camels (Fig. 13). The bags were made of canvas.

The urine bag had two chambers with impervious lining. The first chamber housed penis and acted as a receptacle for urine. It was arched at the lower end and at the tapering point contained an opening with one way valve which drained urine into the second chamber. The second chamber was curved on the posterior side and was straight on the anterior side for easy and complete drainage through an outlet provided for collection of urine at desired intervals. The outlet had a tight-fitting stopper assuring prevention of leakage. Suitable straps were provided for fastening the bag to the animal.

The faecal bag was also made of canvas. It had provision for periodical removal of faecal-mass through an opening which was kept closed by buttons when not in use. The bag was fastened to the animal at a suitable position with the help of straps provided for the purpose.

### Fometa green fodder

A Fometa green fodder production unit was allotted by the ICAR to this Centre. The unit was installed by the middle of September, 1988. Barley fodder was grown in this unit. The studies on characteristics of barley plant grown in "Fometa" and harvested on 8th day, revealed that average length and weight of plant was 22.35 cm and 0.244 g respectively. The ratio of dry matter : water was 16.4 : 83.6. The average shoot length was 13.07 cm and diameter was 1.06 cm. The shoot root ratio was 58.5 : 41.5. The average number of root branching was 5.4 with main root diameter

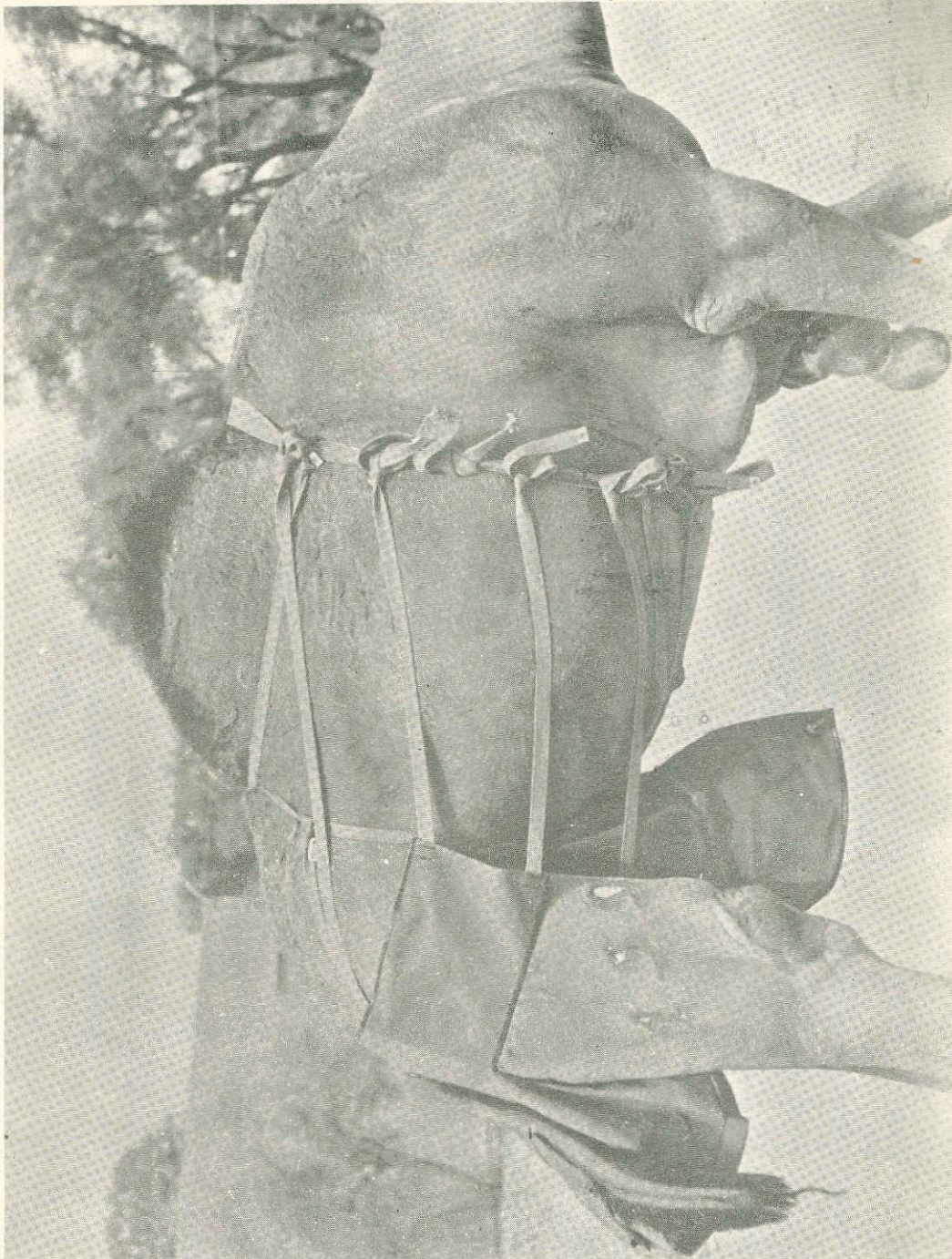


Fig. 13 Special canvas bags for collecting urine and feces for digestion trials.

TABLE - 24  
Plane of Nutrition of growing camels under Moth Chara and Moth Chara + Subabool

	Moth Chara			Moth Chara + Subabool			Average	
	Animal No.	166	164	153	167	159		168
Av. Body Wt.	414.5	414.0	509.0	445.8 ±31.58	376.5	397.5	391.5	388.5 ±6.24
DM Intake (kg/d)	8.077	7.120	7.860	7.686 ±0.290	7.690	8.240	7.850	7.927 ±0.163
kg/100 kg	1.949	1.720	1.544	1.738 ±0.117	2.042	2.073	2.005	2.040 ±0.020
DCP Intake (kg/d)	0.631	0.540	0.614	0.595 ±0.028	0.901	0.911	0.941	0.918 ±0.012
kg/100 kg body wt/d	0.152	0.130	0.120	0.134 ±0.0094	0.239	0.229	0.240	0.236 ±0.0036
TDN Intake (kg/d)	5.741	5.058	5.435	5.411 ±0.198	5.107	5.570	5.376	5.351 ±0.134
kg/100 kg body wt/d	1.385	1.222	1.068	1.225 ±0.092	1.356	1.401	1.373	1.373 ±0.013



0.08 and length 9.28 cm. The plant characteristics varied with the seed batches.

The barley green fodder was accepted well by the camels, though, there was initial reluctance for first few days. Later on, however, animals exhibited liking for this fodder.

In the beginning, 20-30% dry matter replacement with Fometa green fodder was tried in studs and adult females. No adverse effect was noticed. Further studies on long term feeding effects of this fodder on growth and reproduction are in progress.

The fometa green (Barley) was analysed for proximate composition, the result obtained is presented below:-

	Average (%)	Range (%)
Dry matter	14.83	14.00 - 16.03
Crude protein	16.11	16.02 - 16.19
Ether extract	2.48	2.46 - 2.52
Crude fibre	12.84	12.47 - 13.29
Nitrogen free extract	64.90	64.29 - 65.75
Ash	3.67	3.29 - 3.88

The feeding of Fometa green barley to animals at the rate of 30% of TDM had resulted in drastic reduction of water intake. It reduced from 19.1 to 9.7 ml/kg during winter season.

Further observations of this experiment on health and growth are in progress.

### 7.3.5 Water intake

The water intake of growing (2-3 years) and adult camels was recorded twice a week in six animals of each group from January to November. In general, the water intake was higher in the growing animals than adults. There was a gradual increase in water intake from January to May/June (growing animals 47.7 ml/kg to 86.4 kg; adult 36.7 ml/kg to 69.2 ml/kg). It remained at a higher plane upto August, declined thereafter reaching 45.2 ml/kg in growing and 30.8 ml/kg in adults in November (Table 26).

### 7.3.6 Hair production

Average hair production' age group wise during 1985-1987 is presented in (Table 27). Maximum hair were produced in the age group of 2-3 years during 1986 and 1987. In general hair production was lower in 1985. This variation was found to be due to breed difference. Kutchi animals were introduced at the farm during 1986. The hair production breed wise revealed that it was 800.58 g  $\pm$  12.64 (386 animals) in Bikaneri, 1085.29  $\pm$  32.77 (17) in Kutchi and 800.00  $\pm$  132.37 (3) in crossbreds.

TABLE - 26  
Water intake of growing and adult camels

Months	Growing Camels		Adults	
	l/d	ml/kg body wt.	l/d	ml/kg body wt.
January	17.8 ± 0.79	47.7 ± 2.01	18.4 ± 1.49	36.7 ± 2.51
February	19.6 ± 1.16	50.7 ± 2.89	21.5 ± 2.02	39.3 ± 2.79
March	22.6 ± 0.90	58.1 ± 0.15	26.9 ± 1.73	49.8 ± 3.46
April	29.8 ± 2.92	65.4 ± 1.93	32.6 ± 2.32	58.2 ± 4.09
May	28.3 ± 0.99	68.2 ± 2.25	38.6 ± 1.73	69.2 ± 2.76
June	35.7 ± 1.16	86.4 ± 2.58	38.0 ± 1.61	65.3 ± 2.40
July	32.3 ± 1.07	79.7 ± 2.60	30.6 ± 1.93	52.3 ± 2.65
August	36.6 ± 0.93	89.2 ± 2.13	39.7 ± 1.73	67.4 ± 3.12
September	35.2 ± 0.70	80.9 ± 2.17	40.0 ± 1.29	65.5 ± 1.80
October	25.9 ± 1.68	59.3 ± 3.71	27.4 ± 3.70	45.0 ± 6.16
November	16.4 ± 1.34	45.2 ± 8.25	18.6 ± 3.56	30.8 ± 6.00

TABLE - 27  
Hair production of camel (g) (1985-87)

Age group	1985 (g)	No. of animals	1986 (g)	No. of animals	1987 (g)	No. of animals
0-2 years	745.83 ±42.19	30	762.20 ±34.22	41	984.00 ±29.54	25
2-3 years	675.00 ±93.30	9	1102.94 ±38.01	17	1021.43 ±92.98	7
Above 3 years	730.79 ±33.09	95	770.21 ±22.56	93	883.37 ±23.14	89



## INTER INSTITUTIONAL COLLABORATION

8

### 8.1 Pharmacokinetics of Sulphonamides in Camels

Report by

Dr. M. Kapoor and Rajiv Kumar, Department of Pharmacology, College of Veterinary & Animal Science, Bikaner.

Pharmacokinetics of Sulphadiazine (SDZ) was conducted on 14 healthy camels of both the sexes weighing between 325-450 kg. In the first study SDZ was injected in 7 camels in the jugular vein at the rate of 20 mg/kg body weight. The blood samples were collected at regular intervals for 24 hours after drug administration and the plasma was analysed for SDZ employing spectrophotometric method. The mean plasma levels of SDZ decreased progressively from 66.53  $\mu\text{g/ml}$  at 0.17 hour to 10.30  $\mu\text{g/ml}$  at 24 hours after injection. However, minimum inhibitory concentration (MIC) i.e. 50  $\mu\text{g/ml}$  was maintained only upto 40 minutes (0.67 hr) after drug administration. The biological half-life  $t_{1/2}(\beta)$  of SDZ was 17.6 hours, with an elimination rate constant ( $\beta$ ) of 0.039/hr., while the absorption/distribution half-life  $t_{1/2}(\alpha)$  was 0.71/hr., with absorption/distribution rate constant ( $\alpha$ ) of 0.97/hr. The Zero-time concentration ( $C_0$ ) of SDZ in plasma was 68.93  $\mu\text{g/ml}$ . The apparent volume of distribution ( $V_d$ ) of SDZ was 0.29 l/kg., while the volume of distribution on area basis  $V_d(\text{area})$  was 0.69 l/kg. The area under curve (AUC) was 729.10  $\mu\text{g/hr/ml}$  while total body clearance ( $Cl_B$ ) was 27.41 ml/kg/hr.

In the second study SDZ was administered to other 7 camels by oral route at the rate of 100 mg/kg body weight and blood samples

were collected one hour after drug administration up to 72 hours. Analysis of plasma showed peak plasma concentration ( $78.15 \pm 2.95 \mu\text{g/ml}$ ) 24 hours after SDZ administration. The MIC of SDZ was maintained for 36 hours, starting from 12 hours till 48 hours after SDZ administration. The elimination half-life  $t_{1/2}(\beta)$  was calculated to be 22.54 hours, with elimination constant ( $\beta$ ) of 0.031/hr and absorption half-life of 10.37 hours with absorption constant ( $\alpha$ ) of 0.067/hr. The theoretically calculated plasma concentration at zero-time ( $Y_0$ ) was 177.3  $\mu\text{g/ml}$  while the  $C_{\text{max}}$  (maximum concentration achieved) and  $t_{\text{max}}$  (time at which maximum concentration was achieved) were 91.49  $\mu\text{g/ml}$  and 21.53 hours, respectively. The AUC was 8460.84  $\mu\text{g/hr/ml}$ .

### 8.2 Progesterone levels in camel during oestrous cycle

Reported by

Prof. S.P. Agarwal, Department of Vety. Physiology, Haryana Agricultural University, Hisar.

Blood samples of six adult female camels were collected on alternate days during oestrous cycle and the sera were analysed for progesterone by radio-immunoassay. The levels varied from non-detectable to 9.0 ng/ml. One animal invariably had non-detectable levels, indicating anovulatory heat, two animals consistently had the concentration below 1 ng/ml, one animal had rising levels upto mid cycle followed by sudden decline whereas 2 animals exhibited elevated levels which were maintained indicating successful conception. The results

projected progesterone profiles of female camels under various physiological states of estrous cycle.

#### Enhancement of reproduction in prepubertal female camels

Late maturity in female camels is major problem as the age at first calving is around 5 years of age. An effort was made to reduce the age at puberty in the young female camels by hormonal treatment. Nine prepubertal dromedary female camels aged 2-3 years were injected with 1000 and 2000 I.U. of "Folligon" (FSH . predominant gonadotrophin) for 2-3 consecutive days. Oestrus was induced in all animals 4-6 days post-treatment and all these females accepted the male. About one-half of the camels settled in the first service while the rest conceived in the subsequent heat without any further hormonal treatment. Four animals which initially conceived could not carry pregnancy upto full term and suffered either with foetal resorption or unnoticed abortion while rest of the camels delivered a living calf. The elevated progesterone levels in the conceived animals were maintained upto 22 days post mating where as the same declined around mid-cycle in case of unfertile matings. The progesterone levels remained low throughout the cycle in anovulatory heats.

The result showed that Folligon treatment was effective in reducing the age at first calving and higher doses of 2000 IU had no extra advantage over the lower doses of 1000 IU.

### 8.3 Investigations on cytogenetic profile of Indian Camel

Report by

Dr. R. Sahai and R.K. Vijh, National Institute of Animal Genetics, Karnal.

The somatic chromosomes of Kutchi breed of Indian camel were harvested using whole

blood microculture technique after 72 hours of incubation at 38°C. The evaluation of Giemsa stained metaphase with clear spatial distribution of the chromosomes unequivocally established the presence of 37 pairs ( $2n=74$ ) in Kutchi breed. On the basis of karyotypes and ideograms, the entire complement was divided into three groups A, B and C having 25, 5 and 6 pairs of autosomes respectively. The X chromosome was submetacentric and contributed 4.67% to the genome and was of original type. The Y chromosome was acrocentric and ranked between 34th and 35th pair of autosomes. The first twenty five pairs included in the group A were classified as subacrocentrics whereas those of group B and group C were classified as submetacentrics and true acrocentrics respectively. There are conflicting reports on the number of the acrocentric chromosomes in the complement. Since the tiny arms of the subacrocentric chromosomes contributed to the extent of 9% to the total length of each chromosomes these have been separately grouped together (Group A).

#### Nucleolar organiser regions

The nucleolar organiser regions represent the genetic component of the chromatin which is functionally associated with r-DNA. These were visualised by modified silver staining protocol. Scoring of stained metaphases revealed an average of 16.56 and 16.59 NORs per metaphase in male and female respectively. Owing to the preponderance of cells in which NORs ranked between 14 to 16, it was inferred that 7 to 8 pair of chromosomes in both sexes were associated with nucleolus organisation (Tables 28 and 29). The NORs were recorded in both acrocentric and metacentric autosomal pairs.

TABLE - 28

Frequency distribution of NOR's in *Camelus dromedarius*

Sex	≤20	17-19	14-16	≤13	Total number of metaphases.
Male	23	21	58	18	120
Female	19	15	69	17	120

TABLE - 29

Mean number of NOR's in *Camelus dromedarius*

Sex of Animals	No. of Animals	No. of Metaphases	Mean±S.E.
Male	4	120	16.56±0.26
Female	4	120	16.59±0.28

#### 8.4 Common plants available at the National Research Centre on Camel, Bikaner

Report by

D.D. Gautam and S. Bishnoi, Laboratory of Environmental Botany, Post Graduate department of Botany, Dungeer College (Autonomous), Bikaner, (Rajasthan)

Range land area of N.R.C.C., Jorbeer is spread over 824 hectares and is mostly of sandy dunes and sandy plains, is a part of great Indian Thar desert. Both shifting and stabilised dunes are commonly seen. It is totally devoid of ponds. The source of water is, however, through two tube wells.

Soil: The soil is yellowish red in colour and is sandy on dunes and sandy-loam in the plains. Sand hills of different shapes and sizes are found. Some of the dunes reach to a height of 200 ft. or more than this.

Vegetation: The vegetation of this area was xerophytic in nature. All the three types of xerophytes were found.

1. Drought evading (Ephemerals)
2. Drought enduring
3. Drought resisting

The plants which depend upon the rain are drought evading or ephemerals. The plants depending upon under ground water are perennial and have different devices for water up-take and control the excessive rate of transpiration during xeric climate by various modifications. In the sandy plain areas, trees like *Prosopis cineraria* and *Salvadora oleoides* were observed at certain places forming the dominant vegetation. On the slopes of sand dunes *Acacia jacquemonti* along with shrubs of *Calligonum polygonoides*, *Aerva persica*, *Leptadenia pyrotechnica* and some perennial grasses, *Lasiurus indicus*, *Cenchrus biflorus*, *Cenchrus ciliaris* were found.

The only source of fuel of arid region is *Calligonum polygonoides*, which is dominating on the unstabilised sand dunes. Simultaneously at certain places *Leptadenia pyrotechnica*. *Laptadenia pyrotechnice* competes with *calligonum polygonoides* was also observed in association with *Calligonum polygonoides* for water and nutrition and within few years it dominantes the latter.

After studing the *xerophytic vegetation* of this area the writers found *National Research Centre on Camel, Jorbeer, Bikaner* as an interesting place for the study of Desert Ecosystem as it is a protected area from biotic stress.

The list of plants surveyed during the years 1987 and 1988 is as below :

#### Menispermaceae

1. *Cocculus pendulus* Diels. Pilwan
2. *Cocculus hirsutus* Linn. Bajar-Bel

- Papaveraceae :
1. *Argemone mexicana* Satayanashi
- Brassicaceae :
1. *Brassica campestris* Linn. (C) Sarson
  2. *Eruca vesicaria* Linn. (C) Tar-Mira
  3. *Farsetia hamiltonii* Royle. Hiran Chabbo
  4. *Raphanus sativus* Linn. (C) Muli
- Capparidaceae :
1. *Capparis decidua* Forsk. Ker
  2. *Cleome gynandra* Blatt & Hall. Safed bagro
  3. *Cleome vahliane* Farsen. Madhio
  4. *Clenome viscosa* Linn. Handi bagro
- Polygalaceae :
1. *Polygala erioptera* Dc. Bayasan
- Molluginaceae :
1. *Gisekia pharnacioides* Linn. Sareli
  2. *Glinus lotoides* Linn. Bakada
  3. *Limeum indicum* Stocks. Sapari
  4. *Mollugo cerviana* Linn. Chiriya-rokhet
- Portulacaceae :
1. *Portulaca oleracea* Linn. Luni
- Tamaricaceae :
1. *Tamarix aphylla* Linn. Farash
- Malvaceae:
1. *Althea ludwigii* Linn. Golio
  2. *Althea rosea* Linn. (P) Holly-hock
  3. *Hibiscus rosa-sinensis* Linn. (P) Gurhal
- Caryophyllyceae :
1. *Spergula arvensis* Linn.
- Tiliaceae :
1. *Corchorus aestuans* Linn. Bahuphali
  2. *Corchorus depressus* Linn. Cham-gash
  3. *Corchorus tridens* Linn. Kag-nasha
- Zygophyllaceae :
1. *Fagonia cretica* Linn. Dhamaso
  2. *Peganum harmala* Linn. Gandhiyo
  3. *Tribulus alatus* Delile. Bakda
  4. *Tribulus terrestris* Linn. Kanti
  5. *Zygophyllum simplex* Linn. Lunwo
- Sima-Rouraceae :
1. *Ailanthus excelsa* Roxb. (P) Motio-oduso
- Meliaceae :
1. *Azadirachta Indica* A. Juss. (P) Neem
- Rhamnaceae :
1. *Zizypus mauritiana* Lank. Bordi
  2. *Zizypus nummularia* Burm. Jad-bor
- Sapindaceae
1. *Dodonace viscosa* Jacq.
- Papilionaceae :
1. *Cicer arietinum* Linn. (C) Chana
  2. *Cyamopsis tetragonoloba* Taub. (C) Guar
  3. *Crotalaria burhia* Hamilt. Shinio
  4. *Dalbergia sisso* Roxb. (P) Sisham
  5. *Dolichos lablab* Linn (C) Sem
  6. *Indigofera cordifolia* Roth Bekario
  7. *Indigofera hochstetteri* Baker. bekario
  8. *Indigofera linifolia* Linn. Lambio bekario
  9. *Medicago sativa* Linn. (C) Rizca
  10. *Melilotus indica* All. Jangli Methei
  11. *Phaseolus aconitifolius* Jacq. (C) Moth
  12. *Phaseolus vulgaris* (C) Chawla
  13. *Rhynchosia pulverulenta* Stocks. Tapni bel
  14. *Trifolium alexandrium* Linn. (C) Berseem
  15. *Vigna radiata* Linn. (C) Mung

Caesalpiaceae :

1. *Cassia italica* Lank. Bhinda anwal
2. *Delonix regia* (P) Gulmohar
3. *Saraca indica* (P) Ashok
4. *Tamarindus indica* Linn. (P) Imli

Mimosaceae :

1. *Acacia jacquemonti* Benth. Ratio banwal
2. *Acacia senegal* Linn. Kumbat
3. *Acacia tortilis* Linn. (P) Israli Kikar
4. *Albizia lebbeck* Linn. (P) Siris
5. *Parkinsonia aculeata* Linn (P)
6. *Prosopis chilensis* Stunz. Belayti Kikar
7. *Prosopis cineraria* Khejari
8. *Leucaena latisilgua* Linn. (P) Pardeshi banwal

Myrtaceae :

1. *Callistemon* Sps. (P) Bottle brush
2. *Eucalyptus cameldulensis* Linn. (P) Safeda
3. *Psidium guajava* Linn. (P) Amrood
4. *Schyzigium jambolina* (P) Jamun

Lythraceae :

1. *Lowsonia inermis* Linn (P) Mendii
2. *Punica granatum* Linn.

Cucurbitaceae :

1. *Citrullus colocynthis* Linn. Thmbo
2. *Citrullus lanatus* Thunb. Matiro
3. *Cucumis momordica* Cong. Kachro
4. *Cucumis callosus* Cong. Kachri

Caricaceae :

1. *Carica papaya* Linn. (P) Papaya

Cactaceae :

1. *Opuntia dillenii* Graham. Nag phanai

Aizoaceae :

1. *Trianthema portulacastrum* Sata Linn.
2. *Trianthema triguetra* Willd. Lunki

Asteraceae :

1. *Cotula hemispha-erica*
2. *Helianthus annuus* (P) Sun flower
3. *Launea procumbens* Roxb. Gangli gobhi
4. *Volutarella divaricata* Benth.
5. *Xanthium strumarium* Linn. Choto-daturu
6. *Sonchus asper* Linn. Kali Jibi

Primulaceae :

1. *Anagallis arvensis* Linn. Jonkamari

Salvadoraceae :

1. *Salvadora oleoides* Decne. Kharo Jhal
2. *Salvadora persica* Linn. Mitho Jhal

Apocynaceae :

1. *Nerium odorum* Soland. (P) Kaner

Asclepadaceae :

1. *Calotropis procera* Forsk. Aak
2. *Leptadenia pyrotechnica* Forsk. Khimp

Polygalaceae :

1. *Polygala erioptera* DC. Bayasan

Boroginaceae

1. *Arnebia hispidissima* DC. Ram bui
2. *Heliotropium bacciferum* Kali bui
3. *Heliotropium marifolium* Choti samtari
4. *Heliotropium ovalifolium* forsk.

Convolvulaceae :

1. *Convolvulus deserti* Hochst. Santri
2. *Convolvulus microphyllus* Dhol phulli Sieb.
3. *Evolvulus alsinoides* Linn. Santari
4. *Ipomoea pescaprea* Sweet. (P)

5. *Merreemia dissecta* Jacq.  
Cuscutaceae :
1. *Cuscuta reflexa* Roxb. Amarbel  
Soianaceae :
1. *Datura ferox* Linn. Dhatura  
2. *Lycium barbarum* Linn. Morali  
3. *Physalis minima* Linn. Chir photi  
4. *Solanum nigrum* Linn. Makoi  
5. *Solanum surattense* Burm. Ringani  
6. *Withania somnifera* Linn. Asgandh  
Scrophuiariaceae :
1. *Anticharis senegalensis* Walp Dhunnya  
Oropanchaceae :
1. *Cistanche tubulosa* Wight. Beaphor  
2. *Orobanche cernua* Loefl. Lonki mulo  
Bignoniaceae :
1. *Kigelia pinnata* (P)  
2. *Tecoma radicans* (P) Ticom  
3. *Tecomella undulata* Seem. Rohiro  
Acanthaceae :
1. *Blepharis indica* T. Anders. Unt-kantalo  
Verbenaceae :
1. *Bouchea marrubifolia* DC. Bui  
Moraceae :
1. *Ficus bengalensis* Linn. (P) Bar  
2. *Ficus religiosa* Linn. (P) Pipal  
Nyctaginaceae :
1. *Bogainvillea spectabilis* Willd. (P)  
2. *Boerhavia diffusa* Linn. Sata  
Amapanthaceae :
1. *Aerva persica* Burm. Bhui  
2. *Amaranthus viridis* Linn.  
3. *Digera muricata* Mart. Lalaru  
Chenopoiaceae :
1. *Chenopodium album* Linn. Chilaro  
2. *Chenopodium murale* Linn. Goyalo
3. *Salsola baryosma* Seholt. Lana  
Polygonaceae :
1. *Calligonum polygonoides* Linn. Phog  
Euphorbiaceae :
1. *Euphorbia clarkeana* Hook. Dudheli  
2. *Ricinus communis* Linn. (P) Arrendi  
Cupressaceae :
1. *Thuja orientalis* Mor Phankhi  
Gnetaceae :
1. *Ephedra foliata* Boiss. Unt phog  
Liliaceae :
1. *Aloe vera* Linn. Gwar pata  
2. *Asphodelus tenuifolius* Cav. Pyazi  
Cyperaceae :
1. *Cyperus atkinsonii* C.B.  
2. *Cyperus rotundus* Linn. Motha  
3. *Scirpus* Sps.  
Poaceae :
1. *Avena sativa* Linn. (C) Jai  
2. *Aristida adscensionis* Linn. Lampro  
3. *Aristida mutabilis* Edgew. Lamp  
4. *Aristida funiculata* Trin. Lamp  
5. *Brachiaria ramosa* Linn. Murat  
6. *Cenchrus biflorus* Roxb. Bhurat  
7. *Cenchrus ciliaris* Linn. Dhaman  
8. *Cenchrus pennisetiformis* Hochst. Dhamanio  
9. *Cenchrus prieurii* Kunth. Lamlrio bhurat  
10. *Cenchrus setigerus* Vahl. Dhaman  
11. *Chloris virgata* SW. Chinki  
12. *Cymbopogon jwarancusa* Jones. Bur gas  
13. *Cynodon dactylon* Linn. Dhob gas  
14. *Dactyloctenium aegyptium* Linn. Ganthio  
15. *Dactyloctenium indicum* Bioss. Tantio

16. *Eleusine compressa* Forsk. Moto gamthio
17. *Eragrostis gangetica* Roxb.
18. *Eragrostis pilosa* P. Beauv.
19. *Eragrostis tenella* P. Beauv.
20. *Hordeum vulgare* Linn. (C) Jau
21. *Lasiurus indicus* Hens. Sevan
22. *Panicum antidotale* Retz. ghas
23. *Panicum turgidum* Forsk. Murat ghas
24. *Pannistum typhoides* Staupf Bajra & Happ.
25. *Tragus roxburghii* Hall. Barachinti Choti

(C) = Cultivated

(P) = Planted

In conclusion, it could be mentioned that the National Research Centre on Camel area is sandy and has 158 species, belonging to 124 genera and 51 families. The ration between Monocotyledons and Dicotyledon came to 1:4 as shown in table given below:

	Families	Genera	Species
Monocots	3	19	30
Dicots	46	103	126
Gymnosperms	2	2	2
Total	51	124	158

There was a single species of xerophytic Gymnosperm viz. *Ephedra foliata* with male and female plants. It is a woody climber and was observed in association with *Salvadora oleoides*, *Zizypus nummularia*, *Prosopis cineraria* and *Cocculus pendulus*, on the slopes of sand dunes. There were 28 species of grasses. Some plants like *Calotropis procera*, *Cocculus pendulus*, *Citrullus lanatus*, *Datura ferox*, *Ephedra foliata* and *Withania somniferum* etc. are of medicinal importance.

The only source of fuel of arid region is *Calligonum polygonoides*, which is

dominating on the unestablished sand dunes. Simultaneously at certain places *Leptadenia pyrotechnica*. *Laptadenia pyrotechnice* competes with *calligonum polygonoides* was also observed in association with *Calligonum polygonoides* *laptadenia pyrotechnice* competes with *calligonum polygonoides*, for water and nutrition and within few years it dominates the latter.

After studying the xerophytic vegetation of this area the writers found National Research Centre on Camel, Jorbeer, Bikaner as an interesting place for the study of Desert Ecosystem as it is a protected area from biotic stress.

## 8.5 Studies on E. coli in the healthy camels

Report by

Prof. P.N. Mehrotra, Department of Microbiology, college of Veterinary and Animal Science, Bikaner.

Thirty five samples from apparently clinically healthy camels were typed for E. coli identification. The samples were also sent to NSEC, CRI, Kasauli. It was observed that in all the 27 samples where E. coli could be isolated, were of rough type. In the rest 8 samples, E. coli could not be isolated and confirmed.

## 8.6 Studies on placenta in Camels.

Thesis submitted for the award of Master of Veterinary Science by Rakesh Mathur. Report by Dr. G. Chandra, Professor, Department of Anatomy, College to Veterinary Science and Animal Husbandary Mathura, U.P.

Gross histological and certain histochemical studies were conducted on the foetal component of the placenta of 10 apparently healthy camels (*Camelus dromedarius*), which were 6 to 19 years in age with corresponding number of parturitions varying from 1 to 8.

Post-parturient placenta in camel comprised of chorion, amnion and internal membrane, and allantoic sac was not distinct. The foetal sac had one short and one long horn which was curved and elongated and had greater and lesser curvatures.

At the time of parturition the chorion was a pinkish red layer which comprised of folds and villi. The former were short and thick in the central area and relatively long and thin in the polar areas.

The chorionic surface had diffusely distributed villi which were denser in the central area compared to the polar area and on both sides of the umbilical cord on the lesser curvature. The villi in the latter two areas were shorter and relatively unbranched. Amnion was loosely attached with the chorion forming chorioamnion which almost extended upto the apex of the horns of the foetal membrane.

A characteristic feature of the foetal membranes of the *Camelus dromedarius* was the occurrence of a tough within membrane which covered the foetus except at the natural orifices, hooves and umbilical cord. This membrane owing to its location has been designated as internal membrane. It extended to 10-12 cm from the apex of the short horn and upto the mid region of the long horn.

Chorionic villi were seen in varying density and height in different areas. Lining epithelial cells comprised of cytotrophoblasts with cuboidal to columnar cells and few syncytiotrophoblasts.

Maximum concentration of tall villi with extensive branching was observed in the dense villous zone. These villi had a constricted base and flat to convex tips, few were cylindrical with conical tips. Cytotrophoblastic cells exhibited apical cytoplasmic blebs and occasionally fine secretion streamers. A characteristic feature of cuboidal cells was the occurrence of congested intra-epithelial

capillaries. Syncytio trophoblasts were located at the tips as well as other areas of villi and comprised of 4-5 to numerous cells with indistinct cell outlines.

The arcade area was relatively less broad compared to other zones. It was mainly lined by cytotrophoblasts.

In the sparse villous zone which was present on both sides of umbilical cord, villi were less dense and generally short with few larger branching villi. Some of the villi were mere sessile epithelial elevations devoid of a mesenchymal core and intraepithelial capillaries. Lining epithelium was mainly cytotrophoblastic with simple cuboidal to high columnar cells; occasionally syncytiotrophoblasts were observed with vesicular nuclei. The arcade area was very broad and was lined by cuboidal cells which were devoid of intraepithelial capillaries.

In the polar area villi were short and broad with branching limited to sparsely occurring longer villi. The lining cells mainly comprised of cytotrophoblasts with cuboidal to columnar cells and occasionally occurring binucleate cells. Intra-epithelial capillaries were occasionally observed in the cuboidal cells.

The connective tissue zone comprised of loosely arranged collagenous fibers along with reticular fibers. Smooth muscle fibers were seen below the surface and these extended into the chorionic folds. The reaction for acidmucopolysaccharides was relatively greater in the cytotrophoblasts on the tips of the villi. Alkaline phosphatase reaction was observed in both cytotrophoblasts and syncytiotrophoblasts. Calcium was more pronounced in the arcade areas. Reaction for Iron was moderate in the bases of the villi and arcade in the polar area.

The amnion was loosely attached with chorion forming a chorio-amnion. It was highly folded at places and occasionally resembled an



omasla lamina. It comprised of an epithelial lining resting on a connective tissue layer. The lining cells were cuboidal to columnar and at places squamous. It became stratified cuboidal at the point of attachment with the internal membrane. Amniotic pustules were observed and these were formed by the aggregation of

epithelial cells particularly in the specimens obtained from near the umbilical cord.

The internal membrane comprised of an epithelial lining on the internal or the foetal side and a connective tissue layer, the external surface was generally devoid of an epithelium.

## 9.

# LAND AND FODDER DEVELOPMENT

The land resource of the National Research Centre on Camel is spread over 824 h of desertic area. During this year a detailed survey of vegetation available in National Research Centre on Camel rangeland was made. The area is generally sandy with sand dunes. The scanty vegetation of this area is xerophytic in nature. In sandy plain areas, trees like *Prosopis cineraria* and *Salvadora oleoides* form major trees. On the slopes of sand dunes *Acacia jacquemonti* alongwith *Calligonum polygonides*, *Aerva persica* and some perennial grasses like *Lasiurus syndicus*, *Cenchrus biflorus* and *Cenchrus ciliaris* were present.

Plant species 158 belonging to 124 genera and 51 families were identified. The ratio

between monocotyledons and dictyledons was 1:4. In all 28 species of grasses were identified in the rangeland.

In the rainy season, about 80 h of land was put under two crops, namely, moth (*Phaseolus aconitifolius*) and guar (*Cyamopsis tetragonoloba*). five thousand plants of different species were sown during the year. About 10 h of land has been sown with sewan, gramna and anjan pastures. Harvesting of pala has been additional resource for camel fodder. About 10 km of fencing has been completed by the end of this year. As a result, there has been significant improvement in the vegetation cover of the protected area.

## 10.

# PUBLICATIONS

### 10.1 List of articles submitted for publication/ seminar symposium.

1. Agarwal, S.P., Khanna, N.D., Agarwal, V.K. and Dwaraknath, P.K. Circulating levels of thyroid hormones in pregnant

camels (*Camelus dromedarius*). Submitted to Theriogenology.

2. Agarwal, S.P., Rai, A.K., Agarwal, V.K. and Khanna, N.D. Enhancement of reproduction in prepubertal female camels (*Camelus dromedarius*). Submitted to Theriogenology.

3. Khanna, N.D. Perceptions of research programmes in camels by 2025 A.D. Presented at National Seminar on 'Perceptions and Potential of camel Research in India', held on 9-10th October, 1988.
  4. Khanna, N.D. Present status of blood groups and biochemical polymorphism studies in buffaloes, Presented at the 'II World Buffalo Congress', held at Delhi from 12-17th December, 1988.
  5. Khanna, N.D. and Rai, A.K. A description of work performance of camel. Submitted to Indian Journal of Animal Sciences.
  6. Khanna, N.D. and Rai, A.K. Work performance of camel and gaps in knowledge, Presented at I Workshop of 'AICRP on Utilization of Animal Energy with enhanced system efficiency' held at University of Agricultural Sciences, Dharwar from 26—28th May, 1988.
  7. Rai, A.K. Perspective research programmes for Physiology, Biochemistry and Reproduction for camel improvement and herd growth. Presented at National Seminar on 'Perceptions and Potential of Camel Research in India', held on 9-10th October, 1988.
  8. Tandon, S.N. Prospects of utilization of camel products like milk and meat in providing supplementary nutrients to rural masses in the arid zone. Presented at National Seminar on 'Perceptions & Potential of Camel Research in India', held on 9-10th October, 1988.
- 10.2 List of articles published during the year
1. Ahlawat, S.P.S., Khanna, N.D., Pani, P.K. and Tandon, S.N. 1988. Genetic control of multiple molecular forms of erythrocyte acid phosphatase in Chickens. *Indian Journal of Animal Sciences*. 58 (5) : 596-600.
  2. Bissa, U.K., Rai, A.K. and Khanna, N.D. 1988. Testicular descent and development of scrotum in camel calves of Bikaneri breed. *Indian Journal of Animal Sciences*. 58 (10) : 1200-1201.
  3. Khanna, N.D. and Khan, M.A. 1988. The double humped camel (*Camelus bactrianus*) of India. *Indian Farming*, 38 (3) : 29-30.
  4. Khanna, N.D. 1988 Traits and calf behaviour in Bikaneri breed of camels pp. 73-80 In camels in development (Ed. Anders Hjort Ornas). Scandinavian Institute of African Studies. Uppsala, Sweden.
  5. Kohli, I.S., Bissa, U.K. and Khanna, N.D. 1988. Agalactia in she camel and its response to leptaden therapy. *Indian vety. Journal*, 65 551-552.
  6. Rai, A.K., Tandon, S.N. and Khanna, N.D. 1988. A study on copulation time of Bikaneri male camels. *Indian Journal of Animal Sciences*. 58 (10) : 1202-1203.
  7. Singhavi, N.M. and Khanna, N.D. 1988. Heterosis in blood proteins and enzymes in equines. *Journal of R.V.C.*, 27 (4) : 204-208.
  8. Tandon, S.N., Bissa, U.K. and Khanna, N.D. 1988. Mortality rates in the Bikaneri camel maintained at an organised farm. *Indian Journal of Animal Sciences*. 58 (1) : 132-137.

9. Tandon, S.N., Bissa, U.K. and Khanna, N.D. 1988. Camel meat, present status and future prospects. *Annals of Arid Zone*, 27 (1) : 23-28.
10. Tandon, S.N., Bissa, U.K., Rai, A.K. and Khanna, N.D. 1988. Behavioural pattern of camel calves from birth to four weeks of age. *Indian Journal of Animal Sciences*. 58 (9) : 1120-1121.
11. Tandon, S.N., Singh, H.P. and Khanna, N.D. 1988. Genetics studies on birth weight of camel calves of Bikaneri breed. *Indian Journal of Animal Sciences*. 58 (4) : 448-450.

### 10 3 हिन्दी के प्रकाशन

क्र.सं.	विषय	आलेख
1.	मरूस्थल का उपयोगी पशु उष्ट्र	ए.के. राय एवं एन.डी. खन्ना
2.	ऊँटों को कब कितना और क्या खिलाएँ	ए.के. राय एवं आर.डी. प्रसाद
3.	उष्ट्र चरणमाह का विकास कैसे करें	आर.डी. प्रसाद
4.	उष्ट्र चरभूमियों का प्रबन्ध	आर.डी. प्रसाद
5.	ऊँटों की सामान्य बीमारियाँ एवं उपचार	यू.के. बिस्सा एवं नरेन्द्र शर्मा
6.	ऊँट के नवजात बच्चे के पालन हेतु कुछ उपयोगी बातें	एस.एन. टण्डन एवं नरेन्द्र शर्मा
7.	ऊँटों में प्रजनन सम्बन्धी कुछ महत्वपूर्ण जानकारी	एस.एन. टण्डन

## 11.

### OTHER ACTIVITIES

11.1 National Seminar on "Perceptions and potential of Camel Research in India" held on 9th-10th October, 1988 at National Research Centre on Camel, Bikaner.

The seminar was attended by 30 Scientists and Senior Researchers. Five sessions, namely, Inaugural, Camel Production, Draughtability, Physiology and Nutrition, Camel Health and Plenary session were arranged. The seminar was inaugurated by Shri Bhajan Lal Ji, Hon'ble Minister for Agriculture, Government of India. Inaugural session was chaired by Prof. K.N. Nag, Vice Chancellor, Rajasthan Agriculture University, Bikaner, Key note address entitled "Role of camel in desert economy, research and development" was presented by Dr. R.M.

Acharya, Deputy Director General (Animal Science), Indian Council of Agricultural Research, New Delhi. The Plenary session was chaired by Dr. C.M. Singh, Ex-Director, Indian Veterinary Research Institute, Izatnagar. The major recommendations of the seminar are reproduced below :

The detailed Scientific discussion took into consideration present knowledge and future needs both at field and scientific level and technological advancement currently under progress or likely to take place in foreseeable future.

It was decided that the future projections should be confined to the year 2000 AD and the priorities of the area will depend

upon availability of trained scientific man power and adequate laboratory facilities. Good scientific work done in camel so far by the Staff of the Rajasthan Veterinary College, Bikaner, Haryana Agricultural University, Hisar, Gujarat Agricultural University and other Institutions in India was reviewed at the seminar.

The participants of seminar took into account the ongoing activities of the National Research Centre on Camel, Bikaner and good progress made in overall development activities and research conducted during initial 4 years of its establishment. While putting on record their appreciation, it was recommended that the on-going activities should be continued.

The shortage of scientific man power and supporting technical staff at the Centre was noticed and it was recommended that the National Research Centre on Camel, Bikaner, should be strengthened adequately at the earliest.

#### *The areas of strengthening research work in future*

1) Classification of breeds/strains : some useful information has already been collected, however, for future work, it is recommended that actual biometrical measurements, body weights, proper colour gradings, physical characters and other conventional standards as are applicable in other domestic species for breed characterisation, evaluation be utilized to classify camel breeds realistically.

2) Management Practices : research to develop package of innovations to introduce ideal management practices appropriate to ecosystems and traditions applicable to region for economic and healthy upkeep of camels be initiated. There is very great scope for improvement of presently followed traditional pastoral system of rearing camels.

3) Nutritional investigations to focus capacity of camel to survive under stress and evolving grazing and nutritional management practices are recommended. This will include studies on nutrient requirements of camels at different stages of growth, development and pregnancy. Detailed studies are required to be conducted on nutritive values of shrubs, grasses and trees available in the rangeland.

The study of carrying capacity of rangeland and forage development programme of traditional bushes where normally camel graze will be very helpful for future camel nutritional programmes. An inventory of different forage available in the areas has to be made. Package of practices for camel nutrition during crisis period of drought have to be worked out using alternate feed resources and material from agricultural by-products and non-conventional feeds.

4) Camel health programme should include more planned surveillance and epidemiological studies on diseases, their diagnosis, prevention and treatment. A system may be worked out so that chemoprophylaxis can be provided to the camel owners free or on highly subsidised rates against trypanosomiasis, internal and external parasites. Calf mortality should receive special attention. Research on development of vaccines against camel pox and trypanosomiasis using latest biotechnology techniques could be a priority area. Emphasis to be given to new emerging diseases. Attempts should be made to develop diagnostic kits specific to camel diseases.

5) The production programme should consist of developing strain of camels of high genetic potential for faster growth and early maturity through selection. The innate

genetic difference should be studied to develop selection criterion. Better gene combination should be identified for optimum work capacity, survivability, improved growth rate, higher milk potential and meat production. A procedure may be developed through which animals of high genetic potential are identified at the camel herd place and provided with subsidy for maintenance on high plane of nutrition so that these can be made use of in the future breeding programmes.

6) Research should be conducted to develop milk products from camel milk, for optimum utilization through marketing so that producers get maximum remunerative returns. Similarly, research on camel meat and meat products is required.

7) Research should be initiated to utilize *camel hide* for leather industry and *camel hair* for cottage industries.

8) Slow herd growth in camels makes it uneconomical. Research to improve breeding efficiency is, therefore, required. The development of suitable methodology for artificial insemination and deep freezing of semen will prove very useful in disseminating superior germplasm. The age at first service also need to be reduced. Pregnancy diagnosis should be developed.

9) Biotechnological research is another area which should receive attention for faster growth, embryo transfer technology and development of preventive vaccines against common camel diseases.

10) Studies on organisation and functions of *Immune mechanism* in camels, *Cytogenetics*, *Immunogenetics*, *Bacteriological*, *Viral* and Pathological studies of pathogens and immunogenes should be initiated on a moderate scale.

11) Research Programme on Camel Drawn

Implements will be very useful to the camel owners and agriculture workers to utilize camel energy at its maximum for agricultural operations and short transports so as to save upon precious and costly petroleum products in developing economy.

12) There is need to conduct further investigations on *Range management*, *socio-economic status* of camel keepers. Therefore, the future programmes of the project should include investigations on:-

- i) Sustainable camel husbandry and socio-economic transformation.
- ii) Camel fodder & range management.
- iii) Camel products marketing and household economy.
- iv) Scale economy of camel herds.

13) Advanced training should be given to the researches of the centres so that competence of local staff is generated in a manner that atleast "two tier system" of researchers is available in each discipline.

14) It is recommended to initiate research studies on the *Bactrian* camel, inhabiting in the Ladakh area. This animal warrants immediate attention for conservation also as only about 50-60 animals are presently available. The Regional Committee No. VI of the ICAR has recommended introduction of *Alpaca* as wool and meat animal, in the high altitude areas. However, it is necessary to conduct first experimental trials and also economic aspects should be studied thoroughly before any major introduction of this species is attempted.

15) For the accomplishment of these areas, it is proposed that the resources personnels/agencies/institutions at the Regional/Central level should be identified.

11.2 The foundation stone laying ceremony of the Office-cum-laboratory building was solemnised by Shri Bhajan Lal Ji,

Hon'ble Minister for Agriculture, Government of India on 9th October, 1988. The function was chaired by Prof. K.N. Nag, Vice Chancellor, Rajasthan Agriculture University, Bikaner. The function was also graced by the presence of Shri Raghunath Vishnoi, Hon'ble Minister for Health, Rajasthan Government, Shri Manphool Singh Bhadoo, Member of Parliament and Shri Poonam Chand Vishnoi, Chairman, Rajasthan Cooperative Dairy Federation. Shri Balbir Singh, Chief Engineer, Central Public Works Department, assisted the Hon'ble Minister in laying the foundation stone. Dr. R.M. Acharya, Deputy Director General (AS) ICAR presented to the Hon'ble Minister a set of seven handouts on Camel Management and Health Control prepared by the Centre.

11.3 Dr. N.D. Khanna, Project Director was deputed from 9th September to 3rd October, 1988 to review the Somali Camel Research Project at the request of Swedish Agency for Research Cooperation for Developing countries. The project is jointly run by the Scandinavian Institute of African Studies, Uppsala and Somali Academy of Science and Arts, Mogadishu.

11.4 Dr. N.D. Khanna and Dr. S.N. Tandon attended II World Buffalo Congress held at New Delhi from 12-17th December, 1988.

11.5 Dr. A.K. Rai, Scientist S-3, attended: (i) XI workshop on All India Coordinated Research Project on Goats held at Central Institute, for Research on Goat Makhdoom on 27-28th February, 1988 (ii) Course on Human Resource Management at the National Academy of Agriculture Research Management, (NAARM), Hyderabad. (1-12th August, 1988) and (iii) International Conference on Appropriate Agricultural Technologies for Farm Women Future Research Strategy and linkage with Development systems, held at Vigyan Bhawan, New Delhi, on 30th November to 6th December, 1988.

11.6 Popular radio talks were given by the staff members of National Research Centre on Camel, Bikaner.

11.7 The Centre participated in the ICAR Zonal Tournament held at Central Soil Salinity Research Institute, Karnal.

## 12. FINANCIAL STATEMENT

The detailed statement showing year-wise expenditure during 7th plan and budget

estimates for 1989-90 are presented in table 30.

TABLE 30  
Statement of Expenditure and Budget estimates (Rs. in lakhs)

Heads of account	1985-86		1986-87		1987-88		1988-89		1989-90	
	Expenditure Plan	N-Plan	Expenditure Plan	N-Plan	Expenditure Plan	N-Plan	Expenditure Plan	N-Plan	Budget Estimates	N-Plan
Estt. Charges	0.80	2.94	2.03	3.67	4.77	3.70	5.72	4.14	8.00	4.30
Travelling Expendr.	0.06	0.20	0.10	0.25	0.22	0.25	0.23	0.25	0.60	0.25
Other Charges	4.51	6.65	4.72	8.57	12.83	8.90	18.72	8.50	3.00	7.00
Equipments	3.57	0.81	6.99	1.21	6.97	0.08	3.14	0.11	5.00	1.00
Works	5.09	—	8.16	—	5.36	—	12.19	—	20.40	1.00
<b>Total:</b>	<b>14.03</b>	<b>10.60</b>	<b>22.00</b>	<b>13.70</b>	<b>30.15</b>	<b>12.93</b>	<b>40.00</b>	<b>13.00</b>	<b>37.00</b>	<b>13.55</b>

## 13. ADVISORY COMMITTEES

13.1 The following advisory committee was constituted by the Indian Council of Agricultural Research, New Delhi vide Council's Office Order No. 6(1)/88-Cdn. dated 22.8.1988.

1. Dr. N.D. Khanna, Project Director, National Research Centre on Camel, Bikaner. Chairman
2. Dr. C.L. Arora, Asstt. Director General, (AP&B), ICAR, New Delhi. Member
3. Dr. P.R. Jatkar, Dean, CVAS, Bikaner. Member
4. Dr. C.S. Mathur, Ex-Dean, CVAS, Bikaner. Member
5. Dr. A.K. Rai, S-3 (AP), NRCC, Bikaner. Member
6. Sr. Accounts Officer, CAZRI, Jodhpur. Member
7. Asstt. Administrative Officer, NRCC, Bikaner. Member Secy.

13.2 Scientific Research Council of

NRCC for 1988 consisted of following members :-

### A. *External Invitees*

1. Dr. Manohar Singh, Head, CSWRI, A.R. Campus, Bikaner
2. Dr. K.P. Pant, Prof. & Head (AG&B), College of Vety. & Animal Science, Bikaner
3. Dr. S.P. Agarwal, Prof. Department of Vety. Physiology, Haryana Agricultural University, Hisar.
4. Dr. G.N. Mathur, College of Vety. & Animal Science, Bikaner.

### B. *Internal Members*

1. Dr. N.D. Khanna, Project Director, NRCC, Bikaner.
2. Dr. A.K. Rai, S-3 (AP), NRCC, Bikaner.
3. Dr. S.N. Tandon, S-1 (AG&B), NRCC, Bikaner.
4. Dr. U.K. Bissa, T-6, (Vety. Officer), NRCC, Bikaner.
5. Dr. N. Sharma, T-6, (Livestock & Farm Supdt), NRCC, Bikaner.



## 14. VISITORS

National Research Centre on Camel, Bikaner received 1750 visitors during 1988. These included scientists, educationists, administrators and tourists. Prominent amongst these were Shri Bhajan Lal Ji, Hon'ble Minister for Agriculture, Government of India, Shri Manphool Singh Bhadoo, Member of Parliament, Shri Poonam Chand Vishnoi, Chairman, Rajasthan Cooperative Dairy Federation, Shri Raghunath Vishnoi, Hon'ble Health Minister, Government of Rajasthan, Shri Trilok Chand, MLA, Uttar Pradesh, Dr. N.S. Randhawa, Director General, ICAR, New Delhi, Dr. R.M. Acharya, Deputy Director General (AS), ICAR, New Delhi, Prof. K.N. Nag, Vice Chancellor, Rajasthan Agriculture University, Bikaner, Dr. C.M. Singh, Retd. Director, Indian Veterinary Research Institute, Izatnagar, Dr. R. Nagarcenkar, Director, National Dairy Research Institute, Karnal, Dr. V.D. Mudgal, Director, Central Institute for Research on Buffaloes, Hisar, Dr. A.L. Chaudhary, Director, Central Sheep & Wool Research Institute, Avikanagar, Dr. D.S. Balaine,

Director, National Institute of Animal Genetics & National Bureau of Animal Genetic Resources, Karnal, Dr. P.K. Uppal, Project Director, National Research Centre for Equines, Hisar, Dr. C.L. Arora, Asstt. Director General (AP&B), I.C.A.R., New Delhi, Dr. C. Natarajan, Director, Department of Biotechnology, Government of India, Dr. C.S. Mathur, Ex-Dean, College of Veterinary & Animal Science, Bikaner, Dr. P.R. Jatkar, Dean, College of Veterinary & Animal Science, Bikaner, Lt. General F.N. Bilimoria, Brig. N.B. Singh, Prof. B.P. Singh, College of Veterinary Science and Animal Husbandry, Mathura, Shri T.C. Jain, Agriculturist, World Bank, New Delhi, Dr. S.N. Saxena, Director (Research), Rajasthan Agriculture University, Bikaner, Dr. P.B. Mathur, Asstt. Director General, Animal Science Education, ICAR, Shri Balbir Singh, Chief Engineer, Central Public Works Department, New Delhi, Dr. T. Lensche, West Germany, Shri Manohar Lal, Collector, Bikaner, Shri Kawaljit Singh, Chief Commissioner Income Tax, I.A.S. Probationers, Journalists etc.

## 15. ANNEXURE

Summary of an interesting and informative article on camel is being included in this report. This article throws light on significant role of camel in India from ancient times. Particularly, the camel as mount of a female goddess, reflects importance of this species in the religious, social and cultural life of Indian people.

Abstract of an article entitled "The Iconography of the Ustravahini Devi" by Vijay Shankar Srivastava, published in "Cultural Contours of India", Dr. Satya Prakash Felicitation Volume, 1981, pp 178-187. Edited by V.S. Srivastava, Abhinav Publications, New Delhi.

During the protohistoric period, single humped camel was known to the Indus people. In the excavations at Kalibangan (Ganganagar district in Rajasthan), the skeletal remains including bones and antler fragments of this animal have been noticed from the Harappan levels (2300-1800 BC) and Daimabad (Ahmadnagar district in Maharashtra) has yielded a fine painted potsherd with the figure of a camel from the chalcolithic Jorwe culture levels (1300-1200 BC).

Ancient literature, contains many references to this animal. Panini (500 BC) mentions in his *Astadyayi* camel as *Ustra*. Vedic literature has many references of this animal. Mahabharata, Arthasastra, Ramayana, Bhagwat Purana and Harshacharita mentioned camel in script. Camel has also been referred to in various contexts in the celebrated literary works of Sanskrit language viz., *Sishupalavadha* of Poet Magha (7th Century A.D.), *Sarangadhara Paddhati*, *Vikramankadevacharita* (11th Century A.D.), *Naisadha Charitha* (12th Century A.D.), *Sivabharat* (17th Century A.D.) etc. The great Jaina Acharya Hemachandra (1088-1172 A.D.) documents in his *abhidhana Chintamani* the varying terms in vogue for this animal.

Early coinage of India knew camel, specially those of the Bactrian, Indo-Greek, Indo-Parthian and Kusana rulers in the north and the Satvahanas in the south.

Camel, being closely associated with desert, became quite a favourite with the populace in Rajasthan. The lyrics like *Dhola-Maru*, *Mahendra Mumal*, *Nihalde Sultan*, *Amala-Khimvaji* etc., originating in Rajasthan have all praise for camel and the role it played.

Temples in Rajasthan possess delineation of this animal in its varied forms. The tradition of such delineations even continued in the

late-medieval or Rajput period and perhaps the most interesting depiction is met with in the *Abudaji temple* (15th Century) at Chittorgarh where a lady on camel is writing love letter.

A camel rider is found depicted in the friezes of the great stupa at Sanchi, datable to the Sunga period (2nd Century BC). A fine terracotta of the Kusana period (fig. 14) was discovered by Dr. L.P. Tessitori, from northern Rajasthan. Double humped variety of the animal was popular in the Gandhar art. One of the epigraphs incised on the pillar in the *Adinatha Jain temple* at Juna Patrasar (Barmer district) dated 1352 A.D. Some of the memorial tablets from Rajasthan and Gujarat have also fine delineations of warriors on camels who sacrificed for some good cause.

*Virupaksha* has been assigned with camel as his mount in the *Visnudharamottara Purana*. Though no images of *Virupaksha* are known so far from the mainland of India, the two paintings from Tun Huang surprisingly depict this deity and are very much based on the iconographic description of the *Visnudhar amottara Purana*.

*Skanda Purana* enlists the camel-necked *Yogini* prominently amongst the sixty four *Yoginis*. The icons of the female deity with camel as her mount are known in the medium of stone as well as in the metal sculptures. *Ustravahini devi*, seems to be a deity of considerable significance, worshipped throughout the country, as the icons delineating her are found in Orissa, Bengal, Rajasthan, Gujarat, Maharashtra and Madhya Pradesh, some are datable to 8th cent. onwards. An inscribed image of *Untadevi*, installed in Saka Samvat 1742 (A.D. 1820) is being worshipped in *Bodari Bagichi*, *Chandapol*, *Jodhpur*. Images of *Untadevi* are also being worshipped at *Bikaner*. On the banks of the tank at *Tirsinghdi Soda* (Barmer) two images of camel riding deity are noticed

who also possess trident. The Bhojbhai Mata in Gujarat is shown seated in the ardha paryank asana on a camel. At Molela (Udaipur), modern terracotta figures are still being produced of Sanda-Mata, whose vehicle is also camel. In the National Museum at New

Delhi, there are two bronzes of the same deity. These are datable to the late mediaeval or Rajput period. In the same series can easily be placed the bronze in the possession of a Swali family at Bombay.

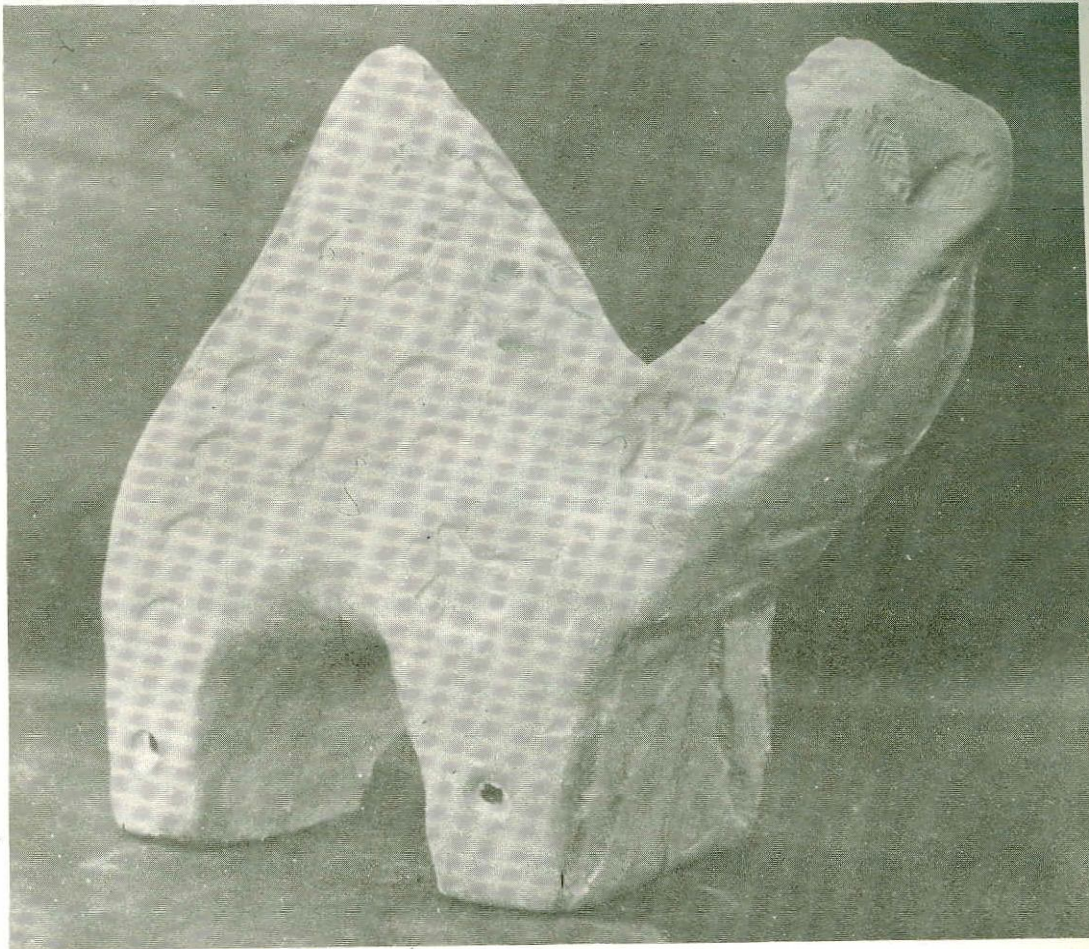


Fig. 14 A terracotta of single humped camel (c. 40-176 AD). Courtesy Director, Archaeology and Museum, Rajasthan Govt. Jaipur)

## NATIONAL RESEARCH CENTRAL ON CAMEL

The National Research Centre on Camel is located in the Jorbeer area at a distance of about 10 km from Bikaner city. The area is arid undulating desert with vast ranges of sand dunes. The soil is mostly loose and sandy. The climate is dry with 58-60% average yearly

humidity. The average yearly rainfall is around 26.5 cm. The temperature varies from 2° to 46°C during the year. The geographical location of the area is 28.3° North latitude and 73.5° East longitude and MSL of 234.84 m.

- PROJECT DIRECTOR :** DR. N.D. KHANNA
- TELEGRAM :** CAMCENTER, BIKANER
- TELEPHONE :** OFFICE: 5489  
FARM: 5683  
RESIDENCE: 5152
- POSTAL ADDRESS :** NATIONAL RESEARCH CENTRE ON CAMEL,  
P.B. NO. 07,  
JORBEER, BIKANER: 334001  
(RAJASTHAN).

## ACKNOWLEDGEMENTS

The National Research Centre on Camel, Bikaner, gratefully acknowledges the considered advice given by the members of Advisory Committee. The Centre records thanks to Dr. N.S. Randhawa, Director General, Indian Council of Agricultural Research, and Secretary Department of Agriculture Research and Education, Ministry of Agriculture, New Delhi and Dr. R.M. Acharya, Deputy Director General (Animal Sciences), Indian Council of Agricultural Research, New Delhi for their interest, guidance and advice given on all aspects of its development and growth.

PUBLISHED BY : PROJECT DIRECTOR  
NATIONAL RESEARCH CENTRE ON CAMEL,  
BIKANER

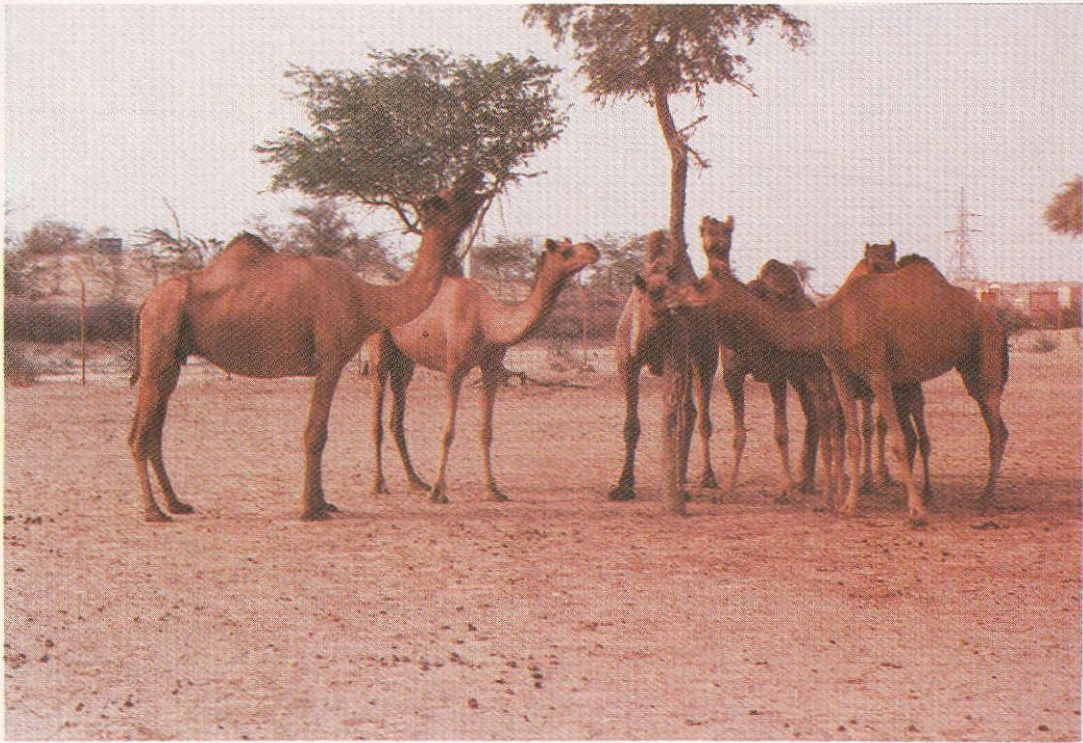
EDITORIAL BOARD : DR. N.D. KHANNA  
DR. A.K. RAI  
DR. S.N. TANDON

STENOGRAPHIC ASSISTANCE : SH. P.K. NAIR

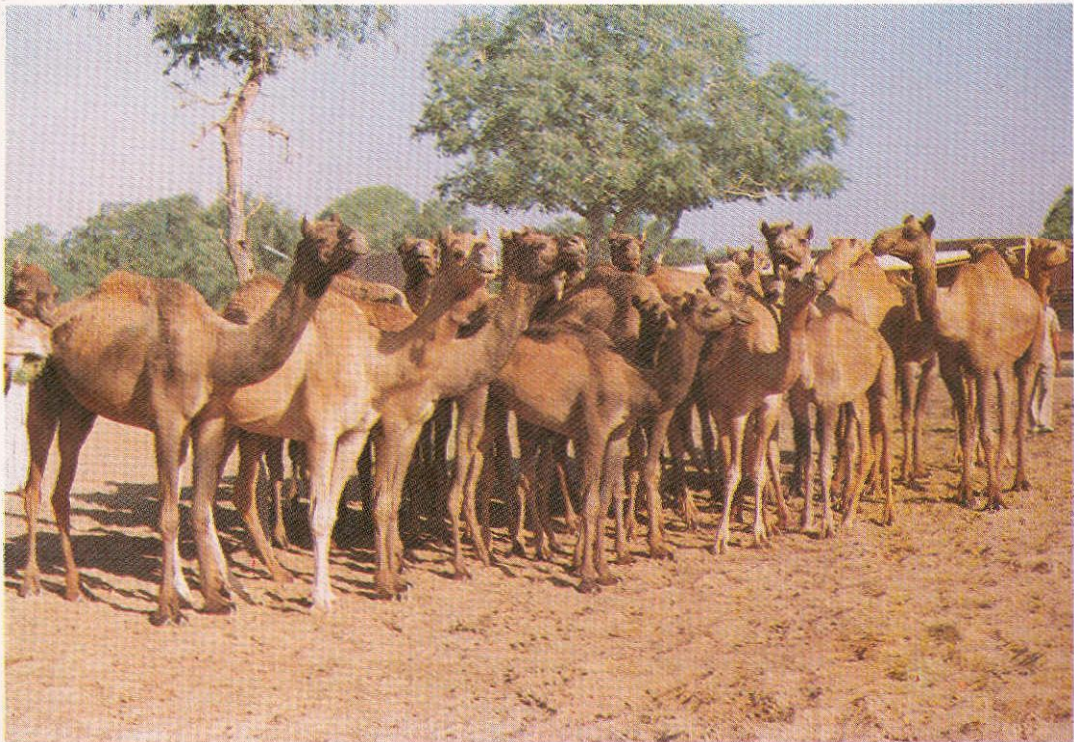
PUBLICATION COMMITTEE : DR. A.K. RAI  
DR. N. SHARMA  
SH. SANTOKH SINGH

COVER PHOTTO : SHIVEJEE

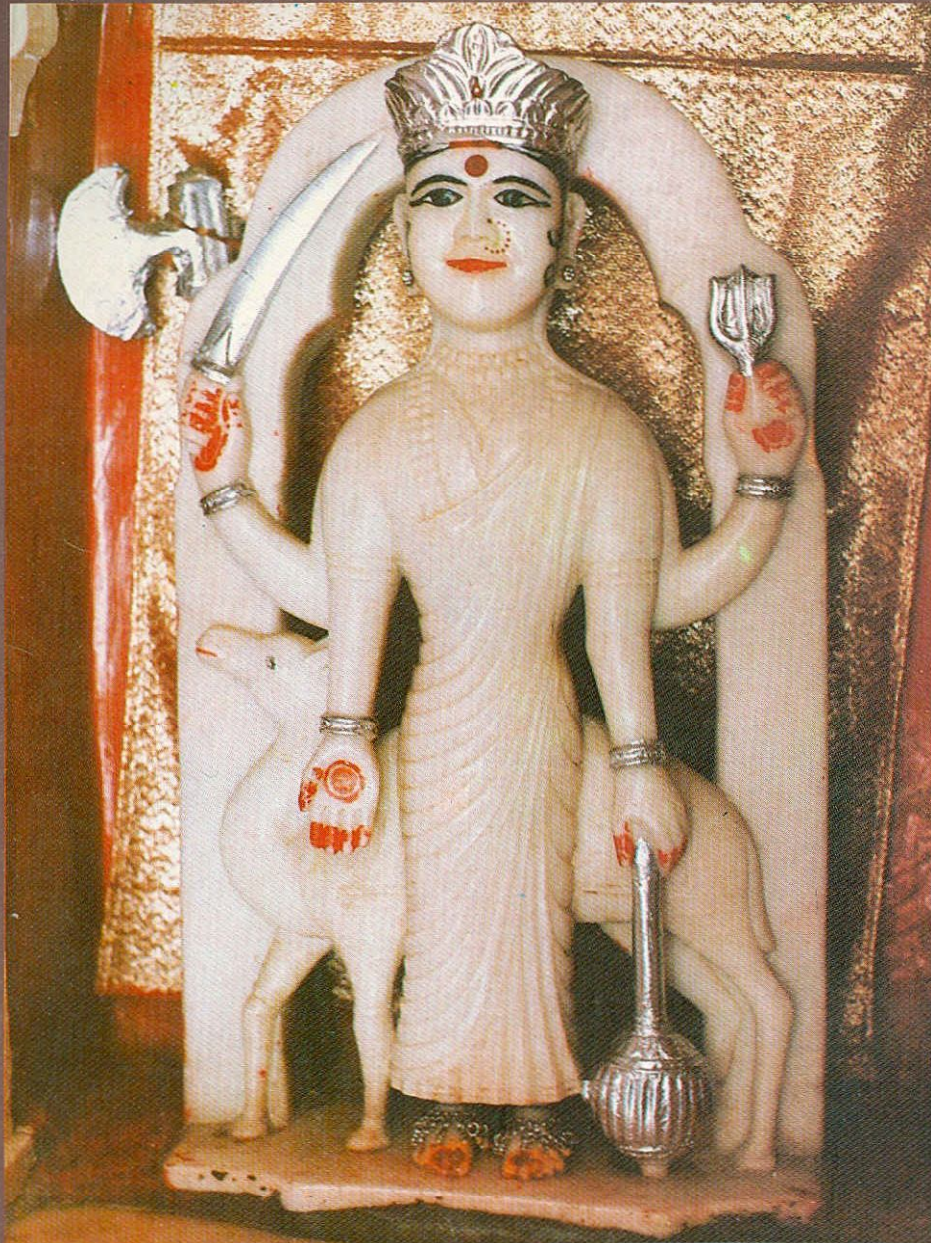
PRINTED BY : SATYAM SHIVAM SUNDARAM PRINTERS  
BISSON KA CHOWK BIKANER.



Bikaneri herd



Kutchi herd



Ustravahini Devi

