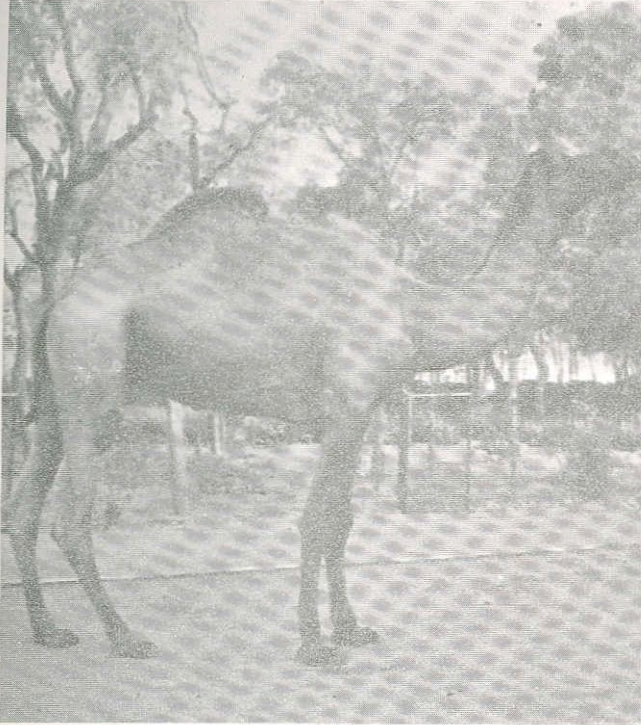
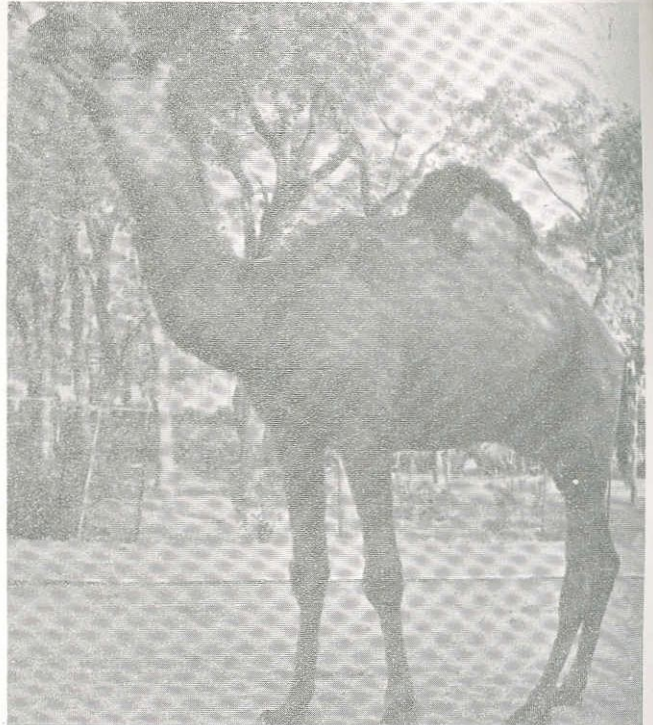




**ANNUAL REPORT 1987**  
**NATIONAL RESEARCH CENTRE ON CAMEL**  
**BIKANER**



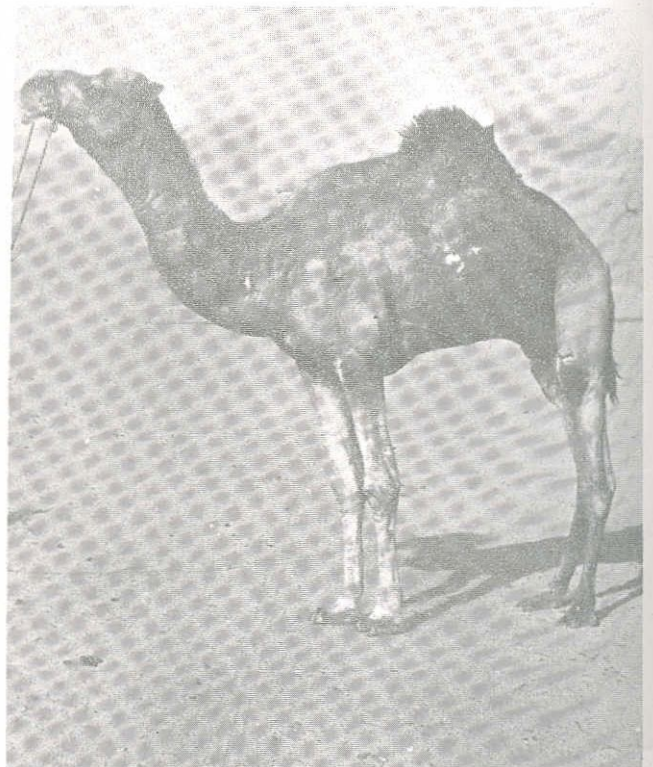
*Kutchi*



*Bikaneri*



*Jaisalmeri*



*Arab*



## **ANNUAL REPORT 1987**



(Estd. 5th July, 1984)

PROJECT DIRECTOR: DR.N.D. KHANNA

**NATIONAL RESEARCH CENTRE ON CAMEL  
BIKANER**

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# 1.

## BRIEF BACKGROUND

The camel is an important component of the desert eco-system. It is a multipurpose animal, the principal use being draft, transport and agricultural operations. The other areas of camel utility are milk, hide, hair and meat. The Camel is also employed in the defence of desert part of the border areas. It is an important domesticated species which can survive in extreme hot climate under scarcity of food and water and can consume coarse fodder of low nutritive value. Amongst countries having camels, India has a large camel population. Of estimated 17.44 million world population, India possess 1.10 million. Almost all the camel population in India is found in the North Western region. Rajasthan state alone accounts for approx. 72% of the total camel population of the country. The trend in camel population in the country from 1951-85 indicates that there has been almost 75% increase in camel number during last 35 years (Table 1).

The camels of India are of dromedary type (*Camelus dromedarius*) and can be grouped broadly into baggage and riding camels based on their body conformation. Some distinct camel breeds have been classified based on body characteristics and tract where these are predominantly found. These include Bikaneri,

Table 1

Trend in camel population in India

Year	Population (in thousands)
1951	629
1956	776
1961	903
1966	1028
1972	1109
1977	1063
1982	1050
1985	1100

Jaisalmeri, Sindhi, Marwari, Mewati and Kutchi. A small number of double humped camels (*Camelus bactrianus*) are also found in the Ladakh region (cold desert) of the country.

Having recognised the economic and social importance of camel in the development of arid and semi arid zones of India, the National Research Centre on Camel (NRCC), Bikaner was established on 5th July, 1984, by the Indian Council of Agricultural Research, New Delhi.

## 2. OBJECTIVES AND MANDATE

The following are the objectives and missions of the N.R.C.C.:

### Objectives

- 1) To establish the work standards for riding and baggage 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.

### 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.
- 4) Associate established work standards with physical, physiological and biochemical parameters.
- 5) Lowering the age at first service.
- 6) Improve management practices for reducing calf mortality and overall mortality.
- 7) Improvement of fertility rates.
- 8) Faster growth rate and early maturity and

- 9) Development of feed, fodder and browsing resources at the farm land allotted to the Centre.

### Research plan and perspective

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

To achieve the missions of the Centre, the following three research projects have been formulated and are under progress:-

- 1) To study work standards in camels and to associate the work standards with physical, physiological and biochemical parameters.  
(A.K. Rai, N.D. Khanna, H.K. Jindal, S.N. Tandon and U.K. Bissa).
- 2) Studies on quantitative and qualitative genetic parameters in Indian camels.  
(N.D. Khanna, S.N. Tandon, A.K. Rai, H.K. Jindal and U.K. Bissa).
- 3) To develop suitable managerial practices for rearing camels.  
(S.N. Tandon, U.K. Bissa, A.K. Rai, N.D. Khanna and H.K. Jindal).

Supplementary informations are also being collected on the occurrence of diseases and health management of camels. Pasture and

fodder development and range land management are concurrently in progress to achieve self sufficiency in feed and fodder resources at the Centre.

#### Research thrust by 2000 A.D.

To achieve the objectives of the Centre, it is proposed to augment research activities on camels by 2000 A.D. The existing infrastructural facilities will be improved upon and scientific and other staff positions will be strengthened. The laboratories will be modernised and latest possible technological advancement will be utilized to conduct research. It is proposed to undertake research on defining work standards for baggage and riding camels and to associate these with various physical, physiological and biochemical parameters. It is also envisaged to develop suitable selection criterion on the basis of these standards. Detailed studies will be conducted to develop economic ration using those low cost ingredients which are freely available in the arid and semi-arid zones.

The camel health programme will include surveillance and epidemiological aspects of diseases, their diagnosis, prevention, treatment and reducing mortality.

The production programme will consist of developing strain of camels of high genetic

potential. The innate genetic differences will be studied in various breeds/genetic groups for exploiting heterogeneity and developing suitable selection criterion. Better gene combination will be identified for optimum survivability, improved growth rate, draught capacity and hair, milk and meat production.

The management programme will consist of developing package of practices adoptable under field conditions for overall economic maintenance of camels. It is also proposed to conduct studies on different aspects of camel reproduction. The development of suitable methodology for artificial insemination and deep freezing of semen will prove very useful in disseminating superior germ plasm and breeding camels round the year. Biotechnological research will be another area which will receive attention during next two decades. Investigation will be initiated to evolve methodology for economic utilization of camel products and by-products, namely, milk, meat, hide and hair. Camel milk and meat are likely to prove very useful supplement protein source in the desertic areas, where malnutrition is mostly prevalent. Technology on utilization of hide and hair will help small scale industries in the villages by providing additional source of income to the marginal and small farmers.

### 3. STAFF POSITION

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

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

Staff categories	Sanctioned posts		Positions filled (year-wise)			
	VI Plan	VII Plan	84-85	85-86	86-87	87-88
R.M.P.	1	—	1	1	1	1
Scientific	2*	4	—	1	3	3
Technical						
Category I	2	1	2	2	2	3
Category II	—	2	—	—	—	1
Category III	2	1	—	2	2	3
Administrative	4	4	3	6	7	7
Auxilliary	2	2	1	2	2	3
Supporting	11	11	11	11	14	22
	24	25	18	25	31	43

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

The details of staff members in position during the year is given below:-

Project Director : Dr.N.D. Khanna

#### Scientific

Scientist S-3  
(Animal Physiology) : Dr.A.K. Rai

Scientist S-1  
(Animal Genetics & Breeding) : Dr.S.N. Tandon

Scientist S-1  
(Biochemistry) : Dr.H.K. Jindal

#### Technical

Farm Manager (T-6) : Sh.R.D. Prasad

Veterinary Officer (T-6) : Dr.U.K. Bissa

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

Agric. Asstt. (T-II-3) : One

Livestock Asstt. (T-2) : Two

Lab. Technician (T-1) : One

#### Administrative

Asstt. Adm. Officer : Sh. Santokh Singh

Asstt. Accounts Officer : Sh.G.R. Bhansali

Jr. Stenographer : One

Sr. Clerk : One

Jr. Clerk : Two

#### Auxilliary

Vehicle Driver  
(Jeep) : Two

Tractor Driver : One

#### Supporting

S.S.G.-I : Twenty two



## 4. FACILITIES

The Centre though recently established has developed reasonably good facilities for undertaking research projects as per the objective .

### (a) Animals:

168 camels belonging to three breeds, namely, Bikaneri, Jaisalmeri, Kutchi and cross between Arab and Bikaneri were available.

### (b) Laboratory and other facilities:

Awaiting construction of proper laboratory building, the Centre has developed laboratory facilities in the existing buildings. The rooms housing costly sensitive equipments which include Coulter Heamatological Counter, Blood Chemistry Analyser, Blood Gas Analyser, Multi Channel Physiograph, UV Spectro Photometer are provided with air-conditioners. The Centre is also developing

library facilities. By this year end, the library had 233 books.

The Centre has 824 hectares of land, one tube well, one open well, two tractors, camel carts, water tanker, trolley, two jeeps and other agricultural implements. The land form is undeveloped, undulated, alluvial with interdunal plains harbouring sand dunes of varying sizes of parabolic and longitudinal shape. The soil is predominately sandy with very little vegetation. There has been extreme drought conditions during last three years in the area.

About 10 km of fencing has been constructed to protect the land from unauthorised grazing and trespassing. Irrigation tanks and channels are being constructed to develop range land and cultivable area for growing feed and fodder for camels.

## 5. CAMEL STRENGTH

There were 168 camels at the beginning of the year consisting of 137 animals of Bikaneri breed, 28 Kutchi breed and one animal each of Jaisalmeri, Arab breeds and a crossbred between Arab x Bikaneri.

During the period under report, 6 females of Jaisalmeri breed were added. In all 28 calves (11 males and 17 females) were born at the farm. At the end of the year, the herd strength was 158 out of which 44 were males and 114

were females (Table 2).

The ratio of males and females was 28:72. There were 51% breedable females, 37% growing animals (between 0-3 years) of both sexes, 4% studs for breeding at farm and 8% males which were used for transport and draft capacity experiments. Some of the animals from the last category were also used for providing services to the outside females, as and when needed. 28 animals were culled and dis-

Table 2

Camel strength - 1987

Breed	Age group	Opening balance as on 1.1.1987		Additions						Deductions						Closing balance as on 31.12.1987	
		M	F	Calving	Internal transfer due to change of age group	Purchase	Death	Internal transfer due to change of age group	Disposal	M	F	M	F	M	F		
Bikaneri	0-3 months	-	-	5	-	-	-	1	5	9	-	-	2	5			
	3-12 months	4	10	-	5	9	-	-	4	10	2	3	3	4			
	1-3 years	13	22	-	4	10	-	-	1	9	3	2	11	16			
	3-15 years	18	57	-	1	9	-	3	-	-	1	12	17	52			
	Above 15 years	2	11	-	-	-	-	1	-	-	2	8	-	2			
Kutchi	0-3 months	-	-	5	-	-	-	-	5	-	-	-	-	-			
	3-12 months	-	-	-	5	-	1	-	1	1	-	-	4	-			
	1-3 years	3	3	-	1	1	-	1	-	-	-	-	2	2			
	3-15 years	1	21	-	-	-	-	2	-	-	-	-	2	20			
Arab x Bikaneri	0-3 months	-	-	1	7	-	-	1	1	7	-	-	-	2			
	3-12 months	1	-	-	1	7	-	-	1	-	1	-	-	4			
	1-3 years	-	-	-	1	-	-	-	-	-	-	-	1	1			
Arab	3-15 years	1	-	-	-	-	-	-	-	-	-	-	1	-			
Jaisalmeri	1-3 years	-	-	-	-	-	1	-	-	-	-	-	-	1			
	3-15	1	-	-	-	-	5	-	-	-	-	-	1	5			
Total		44	124	11	17	18	36	-	6	2	8	18	36	9	25	44	114

posed off through auction. 6 male animals were handed over to the Animal Husbandry Department, Govt. of Rajasthan for distribu-

tion as breeding studs in the villages as extension service.

## 6.

# CAMEL HEALTH

### Clinical cases:

A total of 56 clinical cases were treated during the year 1987, out of which 24 cases were of digestive disorder. The other cases were of respiratory infection (9), reproductive disorder (8), circulatory system (1), camel pox (10) and unspecified (4). In addition, 91 cases of mange and 54 of wounds and minor infections were also attended to. Two cases of abortion were also recorded.

### Prophylactic measures:

(i) Ectoparasites - The animals and sheds were routinely sprayed with insecticides twice a year.

(ii) Endoparasites - Faecal samples were examined at regular intervals, for worm load. Out of 510 faecal samples examined 23% were positive for parasitic infestation. *Balanitidium*, *Strongyles* and *Trichuris* were found to be the major infestations. Cases of mixed infestation were also recorded. The animals were routinely drenched with anthelmintics.

(iii) Trypanosomiasis - chemotherapeutic agents (Tribexin or Tevansi) were administered twice a year as a prophylactic measure

against Surra.

The only major infective disease recorded in the herd during the year was camel pox. Ten cases on camel pox were recorded and there was no mortality.

### Mortality

During the year, 2 camel calves out of 28 born, died before the age of 3 months. The mortality between 3 months to 3 years was also two, while six camels died in the age group above 3 years. The sex-wise mortality was 2 males and 8 females. The overall mortality was 6.78% during this year.

The pooled mortality was 0.186/1000 camel days per day. The sex-wise mortality was 0.128/1000 camel days per day and 0.209/1000 camel days per day in the males and females respectively. Although there was heavy mortality in the livestock in the surrounding areas due to very severe and unprecedented drought conditions and non-availability of adequate grazing facilities, the mortality rate at the Centre remained well within the limit.

# 7.

## RESEARCH PROJECT

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

**Title:**

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

**(A.K. Rai, N.D. Khanna, H.K. Jindal, S.N. Tandon and U.K. Bissa).**

The studies on work standards were carried out to ascertain the load carrying capacity of

Bikaneri camels. The adult male camels trained for pulling carts on a typical kutch road of the desert area were made to pull loads varying from 12 to 18 q. The work was taken continuously covering a distance of 20 km in 4 hours at an average speed of 5 km/hr. The draught generated was measured using a hydrolic dynamometer which varied from 90-120 kg. amounting to 17-22% of body weight.

The pulse, respiration and rectal temperature of the animals were recorded and blood

Table 3

Changes in physiological responses due to continuous load pulling for 4 hours.

Load (q)	Respiration (per min.)		Pulse (per min.)		Temperature (°C)	
	Before	After	Before	After	Before	After
12	10.36 ±0.52	20.56 ±1.51	42.00 ±3.02	62.25 ±5.28	36.73 ±0.21	39.76 ±0.69
15	9.75 ±0.96	35.75 ±1.32	41.75 ±3.30	71.00 ±10.65	36.83 ±0.10	40.28 ±1.30
16-17	9.00 ±1.41	15.00 ±1.41	39.00 ±1.41	55.00 ±4.24	36.30 ±0.14	38.40 ±0.28
18	8.33 ±2.52	17.33 ±6.43	36.67 ±1.15	56.67 ±7.03	36.03 ±0.68	38.87 ±0.70
Control	10.08 ±0.67	13.33 ±2.27	40.92 ±3.99	50.25 ±9.56	36.78 ±0.39	37.57 ±0.72

samples collected immediately before the animals proceeded for draught and within 5 minutes of their return. Two animals and two carts were used at a time while one animal served as control in rotation.

Increase in all the three physiological attributes were observed (Table 3). The increase over initial values ranged from 67-267%, 41-70% and 2.1-3.45°C respectively in respiration, pulse and rectal temperature as against 32%, 23%, and 0.79°C for the respective values in the controls.

The magnitude of increase did not exactly match with the increase in load. There were indications that seasons had a remarkable influence on the level of increase. Observations were made to note the time taken for return of pulse, respiration and rectal temperature to their initial levels after an increase due to draught. The values recorded after 1 hr rest showed a decrease in all the three attributes, however, it remained higher by 100%, 29% and 2°C respectively in respiration, pulse and rectal temperature. In the control animals, however, the increase was found to be only 14% for pulse rate and 0.7°C for rectal temperature. (Fig. 1).

The adult camels trained for riding were put under trial for two hrs run @ 10 km/hr. The respiration rate increased by 270% and almost reached to initial levels after 2 hours rest but the pulse rate and rectal temperature remained higher by 14.26% and 1.3 to 1.6°C respectively (Fig. 1).

Preliminary experiments were conducted to find out the changes in blood pH and blood gases consequent to different load pulling by camel.

The pH of the blood recorded at rectal temperature showed an increase of 0.0321 and 0.0288 respectively after 12 and 15 q load pulling. There was a concomitant increase in  $PO_2$  and decrease in  $PCO_2$ . In the control

camels, the pH decreased by 0.044 whereas, both  $PO_2$  and  $PCO_2$  increased. However, the increase in  $PO_2$  was negligible (0.33 mmHg) as compared to values under draught (5.4 and 7.0 mm Hg). With higher load (18q) instead of increase, a marginal decrease was noted in pH and both  $PO_2$  and  $PCO_2$  increased (Fig. 2).

When the values obtained for pH and blood gases were adjusted to 37°C, the pH changes exhibited a gradual decline in the magnitude of increase with increasing load and decrease in  $PCO_2$  under all the three loads which was apparently not related to the extent of stress due to load. The  $PO_2$  showed a decrease under 12 and 15 q but it increased at 18 q load. The calculated values of bicarbonate ( $HCO_3$ ) and total carbon dioxide ( $TCO_2$ ) indicated similar pattern of change. The standard bicarbonate (SBC) is the concentration of bicarbonate in plasma equilibrated at 40 mm Hg  $PCO_2$  (similar to  $CO_2$  combining power).

The base excess (BEb) is the deviation (meq/l) of base buffer with respect to normal values (48 meq/l). It is an indicator of the state of metabolic buffer and buffering capacity of haemoglobin. The increase in base excess and standard bicarbonate after draught under all the experimental conditions indicated increase in carbon-di-oxide combining power and buffering capacity of haemoglobin (Fig. 3). The increase in base excess extra cellular fluid and percentage of Oxygen content was also noted which was considerably higher at 18q load.

After pulling 15 q load for 4 hrs followed by 1 hr rest the pH values declined but did not reach the initial levels (Table 4).

In riding camel the trend was not consistent. One riding camel after two hrs run showed a decrease in blood pH with an increase after rest; while the other camel showed increase in pH which further increased with rest. It is likely that one camel did not feel stress similar to other and could sustain in maintaining the pH (Table 5).

Fig. 1

### CHANGES IN PHYSIOLOGICAL RESPONSES OF CAMEL DUE TO WORK

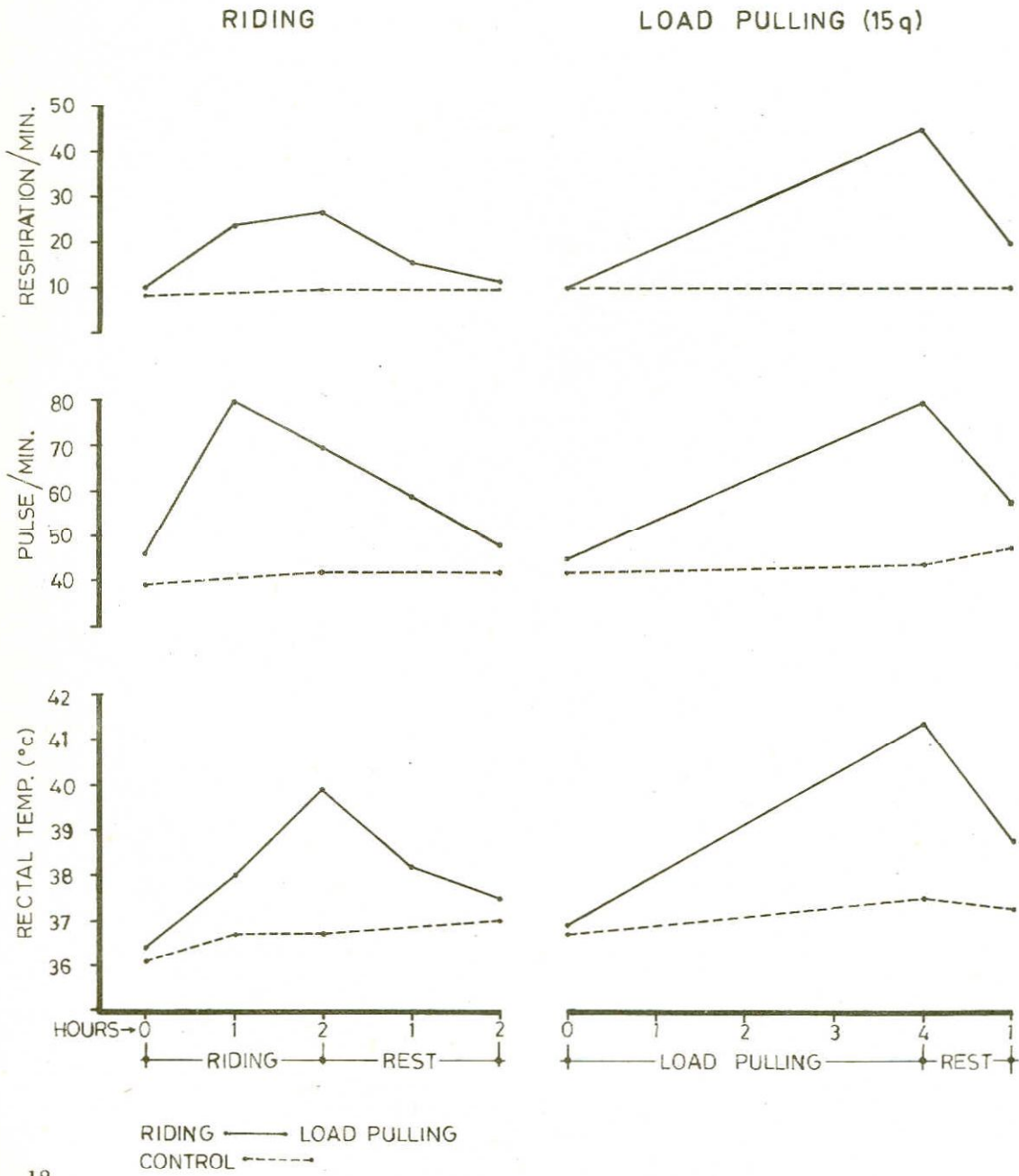


Fig. 2

CHANGES IN pH AND BLOOD GASES ON CONTINUOUS LOAD PULLING FOR 4 HOURS

Control-----■  
 12q-----▨ 15q-----▩ 18q-----■  
 BL = Base Line.

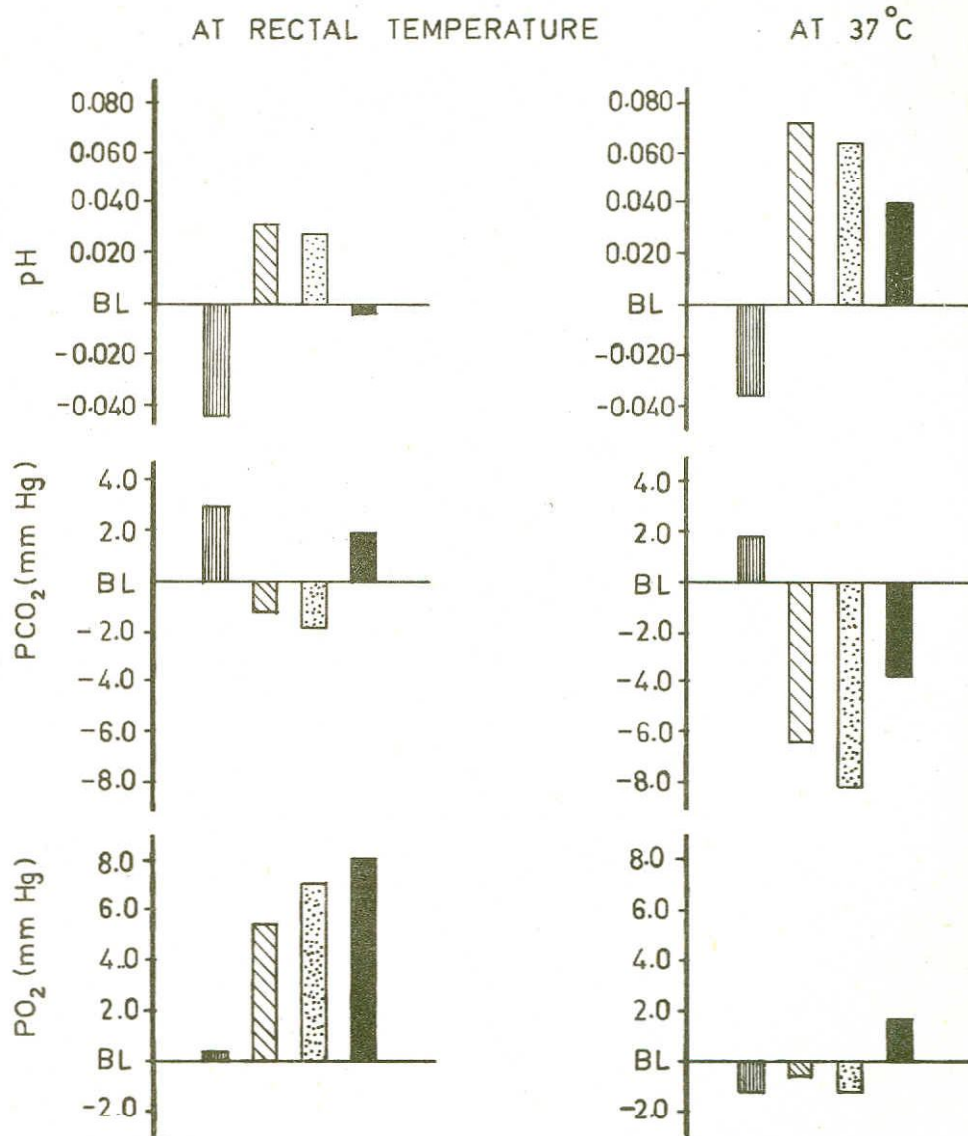
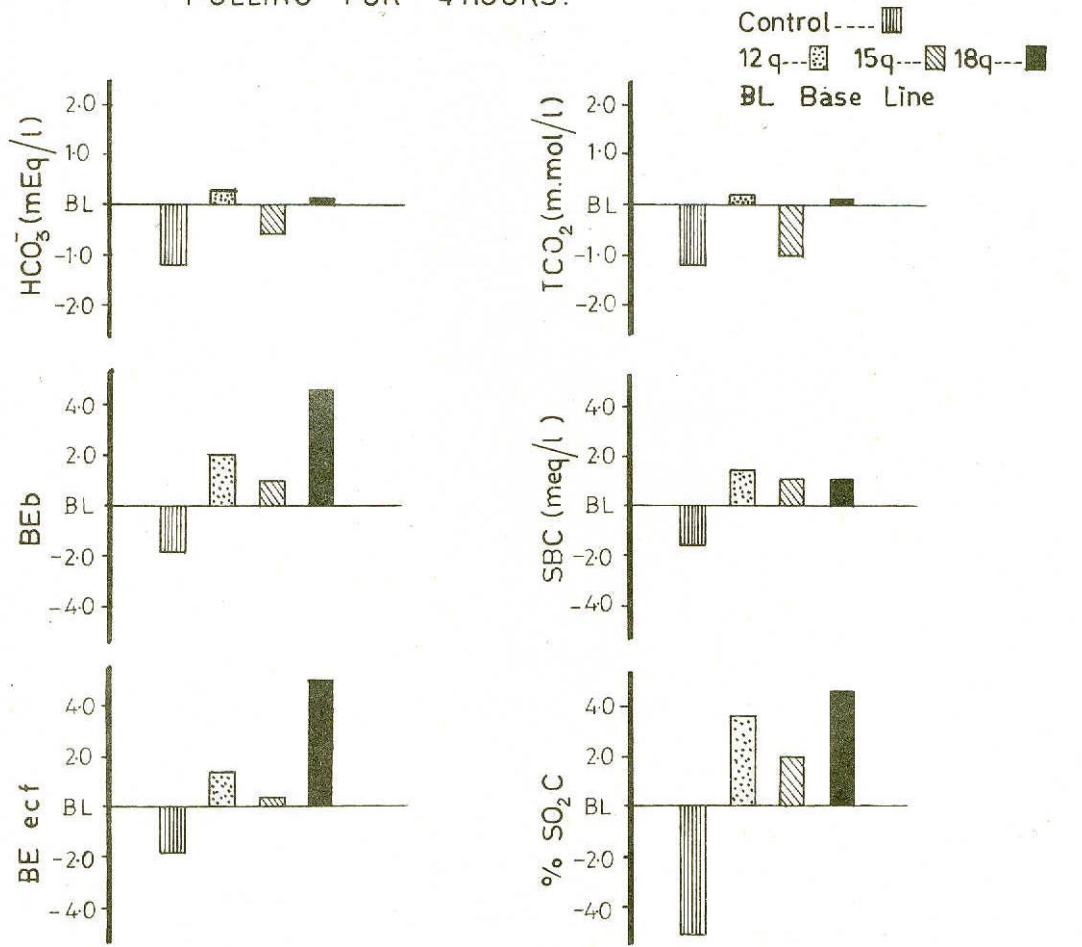


Fig. 3

CHANGES IN CALCULATED PARAMETERS OF  
BLOOD GAS OF CAMEL ON CONTINUOUS LOAD  
PULLING FOR 4 HOURS.



$\text{HCO}_3^-$  - ACTUAL BICARBONATE  
BEb - BASE EXCESS  
BE ecf - BASE EXCESS IN  
EXTRA CELLULAR FLUIDS

$\text{TCO}_2$  - TOTAL  $\text{CO}_2$  CONTENT  
SBC - STANDARD BICARBONATE  
%  $\text{SO}_2\text{C}$  - OXYGEN SATURATION



Table 4

Changes in blood gases (mm Hg) and pH of camel on continuous load pulling (15 q) and after 1 hr. rest

	Camel No. 124			Camel No. 116		
	Initial values	After 4 hr. load pulling	After 1 hr. rest	Initial values	After 4 hr. load pulling	After 1 hr. rest
Haemoglobin (g%)	13.7	11.3	13.6	13.2	12.0	14.0
Rectal Temp. (°C)	36.8	40.9	39.0	36.9	41.8	38.7
pH	7.300	7.327	7.307	7.339	7.417	7.346
PCO <sub>2</sub>	53.7	47.5	48.4	45.7	40.1	47.6
PO <sub>2</sub>	31.0	36.0	37.0	34.0	42.0	40.0
At 37°C						
pH	7.297	7.384	7.336	7.338	7.490	7.371
PCO <sub>2</sub>	54.1	40.1	44.4	45.9	32.5	44.2
PO <sub>2</sub>	31.0	27.0	32.0	35.0	30.0	35.0

Table 5

Changes in blood gases (mm Hg) and pH of camel due to riding stress and after rest

	Camel No. 188				Camel No. 144			
	Initial values	After 2 hr. riding	After 1 hr. rest.	After 2 hr. rest	Initial values	After 2 hr. riding	After 1 hr. rest	After 2 hr. rest
Haemoglobin(g%)	14.2	12.5	12.7	13.0	12.0	11.1	11.0	10.3
Rectal Temp. (°C)	35.6	39.0	37.8	37.2	36.5	39.5	38.6	37.8
pH	7.305	7.280	7.357	7.370	7.251	7.289	7.310	7.316
PCO <sub>2</sub>	51.1	54.7	51.8	47.9	53.8	50.3	51.8	51.6
PO <sub>2</sub>	98.0	133.0	126.0	123.0	103.0	140.0	129.0	123.0
At 37°C								
pH	7.285	7.308	7.369	7.373	7.244	7.331	7.333	7.328
PCO <sub>2</sub>	54.4	50.1	50.0	47.5	54.9	44.3	48.3	49.8
PO <sub>2</sub>	106.6	120.0	121.0	122.0	106.0	121.0	118.0	118.0

Possibly the load pulling upto 15 q was not enough stressful and animal could resist the fall in pH. The levels of CO<sub>2</sub> produced were perhaps balanced by the efficient blood buffer system. Further, increase in load was reflected in a fall which could be due to higher production of CO<sub>2</sub> causing an increase in PCO<sub>2</sub>.

A record of feed consumption of the camels under draught capacity experiment did not show remarkable difference in feed intake during the period of work and rest (Table 6).

### Biochemical constituents of blood of camel

Blood samples from 46 camels (16 males and 30 females) were collected for estimating some biochemical constituents of blood viz. albumin, total protein and serum cholesterol levels. The breed-wise estimation of albumin indicated higher value in Bikaneri animals as compared to Kutchi or cross-bred (Arab x Bikaneri) although, it was not statistically significant. The serum cholesterol was higher in

Table 6

Feed consumption of camels during varying periods of work and rest

Period of Work	Work		Rest	
	Kg/d	g/kg body wt.	kg/d	g/kg body wt.
6-10 days	11.28 ±2.41	17.64 ±3.00	10.63 ±3.21	16.70 ±4.85
12-16 days	12.58 ±1.91	19.80 ±2.00	13.12 ±2.30	20.56 ±1.90

The pooled intake (kg/d) was 10.59 ± 2.35, 12.72 ± 2.13 and 9.65 ± 3.14 respectively.

### Haematological studies

Haematological studies were carried out using Coulter Counter Model ZF-6. Data are being collected on erythrocyte and leucocyte counts, haematocrit values, haemoglobin, mean corpuscular volume, mean corpuscular haemoglobin content and platelet count of the camels of different age groups and sexes. The information on changes in these haematological attributes due to draught and riding is also being collected.

Kutchi animals as compared to Bikaneri or cross-bred animals. The amount of total protein in serum did not show group differences (Table 7).

### Sodium and potassium levels in camel erythrocyte

The sodium and potassium contents of erythrocyte were estimated by flame photometry in 107 blood samples of 4 different age groups. The samples included three genetic groups viz. Bikaneri, Kutchi and cross between Arab x Bikaneri (Table 8). The level of sodium ranged from 115.3 to 125.3 meq/l in Bikaneri animals

Table 7

Some biochemical constituents of camel blood

Genetic group	Sex	No. of observation	Albumin	Total protein	Cholesterol
Bikaneri	Male	12	3.55±1.12	7.06±0.73	59.26±10.08
	Female	25	3.06±0.50	6.95±0.59	66.42±12.29
Kutchi	Male	4	3.29±0.52	7.14±0.66	73.94± 5.20
	Female	—	—	—	—
Cross bred	Male	—	—	—	—
	Female	5	2.92±0.49	6.78±0.74	61.43±12.50

and from 121.5 to 128 meq/l in Kutchi animals. In the crossbreds, it ranged between 120.5 to 122 meq/l. The level of potassium ranged between 9.1 to 11.1 meq/l in Bikaneri animals. In Kutchi animals it was found to be in the range of 8.0 to 10.4 meq/l and was 9.0 to 10.6 meq/l in the cross-breds.

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

##### **Title:**

##### **Studies on quantitative and qualitative genetic parameters in Indian Camels.**

**(N.D. Khanna, S.N. Tandon, A.K. Rai, H.K. Jindal and U.K. Bissa).**

##### **Growth pattern**

Ten body measurements viz. leg length (fore and hind), heart girth, body length, face length, tail length, distance between eyes, height at withers, neck length, circumference of feet (fore and hind), hump factor (Fig. 4) and body weights were measured in 11 males and 11 females which were born during 1987. The measurements were taken at the 1st week, 1, 3, 6, and 9 months. The data were classified according to sex (Tables 9 and 10).

##### **Birth weight**

Sire effect on birth weight of calves was studied. For this purpose, available data of 13 sires were analysed. The herd average of birth weight during the years 1961-87 was 41.02 kg ± 0.20. The average birth weights of the progeny of 4 sires viz. 81, 550, 590 and 667 were observed to be above the herd average (Table 11). Selection differential for the birth weight in respect of these four sires was 5.45 kg.

##### **Body weights**

The variations in the body weights in three genetic groups viz. Bikaneri, Arab x Bikaneri and Kutchi animals were compared from birth to 9 months of age for both the sexes covering a period from 1985-87 (Table 12). It was observed that body weights of Bikaneri breed were higher than Kutchi and crossbreds.

##### **Body measurements**

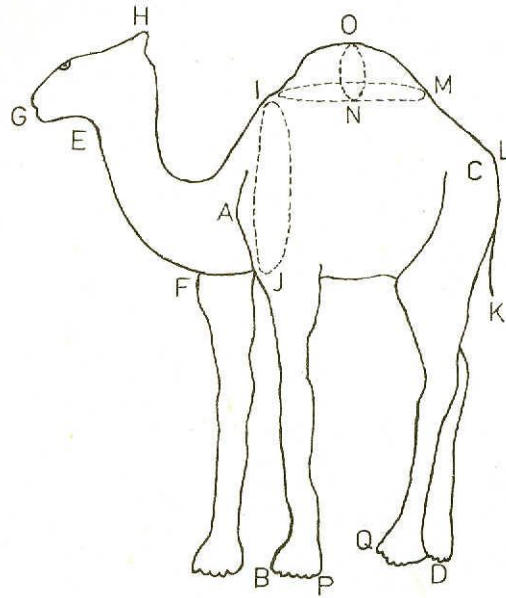
Data on thirteen parameters of body measurements of Bikaneri animals were collected (Fig. 4). Statistical analysis of the data was conducted to estimate averages and standard errors at 4 age groups i.e. 6 months, 1 year, 2

Table 8

Sodium and potassium levels in camel erythrocyte (meq/l)

Age group	Sex	Bikaneri		Kutchi		Arab x Bikaneri	
		Na	K	Na	K	Na	K
0 - 1 year	Male	125.3±7.02	11.1±0.20	121.5±3.41	10.4±0.49	—	—
	Female	123.5±2.52	11.0±0.79	—	—	120.5±5.26	10.6±0.35
1 - 3 years	Male	120.2±5.78	9.2±0.58	—	—	—	—
	Female	124.3±4.43	9.3±0.60	123.0±1.40	8.5±0.99	122.0±0.01	9.0±0.01
3 - 12 years	Male	120.4±5.90	9.2±0.72	128.0±0.01	8.0±0.01	—	—
	Female	122.7±8.57	9.1±1.04	117.9±6.30	8.4±0.97	—	—
Above 12 years	Male	122.0±0.01	9.2±0.01	—	—	—	—
	Female	115.3±7.35	9.7±1.34	—	—	—	—

Fig. 4



A - B - LEG LENGTH (FORE)

C - D - LEG LENGTH (HIND)

A - C - BODY LENGTH

E - F - NECK LENGTH

G - H - FACE LENGTH

L - K - TAIL LENGTH

I - M ] - HUMP FACTOR  
O - N ]

I - B - HEIGHT AT WITHERS

I - J - HEART GIRTH

B - P ] - DIAMETER OF FOOT  
D - Q ]

Table 9  
Growth pattern in male camel calves from birth to 9 months of age

Body parameters	1 week (11)	1 month (9)	3 months (8)	6 months (8)	9 months (7)
Leg length (cm) Fore	90.73±5.73	96.56±5.29	107.00±6.62	116.37±7.05	121.00±6.24
Hind	96.00±6.24	103.44±5.70	112.75±7.23	123.50±7.69	129.86±6.26
Heart girth (cm)	92.45±6.56	106.67±4.27	126.50±8.77	145.81±11.15	156.29±15.54
Body length (cm)	68.00±5.06	76.78±5.59	92.50±6.28	103.87±5.17	108.00±6.56
Face length (cm)	23.90±2.42	25.00±2.12	27.87±1.89	31.00±2.39	31.00±4.65
Tail length (cm)	32.36±3.41	35.22±4.18	39.75±5.06	44.62±5.66	46.57±4.79
Distance between eyes (cm)	15.27±1.10	16.33±1.22	18.12±1.55	20.25±0.71	21.57±0.98
Height at withers (cm)	115.91±7.45	123.33±5.00	131.75±7.03	151.75±11.45	158.00±14.04
Neck length (cm)	52.91±5.61	59.44±5.85	68.62±6.95	75.37±5.68	78.71±5.28
Circumference of foot (cm) Fore	30.27±2.33	31.44±1.81	37.50±4.04	43.75±4.59	45.14±3.80
Hind	27.20±2.10	28.44±1.33	33.75±3.81	39.37±4.53	41.14±4.49
Hump factor (cm)	0.77±0.90	2.82±1.84	5.95±1.47	10.27±6.97	16.42±9.97
Body weight (kg)	47.18±6.38	70.67±13.68	116.75±12.00	172.37±26.55	215.43±28.32

Table 10

Growth pattern in female camel calves from birth to 9 months of age

Body parameters	1 week (10)	1 months (11)	3 months (8)	6 months (8)	9 months (8)
Leg length (cm) Fore	94.40±4.14	96.45±4.43	107.00±4.28	115.37±2.87	120.13±3.48
Hind	99.20±6.36	102.00±6.03	113.12±4.29	123.25±3.01	129.63±3.34
Heart girth (cm)	92.71±8.96	103.54±8.13	123.87±6.03	144.25±5.12	152.63±8.19
Body length (cm)	70.00±5.21	73.73±4.86	86.12±5.41	104.00±5.61	109.00±5.29
Face length (cm)	26.70±1.77	26.00±2.14	27.25±1.49	28.87±1.73	30.50±1.85
Tail length (cm)	32.00±3.20	34.82±3.25	37.62±3.25	43.25±2.12	45.00±2.13
Distance between eyes (cm)	15.10±1.20	15.91±0.94	17.62±1.30	20.12±0.64	21.63±0.92
Height at withers (cm)	117.90±4.82	119.91±6.70	134.62±3.89	151.37±5.32	156.13±7.34
Neck length (cm)	53.60±4.88	57.09±5.22	66.75±2.66	74.37±2.45	77.13±2.17
Circumference of					
foot (cm) Fore	30.10±1.45	30.18±1.89	34.12±3.76	42.25±4.33	44.25±3.73
Hind	27.20±1.40	27.50±1.84	31.75±3.73	37.37±2.72	40.50±3.21
Hump factor (cm)	1.54±1.41	2.54±2.04	5.99±1.77	9.80±3.69	16.36±8.15
Body weight (kg)	44.90±7.82	65.45±14.02	112.87±12.30	165.50±20.40	204.37±14.22



Table 11

## Sire-wise average birth weight (kg)

Sire No.	Birth weight of sires	Birth weight in male calves	Birth weight in female calves	Pooled
119	38	42.55±6.92 (18)	38.31±3.91 (18)	40.58±5.84 (36)
550	45	41.81±4.60 (16)	44.88±2.20 (9)	42.92±4.14 (25)
516	37	42.71±7.36 (7)	37.60±4.27 (10)	39.61±5.94 (17)
590	48	42.81±6.01 (18)	41.50±3.92 (10)	42.69±6.51 (26)
608	52	39.00±8.34 (7)	36.00±9.16 (3)	38.10±8.19 (10)
667	49	45.66±4.04 (3)	45.00±7.02 (4)	45.28±5.49 (7)
18	NA	41.97±5.88(45)	40.51±5.26(54)	41.22±5.56 (99)
82	NA	37.80±5.17(15)	36.53±4.29(15)	37.16±4.71 (30)
07	NA	41.17±5.02(75)	38.27±4.34 (58)	39.94±4.97(133)
101	NA	42.92±3.12(13)	38.87±4.15 (8)	41.38±3.99(21)
102	NA	40.66±4.53(12)	39.33±2.67(18)	39.83±5.25 (43)
81	NA	44.11±8.30(34)	42.82±6.45(29)	43.68±7.51 (63)
85	NA	40.52±4.84(23)	39.25±5.77 (20)	39.83±5.25 (43)

NA - Not available

Note - Figures in parentheses denote number of observations

Table 12  
Body weights (kg) from birth to adult-hood in three genetic groups (1985-87)

	Sex	Bikaneri	Arab x Bikaneri	Kutchi
Birth weight	Male	45.53±6.15 (29)	38.67±0.58 (3)	33.60±3.36 (5)
	Female	38.86±3.67 (31)	35.75±5.47 (9)	-
3 months body weight	Male	109.60±19.89 (25)	134.00±14.00 (2)	95.20±6.53 (5)
	Female	108.86±13.76 (23)	102.83±14.29 (6)	-
6 months body weight	Male	169.58±27.17 (24)	179.50±14.85 (6)	157.75±15.11 (4)
	Female	168.36±16.57 (23)	165.83±21.45 (6)	-
9 months body weight	Male	211.57±30.71 (24)	-	189.33±26.10 (4)
	Female	205.91±21.59 (22)	205.83±29.23 (6)	-
12 months body weight	Male	246.04±32.60 (22)	-	200.00±14.11 (2)
	Female	239.94±15.46 (17)	239.90±20.68 (3)	-
Adult body weight (4 years and above)	Male	647.87±106.39 (20)	-	529.50±167.03 (3)
	Female	566.95±67.79 (75)	-	481.55±63.48 (21)

Note - Figures in parentheses denote number of observations

years and 3 years (Table 13). The correlation co-efficients between body weights and body measurements at various stages of growth were calculated between all possible pairs and were analysed. The statistically significant results are presented in table 14. The results indicated that correlation co-efficient between body weight and heart girth was significant and positive in all the age groups presently studied.

The results further revealed a positive significant correlation between heart girth and leg length in all the groups. To estimate the relative importance of various body measurements influencing body weight, step-wise multiple regression procedure was applied. For this purpose, only first three most contributing variables were taken in the multiple regression equation at all the stages. The total sum of squares due to regression based on 3 degrees of freedom was further partitioned into individual degrees of freedom for finding the contribution of each variable to the total amount of variation. In order to determine the points of insertion of the variables, the first variable was selected which was highly correlated with the body weight and the linear regression equation was fitted. Next the second variable with highest partial correlation co-efficient with the body weight was selected and second regression equation between weight and two independent variables was fitted and lastly the regression was fitted by taking all the three variables as explained earlier. At three points of time i.e. at 6 months, 2 years and 3 years most of the variation in the body weight was explained by the heart girth of the animal. The multiple regression coefficient was found to be quite high and there was no substantial gain by introducing any other variable further in the regression equation (Table 15).

The prediction equation for the body weights at these points of time were:-

6 months :  $2.68 \times \text{heart girth} - 217.10$   
2 years :  $3.83 \times \text{heart girth} - 355.4$   
3 years :  $4.42 \times \text{heart girth} - 429.37$

At 1 year point, however, the results of analysis in respect of heart girth were not significant and were not in line with rest of the three points. Analysis with larger data will be further carried out to arrive at some conclusive interpretation.

#### **Project No.P.I.86/3-ICN/L-05/5220**

##### **Title:**

**To develop suitable management practices for rearing camels.**

**(S.N. Tandon, U.K. Bissa, A.K. Rai, N.D. Khanna and H.K. Jindal).**

##### **Body weight**

The details of body weights at different age groups as on 1.1.1987 to 31.12.1987 are presented in table 16.

##### **Feeding**

The animals were provided with normal scale of ration upto June, 1987. However, the schedule was modified from July, 1987 because of severe drought conditions prevailing in the area. A schedule for crisis feeding was tried. The quantity of fodder was reduced to half of normal quantity for two months and then increased to 3/4th for one month, again reduced to half during next two months and raising to 3/4th in the next month. During this period, however, concentrates were fed at half of the recommended quantity. The general condition of animals did not exhibit any appreciable deviation.

During the year, the body weight gain in the growers was observed to be 267 g per day in calves aged 2-3 years to 528 g per day in calves aged 0-6 months (Table 17).

Studies on growth performance and efficiency of feed conversion are in progress. In three calves *ad-lib* feeding of Moth chara was

Table 13  
Mean values of various body measurements at different age groups of Bikaneri breed

Parameters	Age groups			
	6 months (18)	1 year (17)	2 years (17)	3 years (14)
Body weight (kg)	158.6±6.15	234.1±6.75	271.6±6.35	398.4±0.72
Birth weight (kg)	44.3±1.90	44.1±2.00	38.7±0.60	40.0±1.72
Leg length (cm)	116.8±1.41	120.8±1.66	132.2±1.27	144.5±0.99
Heart girth (cm)	140.1±1.69	153.4±1.78	172.1±1.73	187.4±1.86
Neck length (cm)	83.6±0.99	86.3±0.91	98.0±1.04	105.1±1.40
Distance between eyes (cm)	22.6±0.30	23.9±0.24	24.8±0.14	27.4±0.17
Face length (cm)	29.7±0.40	32.0±0.30	37.2±0.32	40.4±0.40
Tail length (cm)	46.8±0.67	49.5±0.63	53.6±0.66	55.8±0.59
Circumference of fore feet (cm)	—	49.8±0.59	54.4±0.47	58.2±0.70
Circumference of hind feet (cm)	—	45.2±0.55	49.2±0.47	53.0±0.61
Height at withers (cm)	—	160.4±0.92	180.1±1.13	190.1±1.16
Weight of dam at the time of calving (kg)	721.7±14.82	722.3±15.66	574.8±14.72	630.2±10.64
Hump factor (cm)	21.1±1.51	28.5±1.42	29.1±1.50	34.4±1.55

Note: Figures in parentheses denote number of observations

Table 14

Correlation co-efficient showing significant associations

	At the age of 6 months						Weight of dam at the time of calving
	Leg length	Heart girth	Neck length	Distance between eyes	Face length		
Body weight at 6 months	0.670**	0.736**	0.673**	-	-	-	-
Birth weight	0.788**	0.585**	-	-	-	-	-
Leg length	-	0.727**	0.515**	-	-	-	-
Heart girth	-	-	0.754**	0.620**	-	-	-
Neck length	-	-	-	-	0.829**	-	0.492**

	At the age of 1 year								
	Birth weight	Leg length	Heart girth	Neck length	Distance between eyes	Face length	Tail length	Height at withers	Wt. of dam at the time of calving
Body weight at 1 year	0.487**	0.600**	0.691**	0.712**	0.518**	0.533**	0.486**	0.529**	-
Birth weight	-	0.815**	-	-	-	-	-	-	-
Leg length	-	-	0.806**	0.531**	-	-	-	-	-
Heart girth	0.681**	-	-	0.612**	-	-	-	-	-
Neck length	0.478**	-	-	-	0.505**	-	-	-	-
Distance between eyes	-	-	-	-	-	0.581**	-	-	-
Circum. of fore feet	0.517**	-	-	-	-	-	-	0.934**	0.764**
Circum. of hind feet	0.552**	-	-	-	-	-	-	-	0.894**
Wt. of dam at the time of calving	-	-	-	-	-	0.463**	-	-	-

	At the age of 2 years					
	Leg length	Heart girth	Distance between eyes	Tail length	Height at withers	Wt. of dam at the time of calving
Weight at 2 years	0.748**	0.870	0.507*	0.583*	-	0.498*
Leg length	-	0.783**	0.482*	0.550*	-	0.542*
Heart girth	-	-	-	-	-	0.626**
Face length	-	-	-	-	0.522*	-
Circum. of fore feet	-	-	-	-	0.778**	-
Circum. of hind feet	-	-	-	-	0.585*	-

	At the age of 3 years			
	Leg length	Heart girth	Distance between eyes	Face length
Weight at 3 years	0.694*	0.729**	-	-
Leg length	-	0.665**	0.617*	-
Heart girth	-	-	-	0.568*

\* Significant at 5% level

\*\* Significant at 1% level

Table 15  
Analysis of variance

Source of variation	At 6 months		
	df	SS	R
Total	17	11570.27	
Due to regression	3	7627.95**	
Due to heart girth	1	6267.57**	0.736
Due to heart girth and face length	1	876.56	0.786
Due to heart girth, face length and neck length	1	483.82	0.812
Due to error	14	3942.32	
	At 2 years		
Total	16	15793.88	
Due to regression	3	13507.52**	
Due to heart girth	1	11974.46**	0.870
Due to heart girth and hump size	1	993.88	0.906
Due to heart girth, hump size and height at withers	1	539.18	0.925
Due to error	13	2286.36	
	At 3 years		
Total	13	23045.21	
Due to regression	3	16044.03**	
Due to heart girth	1	12336.69**	0.729
Due to heart girth and weight of dam at the time of calving	1	2722.11	0.806
Due to heart girth, weight of dam at the time of calving and face length	1	1085.23	0.834
Due to error	10	7001.18	

\*\* Significant at 1%

Table 16  
Average body weights of camels (kg)

Age group	No. of observations	Average weight as on 1.1.1987	No. of observations	Average weight as on 31.12.1987
0-6 months	—	—	9	54.90±11.21
6-12 months	31	243.00	15	215.50±20.16
1-2 years	9	317.30	24	355.20±30.18
2-3 years	10	376.70	10	416.00±46.71
3-4 years	9	517.40	14	454.20±70.12
4-5 years	7	527.10	16	514.10±81.13
5-6 years	9	546.20	9	597.80±107.71
6-7 years	11	606.00	16	573.20±80.96
7-8 years	5	607.80	14	625.30±68.94
8-9 years	16	647.20	2	700.00±98.99
9-10 years	4	686.50	14	687.40±78.85
Above 10 years	28	686.60	14	675.90±100.11

Table 17  
Average body weight gain per day (g)  
(1.1.87 to 31.12.87)

Age group	No of observations	Average daily weight gain
0 - 6 months	19	528
6 - 12 months	14	359
1 - 2 years	16	352
2 - 3 years	20	267

provided. The average body weight gain per month was observed to be  $11.9 \pm 1.84$  kg.

The dry matter consumption was  $7.65 \pm 0.52$  kg per day and  $2.06 \pm 0.13$  kg per 100 kg body weight (Table 18). Incorporation of 20% Subabool dry leaves with Moth chara did not appreciably effect body weight gain which was  $11.02 \pm 2.02$  kg/month. The dry matter intake was  $6.20 \pm 0.52$  kg per day and  $1.99 \pm 0.13$  kg per day per 100 kg body weight.

### Breeding

During this year, 44 females were provided services. 27 females were served during January - March and 17 during the month of December. The males did not exhibit optimum rutt till December. In all, 61 services were provided resulting in 29 confirmed pregnancies. The conception rate was maximum during February and March.

Twenty eight calves were born during the year under report. The sex ratio of male and female calves was 11:17. Maximum calvings were observed in January (9) followed by December (8), February (6), May (2) and March, April and November (1 each). An important management problem in the camels is management of new born calves which are born during off breeding season i.e. after the month of March. Therefore, an experiment

was planned where one calf was born in April and two in May. In spite of proper care two calves born in May died before reaching the age of 3 months. Heat stroke was diagnosed as the main cause. It appears that thermo-regulation system in the new born calves is not sufficiently developed by first three months of age to combat high ambient temperature.

The average gestation length for pregnancies resulting in female calves was  $396.57 \pm 13.63$  days and for male calves  $390.20 \pm 11.56$  days. During the year, the calving interval was  $665.00 \pm 93.63$  days. The average age at first service was  $1487.75 \pm 298.11$  days and age at first calving was  $1818 \pm 316.53$  days.

Overall average copulation time in the current year was 5 minutes and 44 seconds on the basis of 231 services given by 9 sires, range being 2 to 18 minutes.

### Age at first calving

In order to reduce the age of first calving, nine heifers between 2-3 years of age were injected folligon. Their blood sera were analysed for estrogen and progesterone. The results indicated that most of the experimental females conceived either after first service or subsequently. Five animals carried their pregnancy through. The average body weights of these experimental animals during pregnancy and comparison with average body weights of animals in the first pregnancy are presented in Fig. 5.

The average birth weight of calves born out of treated animal was  $27.20 \pm 1.30$  kg and those of untreated animals in the first calvings was  $34.60 \pm 7.64$  kg.

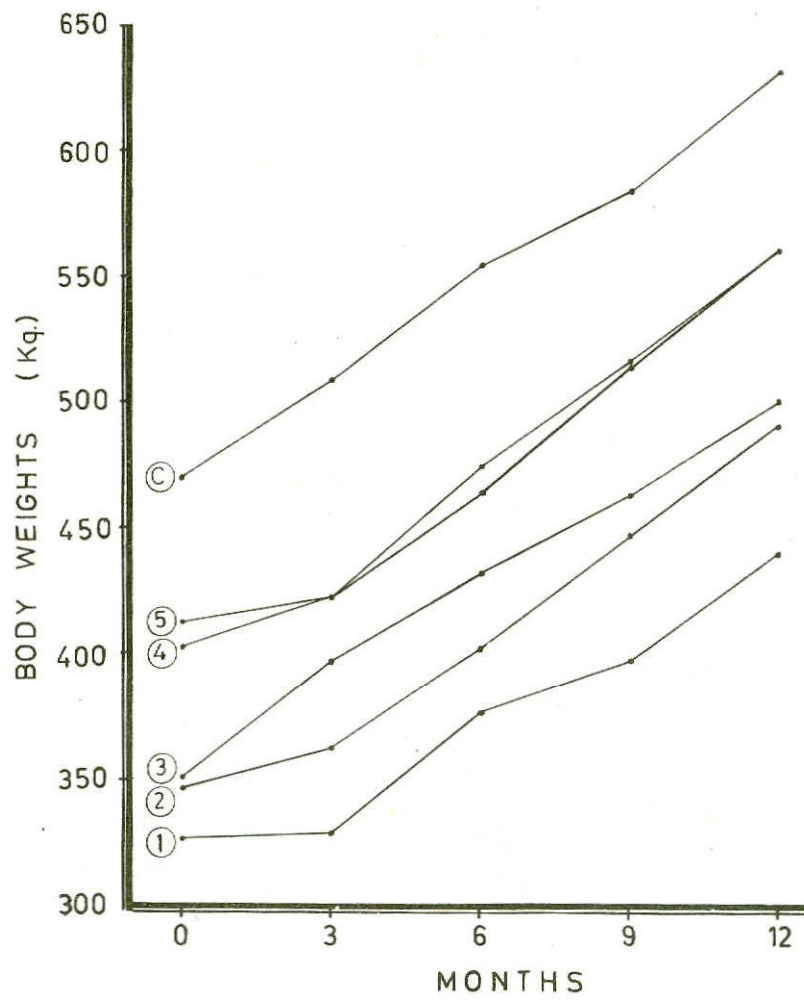
### Season and diurnal effect on physiological parameters

Observations are being collected to record rectal temperature, pulse and respiration rates



Fig. 5

BODY WEIGHTS OF FOLLIGON  
TREATED CAMEL HEIFERS



1-5.....TREATED  
C.....CONTROL

Table 18  
Percent drymatter consumption in growing camel under ad-lib  
feeding of Moth chara and Moth chara + 20% Subabool ( kg)

Animal no.	Moth chara										Moth chara + 20% Subabool											
	153	164	166	168	159	167	153	164	166	168	169	170	171	172	173	174	175	176	177	178	179	
Month	Body wt.	DM intake per 100 kg body wt. per day	DM intake per 100 kg body wt. per day	DM intake per 100 kg body wt. per day	DM intake per 100 kg body wt. per day	DM intake per 100 kg body wt. per day	Body wt.	DM intake per 100 kg body wt. per day	DM intake per 100 kg body wt. per day	DM intake per 100 kg body wt. per day	DM intake per 100 kg body wt. per day	DM intake per 100 kg body wt. per day	DM intake per 100 kg body wt. per day	DM intake per 100 kg body wt. per day	DM intake per 100 kg body wt. per day	DM intake per 100 kg body wt. per day	DM intake per 100 kg body wt. per day	DM intake per 100 kg body wt. per day	DM intake per 100 kg body wt. per day	DM intake per 100 kg body wt. per day	DM intake per 100 kg body wt. per day	
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19				
June	414.00 ± 4.32	7.29 ± 0.19	1.75 ± 0.04	347.50 ± 1.91	5.27 ± 0.21	1.52 ± 0.06	322.50 ± 0.06	5.81 ± 0.12	1.80 ± 0.04	301.00 ± 5.77	3.54 ± 1.13	1.82 ± 0.36	310.00 ± 2.83	4.48 ± 0.76	1.44 ± 0.24	298.00 ± 1.63	4.90 ± 0.84	1.65 ± 0.28				
July	424.00 ± 5.16	7.96 ± 0.51	1.88 ± 0.14	349.50 ± 4.43	4.97 ± 0.34	1.42 ± 0.81	331.00 ± 5.29	6.05 ± 0.25	1.83 ± 0.07	310.50 ± 5.00	4.59 ± 0.67	1.42 ± 0.25	316.00 ± 1.63	5.02 ± 0.50	1.58 ± 0.15	301.00 ± 3.83	5.28 ± 0.08	1.76 ± 0.03				
August	439.00 ± 2.58	8.64 ± 1.31	1.97 ± 0.29	367.50 ± 8.39	7.69 ± 1.58	2.09 ± 0.39	339.50 ± 1.91	8.35 ± 0.12	2.46 ± 0.50	325.00 ± 7.39	6.46 ± 1.48	1.98 ± 0.42	323.50 ± 8.85	7.36 ± 2.18	2.26 ± 0.63	307.50 ± 1.91	7.56 ± 1.65	2.46 ± 0.53				
Sept.	454.50 ± 6.19	10.16 ± 0.59	2.95 ± 0.08	388.00 ± 6.32	9.76 ± 0.45	2.51 ± 0.15	359.00 ± 13.90	9.90 ± 0.56	2.58 ± 0.15	345.50 ± 8.70	9.11 ± 0.14	2.64 ± 0.09	339.80 ± 7.14	7.67 ± 0.48	2.26 ± 0.15	325.00 ± 10.39	8.46 ± 0.54	2.60 ± 0.12				

at different time of the day in the adult animals (Table 19).

### Semen collection

Experiments were initiated to collect semen in the artificial vagina (AV) for studies on semen and artificial insemination. For this purpose, several methods were tried. Good results were obtained when AV for cattle was used (Fig. 6). Usual procedure was followed except a rubber sphincter was applied at the neck of the cone so that some pressure could be exercised on the penis. Great variation was observed in the quantity of semen ejaculated which ranged from 5 to 25 ml. Studies will be continued next year. The semen contained gel and was thick in consistency.

### Camel milk

Work has been initiated on the camel milk. The preliminary results indicated that average fat% was  $4.033 \pm 0.314$  and SNF  $8.267 \pm 0.103$  in the early stages of lactation. Studies on keeping quality of camel milk at room temperature (winter) and at  $5^{\circ}\text{C}$  were conducted. Physical characteristics and pH of milk were noted. Initial pH of raw milk was  $6.60 \pm 0.15$  which reduced to less than 6.0 at room temperature after 7 days and milk became rancid. Milk kept under refrigeration did not get rancid even after two weeks and the pH remained above 6.0. Further studies are in progress. Observations are being made on weekly milk yield. The average milk yield during peak period varied from 3 to 6 kg per day.

*Semen collection in camel*

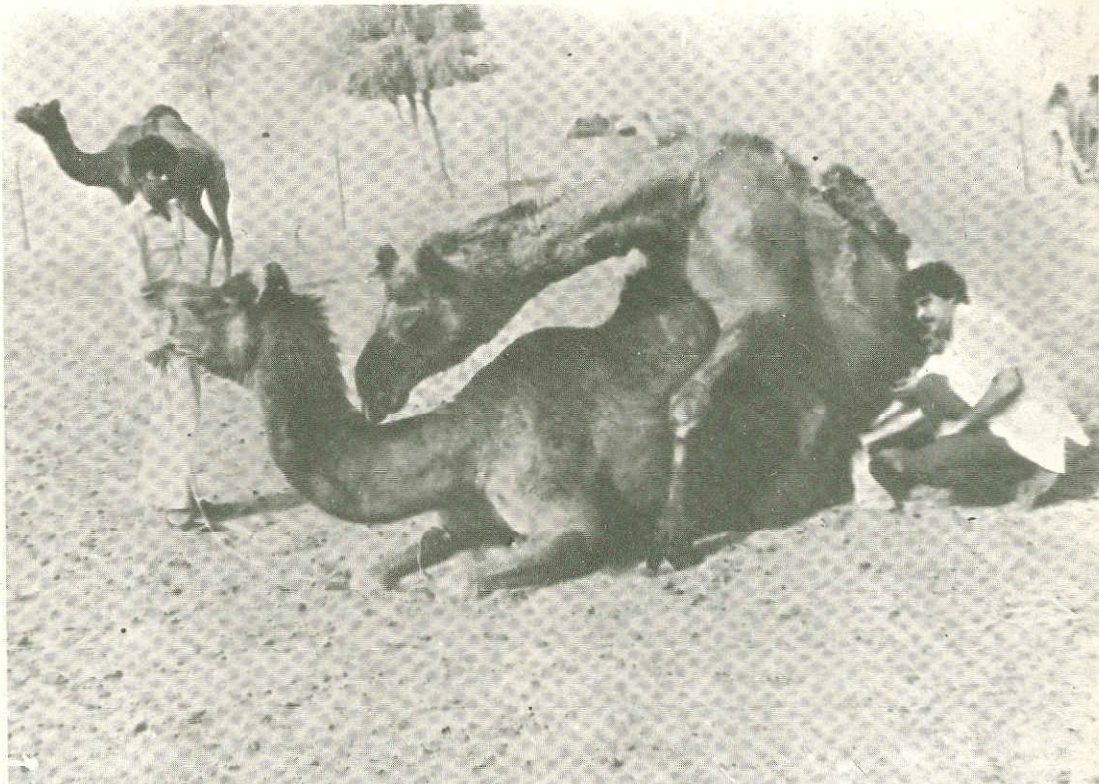


Table 19  
Respiration, pulse rate and rectal temperature of adult camels

Month	Respiration			Pulse			Temperature		
	8 hr.	13 hr.	17 hr.	8 hr.	13 hr.	17 hr.	8 hr.	13 hr.	17 hr.
April	8.67 ±1.21	7.67 ±1.21	8.83 ±2.04	48.66 ±3.01	54.00 ±4.90	54.67 ±3.27	36.65 ±0.58	37.06 ±0.21	37.30 ±0.55
May	10.33 ±1.03	8.16 ±0.98	9.66 ±1.21	48.67 ±6.40	49.33 ±8.26	50.67 ±10.01	36.85 ±0.39	36.78 ±0.51	37.50 ±0.68
June	7.83 ±1.17	8.17 ±1.17	8.83 ±1.47	48.33 ±4.46	45.33 ±4.13	51.33 ±3.93	36.85 ±0.33	37.35 ±0.18	37.58 ±0.12
July	9.50 ±1.52	9.17 ±0.98	9.50 ±0.55	39.33 ±5.89	41.33 ±5.46	46.67 ±4.84	36.68 ±0.31	37.13 ±0.58	37.52 ±0.34
August	7.50 ±0.55	9.00 ±0.63	9.33 ±0.51	45.67 ±5.13	47.00 ±5.33	51.67 ±3.20	36.97 ±0.43	37.55 ±0.26	37.48 ±0.36
September	8.00 ±0.63	9.33 ±1.21	9.16 ±0.98	52.67 ±3.01	50.67 ±2.07	54.00 ±2.19	37.48 ±0.19	37.59 ±0.22	37.69 ±0.19
October	7.83 ±0.75	7.83 ±1.33	9.00 ±0.63	42.67 ±8.64	50.67 ±7.00	52.00 ±5.66	36.90 ±0.24	37.15 ±0.31	37.31 ±0.34
November	7.33 ±0.51	7.00 ±0.89	8.17 ±1.17	42.00 ±4.20	42.67 ±3.27	44.00 ±8.00	35.85 ±0.59	36.52 ±0.61	37.23 ±0.30
December	7.67 ±0.82	7.67 ±1.37	8.17 ±0.98	42.67 ±2.07	48.67 ±5.32	48.57 ±7.81	36.38 ±0.43	37.03 ±0.24	37.37 ±0.32

## Dentition in camel from birth to 1 year of age

Eruption of deciduous teeth in camel is generally completed by one year of age. This includes, Incisors - one pair in the upper jaw and three pairs in the lower jaw, Canines - one pair in the lower and one pair in the upper jaw, Premolars - 3 pairs in the upper jaw and two pairs in the lower jaw. In the lower jaw, the incisors are generally absent at birth, however, one pair may be observed in some exceptional cases. The first pair of incisors appear between 4-5 days while the 2nd and 3rd pairs erupt at about 17-18 days and 40-41 days respectively.

In the lower jaw after the eruption of third pair of incisor, one pair of canine appears at about 72-75 days and occupies the position just adjacent to the third pair of incisor. In the

upper jaw, only one lateral pair of incisor is present which erupts at about 7-8 months of age, much later in comparison to the incisors in the lower jaw. This pair of incisor is of rudimentary type. Similarly, the upper canines are also of rudimentary type erupting late i.e. at about 4 months of age. There are three pairs of premolars in the upper jaw and two pairs in the lower jaw. The eruption of two pairs of premolars in the upper and lower jaw varied from 0-20 days. The third pair of premolar in the upper jaw takes about 25-40 days to erupt.

The first upper molar erupts between 280-335 days with an average of  $306 \pm 27$  days. The lower 1st molar erupts by 250-285 days, the average being  $267 \pm 16$  days. These are only preliminary observations and work is being continued both in growing calves and adult animals.

## 8.

# INTER-INSTITUTIONAL COLLABORATION

1) Hormonal studies: Report by Dr. S.P. Agarwal, Professor, Department of Veterinary Physiology, Haryana Agricultural University, Hisar.

i) Circulating levels of estrogen and progesterone in female camel (*Camelus dromedarius*) during pregnancy

Monthly blood samples from 16 pregnant camels were collected commencing from 60 days post service until the last month of gestation. Two animals aborted and two did not conceive. The average length of gestation was  $398 \pm 13$  and  $372 \pm 11$  days in camels carry-

ing male and female foetus, respectively, with a mean of  $383 \pm 9$  days. Sera were analysed for estradiol-17 beta and progesterone by radioimmunoassay. The mean estradiol levels increased progressively from a basal level of 20 pg/ml at 2 to 3 months of pregnancy to about 450 pg/ml at the final stages of gestation. The dam bearing a male foetus had relatively lower estradiol concentrations ( $76.5 \pm 10.8$  pg/ml) as compared to those carrying a female foetus ( $112.3 \pm 19.6$  pg/ml). The mean progesterone levels fluctuated between 4 and 5 ng/ml throughout pregnancy except for a slightly lower value ( $2.5 \pm 0.27$  ng/ml) at 9 to 10

months of gestation. On an average, the camels carrying a male foetus had higher progesterone levels ( $5.13 \pm 0.69$  ng/ml). The data suggested that the steroid hormone levels are influenced by the stage of pregnancy and sex of the foetus. Cases of un-noticed abortion and unsuccessful conception could be identified (Table 20).

ii) Administration of folligon in camel heifers just reaching puberty

Late maturity is a menacing problem in camel as they attain puberty at 4-5 years of age. An effort was made to enhance puberty in female camels by folligon treatment. Nine female camel heifers just reaching puberty (2-3 years of age) were injected with folligon as shown in table below:

Dose of folligon	Number of animals	Schedule of injection
1000x3	4	Three consecutive days
1000x2	2	First two days
1000x3	2	Three consecutive days
1000x1	1	First two days.

The animals were mated on 6th and 7th day post-treatment. Blood samples from these animals were collected on two consecutive days prior to folligon treatment, on days of folligon administration, on days of mating and on alternate days during post-mating period till one full cycle length i.e. 23 days. Sera were analysed for progesterone by radio-immunoassay.

The results showed that of the four animals receiving 1000x3 I.U. of folligon, two (No. 93 and 104) showed rising levels of progesterone which were maintained upto 22 days post mating suggesting formation of active corpus luteum and successful conception. The other two animals (No. 99 and 103) had rising levels for about 10-15 days after mating and then

declined indicating failure of conception. However, they conceived in subsequent heat.

Among animals receiving 1000x2 I.U. of folligon, one animal (no. 100) had undetectable levels throughout the experimental period suggesting inactive ovary. However, it conceived after subsequent service. The other animal (No. 102) showed constantly higher progesterone levels indicating development of active corpus luteum and conception.

Of the two animals receiving 1000x3 I.U. of folligon one (no. 94) showed progesterone levels below 1 ng/ml indicating failure of ovulation and development of corpus luteum. It conceived in the subsequent oestrus but could not sustain pregnancy. The other animal (No. 101) showed medium levels of progesterone (between 1 and 3 ng/ml) giving a doubtful picture. However, its follow up revealed it to be pregnant.

The serum progesterone in one animal (No. 15) receiving 1000x1 I.U. of folligon could not be detected during the experimental period. However, in the subsequent heat, it was covered and became pregnant.

Four folligon treated animals did not carry pregnancy upto the full term, either due to foetal resorption or un-noticed abortions. The results of this experiment suggest that folligon treatment to pre and parapubertal female camels triggered the hypophysio-gonadal axis and most of the animals conceived in the first or subsequent heat.

(iii) Circulating levels of thyroid hormones in pregnant camels

Blood samples from 16 female camels were collected at monthly interval commencing from 60 days post-breeding till last month of gestation. Two camels did not conceive and two suffered from un-noticed abortions. The average gestation period was  $398 \pm 13$  and  $372 \pm 11$  days in camels bearing male and

Table 20

Serum estrogen (pg/ml) and progesterone (ng/ml) levels in female camels that had un-noticed abortions or failed to conceive

Status	Camel No.	Pregancy in days														
		61-90	91-120	121-150	151-180	181-210	211-240	241-270	271-300	301-330	331-360	361-390				
Abortion	661	Estrogen	5.0	27.5	-	36.0	-	47.0	65.0 <sup>a</sup>	16.5	7.8	8.4	5.0			
		Progesterone	8.6	6.8	-	5.1	-	4.9	4.0 <sup>a</sup>	0.35	0.31	1.0	0.27			
Failure of Conception	697	Estrogen	7.2	-	16.5 <sup>a</sup>	-	6.2	9.4	9.4	5.0	16.5	12.5	2.4			
		Progesterone	8.6	-	6.0 <sup>a</sup>	-	2.0	b	0.38	0.35	b	b	-			
Conception	583	Estrogen	14.5	23.0	8.2	9.8	13.0	14.0	10.5	-	-	37.0	-			
		Progesterone	0.68	b	b	b	b	b	-	-	-	-	-			
	596	Estrogen	6.3	-	-	5.0	13.5	32.5	5.8	11.5	-	5.0	-			
		Progesterone	0.33	-	-	0.50	0.31	0.36	0.22	0.42	-	-	-			

a Indicates the probable time of abortion

b Not-detectable

- Samples not available

female foetus respectively with an overall mean of  $383 \pm 9$  days. Sera were analysed for thyroxine ( $T_4$ ) and triiodothyroine ( $T_3$ ) by radioimmunoassay. Mean  $T_4$  and  $T_3$  levels varied from 76 to 116 ng/ml and 0.73 to 1.32 ng/ml, respectively during various stages of gestation. In general, the  $T_4$  and  $T_3$  levels were significantly higher during early pregnancy with lowest values in tenth month.  $T_4:T_3$  ratio showed minor and non-significant fluctuations. Age of dam or sex of foetus had no effect on hormone levels. Similarly, the hormone levels were not affected by failure of conception or abortion.

2) *Studies on some serum enzymes in camel:* Thesis submitted for the degree of Master of Veterinary Science by Miss Nalini Gahlot to the Sukhadia University, Udaipur (Report by Dr.J.S. Bhatia, Assoc. Prof.)

Studies on quantitation of some serum enzymes viz. aminotransferases, phosphatases and dehydrogenases, total serum proteins and fractions and qualitative characterization of isoenzymes of lactic-dehydrogenase and alkaline phosphatase were made in 147 camels of both sexes. Effects of climatic condi-

tions viz. extreme hot (May, June), extreme cold, (December, January) intervening period (Comfortable Period), sex and age were also studied. The age group i.e. group-I (below 4 years), group-II (4 to 10 years) and group-III (above 10 years) were studied.

Overall mean values of aspartate amino-transferase, alanine amino-transferase, alkaline phosphatase, acid phosphates, lactic-dehydrogenase, isocitric-dehydrogenase and total serum protein were  $77.88 \pm 0.74$  RF units per ml,  $9.90 \pm 0.17$  RF units per ml;  $4.99 \pm 0.07$  B.U. per dl,  $1.35 \pm 0.03$  B.U. per dl,  $480.66 \pm 6.05$  units per ml,  $7.82 \pm 0.14$  M.I.U. per ml and  $7.53 \pm 0.09$  g per dl, respectively.

Agar gel electrophoretic separation yielded 4 to 7 bands of serum protein fractions. Mean values of major 4 fractions of the serum proteins in percentage were  $45.27 \pm 0.46$ ,  $17.77 \pm 0.13$ ,  $14.89 \pm 0.28$  and  $22.27 \pm 0.26$  for albumin, alpha, beta and gamma globulins, respectively. Electrophoretic studies were also conducted on lactic-dehydrogenase and alkaline phosphatase.

## 9.

### LAND AND FODDER DEVELOPMENT

The range resources of the farm spread over an area of 824 ha. The area is being fenced in phases and the developmental activities are mainly confined to the fenced area of about 125 ha. This zone has been under unprecedented severe drought during this year, which has been continuing for the last 2 years.

About 8500 plants of different species were planted and survivability was found to be quite low due to extreme drought conditions.

About 80 ha of undeveloped land was tilled and sown with seasonal crops, Moth and Guar for fodder and sewan and Anjan pastures.



Irrigation facility was extended to about 2 ha of additional land by providing channels for supplementary irrigation for fodder crops.

Harvesting of pala was additional resource of fodder apart fodder trees, shrubs and grasses in the area.

## 10. PUBLICATIONS

### *List of articles submitted for publication*

1. S.N. Tandon, U.K. Bissa and N.D. Khanna. Mortality rates in Bikaneri camels, maintained at an organised farm. Submitted to *Indian Journal of Animal Sciences*.
2. S.N. Tandon, U.K. Bissa and N.D. Khanna. Camel meat, present status and future prospects. Submitted to *Annals of Arid Zone*.
3. N.D. Khanna, A.K. Rai, S.N. Tandon and H.K. Jindal A review on camel reproduction. Submitted to *Annals of Arid Zone*.
4. S.N. Tandon, H.P. Singh and N.D. Khanna. Genetic studies on birth weight of camel calves of Bikaneri breed. Submitted to *Indian Journal of Animal Sciences*.
5. A.K. Rai, S.N. Tandon and N.D. Khanna. A study on copulation time of Bikaneri male camels. Submitted to *Indian Journal of Animal Sciences*.
6. U.K. Bissa, A.K. Rai and N.D. Khanna. Testicular descent and development of scrotum in camel calves of Bikaneri breed. Submitted to *Indian Journal of Animal Sciences*.
7. S.N. Tandon, U.K. Bissa, A.K. Rai and N.D. Khanna. Behavioural pattern of camel calves from birth to four

weeks of age. Submitted to *Indian Journal of Animal Sciences*.

8. N.D. Khanna and M.A. Khan. The double humped camel (*Camelus bactrianus*) of India. Submitted to *Indian Farming*.
9. N.D. Khanna. Production status of Bikaneri breed of camels inhabiting Thar desert of India. Paper presented at workshop on "The case of African drylands and balanced camel production" held at Frudal, Sweden on October 19- 22, 1987.
10. N.D. Khanna. Scope of camel development and proposed integrated study plan for survey and camel production in the Arid Zone. Paper presented at National Workshop on Scope of Animal Husbandry in Desert Region held at Jodhpur on 30-31, October 1987.

### List of articles published

1. N.D. Khanna 1987. Camel, the work animal. *Indian Farming* 37(4):27-30.
2. N.D. Khanna and U.K. Bissa 1987. Camel health and disease. *Pashudhan*, Vol. 2 Issue 1 and 2 (two parts).

3. S.P. Agarwal, V.K. Agarwal, N.D. Khanna and P.K. Dwaraknath, 1987. Profiles of steroid hormones in male camel (*Camelus dromedarius*). *Indian Journal of Animal Sciences*, 57(7):659-661.
4. S.P. Agarwal, N.D. Khanna, V.K. Agarwal and P.K. Dwaraknath, 1987. Circulating levels of estrogen and progesterone in female camel (*Camelus dromedarius*) during pregnancy. *Theriogenology*, 28(6):849-859.
5. N.M. Singhvi and N.D. Khanna, 1987. Electrophoretic studies on haemoglobin polymorphism in Indian Horses, Donkeys and Mules. *Indian Veterinary Journal* 64(9):748-750.
6. N.D. Khanna and S.N. Tandon, 1987. Electrophoretic variations of haemoglobin and serum amylase in Mithun and Mithun Crossbred. *Indian Veterinary Journal*, 64(11):961-964.

## 11.

### OTHER ACTIVITIES

#### 1. Short course on Camel Production and Management.

An ICAR sponsored short course was conducted from 17th-26th November, 1987. 15 candidates attended the course. Eleven lecturers from outside N.R.C.C. were invited to deliver lectures in different specializations.

The course was inaugurated by Prof. K.N. Nag, Vice- chancellor, Rajasthan Agric. University. The Inaugural session was chaired and addressed by Dr. R.M. Acharya, Deputy Director General, ICAR. The valedictory function was chaired by Dr. P.R. Jatkar, Dean, College of Vety. and Animal Science, Bikaner and the Chief Guest was Sri Manohar Lal, I.A.S., Collector of Bikaner who apprised the participants about developmental programme on camel being undertaken at the District level.

The course outline and learning out come of the course were as under:-

#### Course Outline

- (1) Origin and distribution:- Origin, evolution, classification and geographical distribution of camel and general information about cameloides.
- (2) Camel breeding:- Basic principles of animal breeding, camel genetics and breeding, economic characters and basic statistical information as applicable for camel breeding, recording and analysis of data.
- (3) Camel reproduction:- Basic information on camel reproduction, breeding season, rutting, reproductive organs, semen production, oestrus, pregnancy and parturition.
- (4) Camel nutrition:- Basic information on camel nutrition, feed and fodder for camel, agro-forestry in arid zone including crop production, fodder production and management of grasses, shrubs and trees.

- (5) Physiology and biochemistry:- Basic information on camel physiology and biochemistry, water metabolism and adaptation.
- (6) Camel health management:- Basic information on camel diseases, diagnostic methods, treatment and prophylaxis.
- (7) Camel management:- Housing, grazing, feeding, watering, breeding and management of animals during breeding season, care of pregnant and lactating animals, care of new born calves and growers, care of studs.
- (8) Areas of camel use and its byproducts:- Draft, traction and agricultural operations, milk, meat, hide and hair.

#### Learning outcome

- (a) Candidates were able to learn about camel breeding, feeding, reproduction and health care.
- (b) Candidates were able to learn about the camel management.

- (c) Candidates were able to learn to take care about health cover and prophylaxis to camel diseases.
- (d) Candidates were able to learn about areas of camel use and camel by products.

#### 2. Sports and other activities

- i) Members of staff, both Scientific and Technical officers participated in the Summer Institutes, Seminars, International/ National Workshops, Conferences and Committyees whenever invitation to that effect were received.
- ii) The centre has a staff club which arranges sports and extra-curricular activities. Games and gettogethers were organised on different occasions.
- iii) The Centre also participated in the ICAR Zonal tournament held at Avikanagar.
- iv) Popular radio talks were given by the staff members for the benefit of farmers and rural Animal Husbandry workers. A programme on the Centre and news items were telecasted.

12.

## FINANCIAL STATEMENT

The detailed statement showing budget allocations and expenditure during 1986-87,

and 1987-88 and budget estimates of 1988-89 is presented in table 21.

Table 21

## Statement of Budget and Expenditure (Rs. in lakhs)

Sl. No.	Head of account	Plan 1986-87		Non-plan 1986-87		Plan 1987-88		Non-plan 1987-88		1988-89	
		Budget	Expd.	Budget	Expd.	Budget	Expd.	Budget	Expd.	Budget Estimate (Plan)	Budget Estimate (Non-plan)
1.	Estt. Charges	5.11	2.03	4.70	3.67	4.76	4.77	6.50	3.70	6.50	5.00
2.	Travelling Expn.	0.10	0.10	0.25	0.25	0.25	0.22	0.25	0.25	0.40	0.25
3.	Leave salary, pension contribution & P.F. contribution	0.05	-	-	-	-	-	-	-	-	-
4.	Other charges	4.00	4.72	7.25	8.57	13.14	12.83	6.25	8.90	11.00	8.00
5.	Equipment	4.74	6.99	-	1.21	7.00	6.97	-	0.08	5.00	1.00
6.	Works	8.00	8.16	2.00	-	5.35	5.36	-	-	17.10	-
Total		22.00	22.00	14.20	13.70	30.50	30.15	13.00	12.93	40.00	14.25

## 13. VISITORS

During the year about 2600 persons visited the National Research Centre on Camel, Bikaner. These included scientists, educationists, administrators and tourists. Prominent amongst these were Dr.R.M. Acharya, Deputy Director General Animal Sciences, ICAR; Dr.C.L. Arora, Asstt. Director General (AP&B), ICAR; Prof. K.N. Nag, Vice-Chancellor, Rajasthan Agric. University, Bikaner; Prof. J.B. Khot, Veterinary College, Bombay; Prof. S.P. Agarwal, HAU, Hisar; Prof. V.K. Sharma, HAU, Hisar; Prof. B.P.

Singh, Veterinary College, Mathura; Prof. H.O. Kunkel, Texas, USA; Prof. RC Schroter, Imperial College, London; Shri H.S. Ramani, Home Secretary, Rajasthan State, Jaipur; Sh. Rajendra Pal Singh, Commissioner, Bikaner; Shri Manohar Lal, Collector, Bikaner; Shri N.N. Meena, DIG, Bikaner; Shri S. Yatesh, Consultant, World Bank, Rome, Italy; Dr. C.M. Singh, Retd. Director, IVRI, Izatnagar; Prof. Sehdev Kumar & Students, University of Waterloo, Canada, IAS Probationers and others.

## 14. ADVISORY COMMITTEES

During the current year, the Centre had following committees to advice on various working aspects:-

- 1) Direction Committee (constituted vide ICAR No. 28 (15)/85-EE.I., dated 19.12.1985).

### Members

- i) Project Director, NRCC, Bikaner.
- ii) Dr.C.L. Arora, ADG (AP&B), ICAR, New Delhi.
- iii) Prof.P.N. Mehrotra, CVAS, Bikaner.
- iv) Dr.C.S. Mathur, CVAS, Bikaner.
- v) Director, Animal Husbandry Deptt., Jaipur.

- 2) Advisory Committee for Health Control Programme (constituted vide ICAR No. 28(13)/84- AS(C&P), dated 8.2.1985).

### Members

- i) Project Director, NRCC, Bikaner.
- ii) Prof.P.N. Mehrotra, CVAS, Bikaner.
- iii) Prof.P.L. Arya, CVAS, Bikaner.
- iv) Prof.A.K. Bhargava/Dr.S.K. Diwedi, IVRI, Izatnager.

- 3) Scientific Research Council of NRCC for 1987.

### External invitees

- i) Dr.S.P. Agarwal, Professor, HAU, Hisar.

- ii) Dr.A.K. Ghoshal, Prof. (Physiology), Raj. Agril. University, Bikaner.
- iii) Dr.K.P. Pant, Professor (AG&B), Raj. Agric. University, Bikaner.
- iv) Dr.V.R. Ambani, Joint Director,

Animal Husbandry Department,  
Jaipur.

#### Internal Members

All Scientific & Technical Officers of  
NRCC, Bikaner.

## 15.

### ANNEXURE: DOUBLE HUMPED CAMEL

The double humped camel (*Camelus bactrianus*) of India. (N.D. Khanna and M.A. Khan)

There are two types of camels, the one humped (*Camelus dromedarius*) and two humped (*Camelus bactrianus*) or dromedary and bactrian camels respectively. According to FAO Production Year Book (1985), the total world population of camels is 17.44 million, out of which approximately 7.7% are bactrian camels and the rest are dromedary. The bactrian camels are mostly found in China, Mongolia and USSR. In India, the number of bactrian Camel is only about 50 out of approx. 1.1 million camel population.

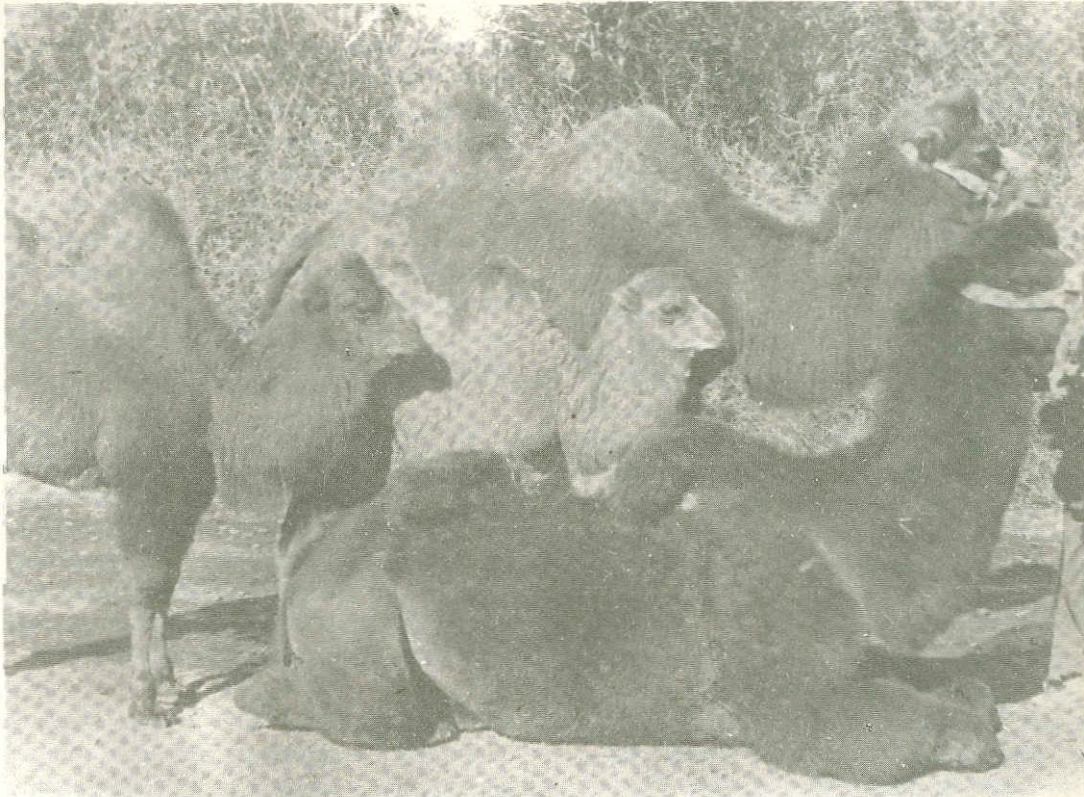
#### Present habitate and population of Bactrian Camel in India

The double humped camels in India are found only in the Ladakh area of Jammu and Kashmir State (Fig. 7). It is believed that the present Indian double humped camels belong to the stock which was originally native to Gobi desert of Asia and was introduced into Ladakh by the traders of Yarkand through silk route.

The Ladakh district of Jammu & Kashmir State forms the northern tip of Indian sub-con-

continent. It is one of the most elevated regions altitude ranging between 2900 to 5900 meters above mean sea level, falling between 30°-0' N latitude and 75°-15' to 79°-0' E longitude in the Indus Valley region. The area is interwoven with a complex network of Himalyan ranges with snow capped peaks. The rainfall is scanty and climate is dry. The district experiences extreme cold during winter when temperature falls as low as - 25°C. The total livestock population of the district is about 0.2 million which include cattle, yak, goats, poultry, horses and bactrian camels etc.

A number of Ladakh families who were involved in trading business were maintaining double humped camels. However, with the closing of silk route and development of alternate routes and mode of transport, the importance of double humped camels reduced drastically in the Ladakh area. It was observed, that even up to early sixties after the closure of silk route, the bactrian animals were profitably used for trading across the "Changla" in the Shyok, "Durbook" and "Changthang" areas. However, the number of double humped camels went on reducing. The door to door survey conducted by the Department of Ani-



*Double humped camels*

mal Husbandry, Ladakh revealed that there were only about 56 double humped camels prior to 1964, which got further reduced to 32 in 1978 and in 1986, the population was 47.

#### **Confirmation and appearance**

The Ladakh double humped camel is strong in constitution with well developed muscular body. The colour varies from light brown to dark brown. The height at withers of the adult mature animals varies from 190 to 220 cm, body length 130 to 150 cm, heart girth 200 to 235 cm, neck length 110 to 120 cm, face length 48 to 62 cm, circumference of fore limb foot pad 65 to 72 and of hind limb pad 55 to 62 cm. The body weight varies from 450 to 550 kg. The male animals are heavier than the

females. The shape and size of hump varies according to amount of fat deposited and is related to physical condition and availability of vegetation. The humps are plump and pliable. During the late winter and early spring when pastures are scanty, the hump collapses.

The coat colour is light brown to dark brown. The camel hair are long and medium in length with soft fine texture. Long hair grow on the top of head, along and lower part of neck, hump and legs. The under coat is woolly and covers the whole body forming soft layers. The hair are shorn in April to June. About 2-4 kg of hair can be collected at a time.

The animals mostly live under wild condition roaming and grazing, when not worked.

The water is given daily but these animals can survive without water for longer periods depending upon the ambient temperature and availability of green vegetation. Females are bred when 3 1/2 to 4 1/2 years old and give birth once every two years. The gestation period is about 13 months. The reproductive life lasts upto 20 years of age.

For handling the camels as pack animals, a wooden nose bar is inserted into the nostrils. The training of camels for work is started at 3 years of age. The normal load carrying capacity is about 35 to 40% of the live weight i.e. 150 to 200 kg. The bactrian camel can cover approx. 10-25 km in a day depending upon terrain. In fast movement, higher speed for short distances can also be achieved if the terrain is not very steep and mountaineous.

#### Economic value

In Ladakh area, the double humped camels were mostly utilized for transport in the cold desert. In addition to being a pack animal there is great potential of this animal being developed for meat, milk and wool. The hair and wool of the double humped camel are very famous and valuable for making woollen garments, shawls etc. The annual yield is 2 to 4 kg per adult animal. The wool of young animals is comparatively fine. However, with proper scientific breeding and selection practices, this animal can be genetically improved for its yearly yield.

The Ladakh area particularly Changthang belt and Nubra valley is cold desert. In spite of the fact that roads are being built in the area, yet it is a well known fact that the maintenance and construction of roads is very difficult and is a very high cost proposition. Amongst the domesticated species which can survive and propagate in this terrain and geocological system of cold arid zone in the Ladakh region, the development of bactrian camel as provider of transport, milk, meat and wool appears to be promising.

The double humped camel is specially adapted to survive in dry cold desert where there is very scanty vegetation. The camel hair and wool will encourage cottage industries in the area as very good blends of camel hair/wool can be made with polyester fibres and thereby will provide opportunity for economic uplift of rural poor and marginal farmers.

In Ladakh about 30% of population is dependent on agriculture and allied services and the area available for cultivation accounts for only 30-40%. The extreme weather condition make agriculture very difficult and uneconomical resulting in scarcity and high prices. The development of this species for milk and meat will provide an important substitute for nourishment to the area where animal protein and milk is scarce due to extreme climate conditions.



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## NATIONAL RESEARCH CENTRE 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 at MSL of 234.84 m.

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